The diffusion of lean production technology within manufacturing industry in West Lothian, Scotland

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Volume 2 (Appendices)
Appendix One presents the questionnaire used, and transcripts of interviews with managers in each of four inward investing companies.

<table>
<thead>
<tr>
<th>Page</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Questionnaire design and summary</td>
</tr>
</tbody>
</table>

Transcripts of interviews:

- 9 Mitsubishi Electric, Bill Barker, Personnel Manager
- 21 Mitsubishi Electric, John Peters, Materials Manager
- 28 Mitsubishi Electric, Allan Sneddon, Production Manager
- 48 NEC Semiconductor (UK), Maidie Cahill, Human Resources Manager
- 64 NEC Semiconductor (UK), David Johnstone, Manager for Planning and Purchasing
- 76 NEC Semiconductor (UK), Jim Weir, General Manager of Production
- 87 Seagate Microelectronics, Margaret Henaughan, Human Resource Manager
- 93 Seagate Microelectronics, Bill Sommerville, Facilities and Purchasing Manager
- 99 Seagate Microelectronics, Alan Spiers, Director of Manufacturing
- 106 Jabil Circuit Ltd, Audrey McGuckin, Human Resource Consultant
- 119 Jabil Circuit Ltd, Ronnie Darroch, Manufacturing and Procurement Manager
QUESTIONNAIRE DESIGN AND SUMMARY

Individual questionnaires were used in interviews with each set of functional managers in inward investing companies: human resources, procurement and manufacturing (excepting Jabil where the latter two functions were combined at the time of interview). Using a semi-structured interview technique, 'lines of questioning' from answers were followed up during interviews - explaining the lack of strict pattern in the transcripts. Also, particular points of interest had been identified during familiarisation in each plant, and questions were included to record these items in individual cases. Questions are repeated to cross-reference answers. Each interview was recorded, transcribed and verified by the interviewee.

(a) The Human Resource Manager interview questionnaire skeleton is reproduced below, using Mitsubishi as an example:

COMPANY HUMAN RESOURCE PROFILE

In your opinion why did Mitsubishi located this plant in West Lothian?
Does Mitsubishi have a Human Resource strategy. If so what is it?
Do you have a model new employee profile? If so what are the main characteristics?
How many employees do you have: permanent and temporary?
What are your levels of turnover and absenteeism?
What is the gender profile at Mitsubishi?
Do you consciously use an internal labour market model i.e. low points of entry, high levels of training and internal promotions rather than external labour market recruitment?
How does Mitsubishi 'eradicate fear' to induce TQM commitment?
Does an effort bargain exist amongst Mitsubishi employees or are levels of commitment to the company of a higher order?
Do you have specialist R&D employees?
What is the ratio of direct employees to indirect?
Can you describe the management structure at Mitsubishi?
Do you employees feel a mutual obligation to you? Is Mitsubishi paternalistic as an employer?
What motivates your workforce?
Do you have a 'rate for the job' payments system?
Do you operate a single-status plant? What does this mean for Mitsubishi?
Appendix One:
Interviews with Inward Investors

Does Mitsubishi believe it has changed the sons and daughters of workers used to a conflictual model of industrial relations into a co-operative workforce?

Mitsubishi as an organisation

Does Mitsubishi organise control of work using technical processes or attitudes of employees?

It is suggested that Scottish workers may have a greater degree of organisational commitment than Japanese workers. Do you think this is true?

What attitude does Mitsubishi adopt to ‘risk-taking’ amongst employees balanced against the needs for predictability in your processes?

MITSUBISHI HUMAN RESOURCE SYSTEMS

Some people comment that single loop learning impacts upon the individual, but double loop learning occurs when the organisation is prepared to re-structure itself to implement new knowledge. Is Mitsubishi prepared for double-loop learning?

How fixed is the structure?

What strategic opportunities for innovation and technological change do you face?

What constraints do you face in taking advantage of these strategic opportunities?

INTERNAL KNOWLEDGE SYSTEMS

Is this a ‘learning organisation’ - constantly generating, transferring-in, accumulating and socialising knowledge?

A learning organisation transfers knowledge in from outside.

Can you give an example of Human Resources in Mitsubishi doing this?

A learning organisation is generates its own knowledge - how does the Human Resources contribute towards this end within this plant?

CONNECTIONS ALONG SUPPLY & VALUE CHAINS

Some people suggest that Japanese plants in Scotland, without local R&D facilities, and are therefore only a limited technology transfer. Do you agree?

Big manufacturing plants in Japan are said to benefit from access to employees in the supply chain - either their ideas, or as a source of recruitment - is Mitsubishi here disadvantaged therefore by the lack of such supply chain linkages?
Have you ever offered human resource assistance to local suppliers to Mitsubishi?

(b) The Procurement Manager interview questionnaire skeleton is reproduced below, using Mitsubishi as an example:

**MITSUBISHI PROFILE ON PROCUREMENT**

What is your annual value-added?
On an average day what might be the value of WIP?
What is your procurement strategy for Mitsubishi?
Can you describe the management structure for procurement?
Could you categorise Mitsubishi's procurement budget in percentages for:

- formal supply agreement
- informal supply agreement
- spot purchases
- other

Can you categorise Mitsubishi's procurement budget by amounts from:

- single sourcing
- multi-sourcing
- competitive sourcing
- spot sourcing

**NON-CUSTOMER KNOWLEDGE TRANSFERS**

Can you give an example of how Mitsubishi has improved its capability for procurement from contacts with from outside?
Do you belong to any trade association which helps identify suitable suppliers?
Have your competitors ever helped you find a supplier. Can you give an example?

**PROCUREMENT POLICIES**

Within this Mitsubishi company who takes a 'make or buy-in' decision?
Does Mitsubishi actively seek a win-win relationship with suppliers, or do you emphasise more competitive sourcing?
What influence do EU directives on local sourcing have on your sourcing policies?
What discretion exists locally on sourcing policy. Can you give an example of a change you have made?
Do you expect suppliers to conform to Mitsubishi protocols. Can you give an example where a supplier has changed to meet your requirements?
Do you have examples of direct JIT deliver to the line without buffer stocks?
How important is the expectation of continuous improvement from your suppliers?
Are there examples of tiering of suppliers located here in Scotland. Can you describe one?

LEARNING ORGANISATION AND PROCUREMENT

A learning organisation transfers knowledge in from outside. Can you give an example of your supply chain doing this?
What is the scope of your supply chain in terms of geography by value from West Lothian, Scotland, EU, RoW?
How extensively to Mitsubishi use vendor rating of suppliers?
What performance indicators does vendor rating include?
What routes do you use to transfer knowledge to you suppliers for example by staff loan, joint development, equipment loan, financial support.

MITSUBISHI’S TRADING WITH LOCAL SMEs

Of the suppliers you use who are located in West Lothian which would you are the most satisfactory and why?

LOCAL NETWORK

Knowledge networks may stimulate innovation, improving competitive-ness. Are you part of one?

(c) The Manufacturing Manager interview questionnaire skeleton is reproduced below, again using Mitsubishi as an example:

GENERAL COMPANY PROFILE

What is your job at Mitsubishi?
What is your annual turnover and expected gross margins?
What WIP do you carry?
What is the production strategy for Mitsubishi?
Can you describe the management structure in production at Mitsubishi?
What systems are used to organise work at Mitsubishi?
What are the main technological processes you use?
Do you use target costing and value engineering (Kaizen costing targets)?
How do you decide on appropriate type of process choice?
Which element would you say drives productivity improvement at Mitsubishi, technological change or changing people processes?
How many permanent and casual employees do you have?
Do you have skill categories, if so which?
How is employment structured? Is it single status?
Describe the teams or cellular manufacturing you use?
How do you judge the flexibility of the workforce, and how do you create flexibility?
What role does Production play in the recruiting and improvement of employees?
What motivates your workforce?
What is the relative weighting you attach to price, quality, time, continuous improvement?
What strategic opportunities for innovation and technological change do you face?
What constraints do you face in taking advantage of these strategic opportunities?

KNOWLEDGE GENERATION WITHIN PRODUCTION AT MITSUBISHI

What staff, budgets and time do you allocate to product research, development, and product design?
Can you give an example of how and why a process innovation has occurred?
Does process innovation arise from a planned and conscious strategy or respond to events and opportunities?
Has information technology stimulated process innovation?
Does design-for-manufacture system in product innovation?
How are you consulted at product design stage?
What drives process innovation at Mitsubishi? What stimulus comes from customers and suppliers?
How influential is the mother plant in driving process innovation?
Appendix One: Interviews with Inward Investors

Does benchmarking within the Mitsubishi organisation result in continuous improvement being implemented here?

**NON-CUSTOMER KNOWLEDGE TRANSFERS**

Can you give an example of how Mitsubishi has improved its capability for production from contacts with from outside?

**CUSTOMER KNOWLEDGE TRANSFER**

Can you give an example of customers making suggestions which have improved your products and/or your processes? How much easier is it to know what the final user of products wants, than to know what an intermediate customer wants? How does the marketing arm of Mitsubishi influence both product and process innovation?

**LEARNING ORGANISATION FEATURES**

Is this a 'learning organisation' - constantly generating, transferring-in, accumulating and socialising knowledge? Is Mitsubishi a learning organisation? Can you give an example?
A learning organisation transfers knowledge in from outside. Can you give an example of production in Mitsubishi doing this?
A learning organisation is generates its own knowledge - how does the production function contribute towards this end within this plant?
A learning organisation accumulates knowledge. How do you ensure that lessons learned in production are not forgotten and become part of Mitsubishi’s knowledge base?
A learning organisation ‘socialises’ knowledge - ensure that those who need to know do know. How does this occur within the production function at this plant?
How do you plan for the new knowledge necessary to introduce new products?
How do you plan for the new knowledge necessary to introduce process innovation?
Do you use project teams to implement product and process innovation?
In production at Mitsubishi is ‘learning by doing’ more important to Mitsubishi than learning from formalised training?
SUPPLY CHAIN CONNECTIONS ALONG SUPPLY & VALUE CHAINS

How far does procurement limit the potential for improved productivity in production?
Do you regard your suppliers as partners? Give an example.

MITSUBISHI's TRADING WITH LOCAL SMEs

How satisfactory are your relations with West Lothian suppliers to Mitsubishi?
What bad experiences of local suppliers has Mitsubishi had?
Can you give me an example?
How much of a constraint on this Mitsubishi plant is the supply chain you use?
How different are production arrangements here than in a plant with a similar product in Japan?
What do you understand lean production to mean?
Should local SMEs set out to learn from Mitsubishi?

LOCAL NETWORK

Knowledge networks may stimulate innovation, improving competitive-ness. Are you part of one?
Is a knowledge network amongst West Lothian-owned manufacturers an achievable goal?
From a knowledge network what sort of knowledge would this company find most useful?

PUBLIC POLICY SUGGESTIONS

What could the local authority or the government do to improve the institutional framework facing West Lothian-owned manufacturers?
How adequate are West Lothian training providers for your purposes?
MITSUBISHI - HUMAN RESOURCES

Bill Barker, Personnel Manager at Mitsubishi Electric, was interviewed at the Livingston plant on Wednesday, 5 February, 1997.

COMPANY HUMAN RESOURCE PROFILE

In your opinion why did Mitsubishi located this plant in West Lothian?

They wanted a European location for our video recorder product. Mitsubishi had already set up a television factory in Haddington which appeared to be successful. Livingston was close to it and the Japanese knew this area. English is the second language in Japan, so an English speaking country as opposed to one of the other European countries was easier for them. Also the efforts of central and local government to attract inward investment played a significant part in the decision.

Does Mitsubishi have a Human Resource strategy. If so what is it?

One of the things I was surprised about when I took on the role of Personnel Manager was how wrong my previous impressions were of a company with rules set out in tablets of stone with narrow parameters. On the personnel side that just does not happen - it is basically let to each site to establish its own practices, policies and procedures. From a personnel point of view they are developed by the management team on an ad hoc basis as the company has grown. I was surprised at how few formal personnel policies and procedures actually were written down when I joined Mitsubishi nine years ago. Probably not a lot more exist now. The way we operate can be completely different from the way Haddington have developed - and there are some significant differences from the way the Glenrothes Apricot factory has developed and equally the way the Livingston Air Conditioning factory down the road is developing. The Japanese philosophy certainly within Mitsubishi Electric is each individual location can basically do what they feel is appropriate within its own organisation.

Do you have a model new employee profile? If so what are the main characteristics?

Our ideal recruit depends on the level of position. They tend to be of two types of actual recruit. If we are talking about somebody coming in to work as
an operator, either on the production line or within our QC engineering or within our Materials department, then basically what we look for are young people, preferably direct from school. Qualifications - we don't specify qualifications. Everyone operator applicant completes an aptitude test as the first stage of the selection procedure. That has a basic arithmetic element to it, also identifying or linking up shapes and objects - using imagination to re-shape objects to form other shapes. We feel this is helpful in the production process where we are identifying and using a lot of components. Also, manual dexterity is important because of our processes. So if everybody passes the aptitude test it does not matter to us to be honest whether they have been a total failure at school. If they have done well at school then obviously that gives us up front some indication of their ability. But if they have not got three Standard Grades and two Highers we are not interested. School is behind them - they may have had particular problems at school. If they have had particular problems at school then in the interview process we would hopefully identify that and we would make a judgement as to whether or not we thought those problems would continue to arise here. We are really looking for young people to have recently left school (95% of recruits are within six months of having left school). We are looking for people who can pass our aptitude test. At the interview and during the factory tour they need to show some interest in the type of work that we are doing, in the type of work required from them. We want them to come over as being enthusiastic and wanting the job. If they come in totally laid back and uninterested they probably would not be offered a job. If they show enthusiasm, keen-ness to work in our type of environment then we would offer them employment. That is our ideal type for operators.

For our technical people, which is other main recruitment area it tends to be mostly graduates, direct from college or university with a degree or HND in electrical or electronic engineering, or mechanical engineering. Again, they have demonstrated by completing those courses that they have a certain technical knowledge, what they will not have is practical experience; unless there was a practical element to the course. We have two interviews starting off with junior technical people and then more senior technical people, and then possibly senior managers could be involved in the selection procedure. Basically, what we are looking for, again, is enthusiasm. That is mainly the thing we are looking for.

People say why go down that road, and I think probably the reasoning is that if your bring people direct from college, university, or school they have got no pre-conceived ideas about work. If they have a number of years of experience outside of Mitsubishi, in another company, the works practices that they may have been subjected to may be completely different. They may be able to get away with things which would not be acceptable within
Mitsubishi, and it can be more difficult to get them settled. It is easier to develop skills than to alter attitudes.

**How many employees do you have: permanent and temporary?**

We employ 750 on this site, all permanent. Incidentally the average age is 21, and gender split is 47% male and 53% female.

**What are your levels of turnover and absenteeism?**

Our absenteeism is 3.8%. Operator turnover is our highest. It fluctuates, if we are in a recruitment phase, turnover increases. Turnover is less than 10%. Our technical people we have lost a few in the last year, which is unusual for us. We tend not to lose a lot of people, never three or four going to one company in a short period of time. Hyundai setting up may cause us problems. Sun and Motorola we have lost odd ones to. In the main technical people leaving us go to American companies.

Young people either really like it here, or really dislike our ways. People leave within the first year of employment with us. Those staying for longer than that tend to stay with us. When you are recruiting sixteen and seventeen year olds, they may very well settle in and go on with us. In their early twenties when they are leaving home or getting married or buying a house, security of employment can become less important. Security has always been an important point Mitsubishi like to portray. For some people this is a major issue. Our terms and conditions of employment, including salary, is probably middle of the road or just above. We know that there are other companies that offer higher salaries. We do find that the other group of operators who tend to leave may be the six, seven year operators who think it's time for a change - I've got the opportunity to earn more elsewhere. If the other job is shift working the increase can be considerable. There are different stages in people's lives.

**What is the gender profile at Mitsubishi?**

Sixty percent of our workforce are female.

**Do you consciously use an internal labour market model i.e. low points of entry, high levels of training and internal promotions rather than external labour market recruitment?**

Yes. The two main areas of external recruitment which I have mentioned: operators and technical people. All of our technical people have joined us direct from college or university as a technician, or up to five years ago we took on a few old-fashioned engineering apprenticeship people; who had
served for a few years with other companies - they are the minority. All of our technical people with the exception of one (a female we recruited two years ago who had an honours degree in engineering and five years experience with another major employer, and was about to be made redundant when we were looking to increase skills in a particular area, so we recruited her from outside) have joined as technicians and moved through the structure over the years. We have go our most senior technical people, up to the level below assistant manager, all joined us (say) ten years ago, and obviously people have followed on behind them.

The same applies for the operators. Operators have got various ways that they can progress. If we have a basic clerical vacancy in the offices, that will be filled internally. We would advertise the position and fill it internally. Operators if they stay within production area can progress by two other routes. One is if they are interested in supervision. If they join at sixteen, we are probably talking by the age of twenty one years of age before they have got the necessary knowledge of the job and the maturity to start to take on that role. Operators after five years service may be offered Assistant Supervisor leading to Supervisor - this is quite a wide salary band. The other alternative would be if they are keen to move into the technical area, they have the opportunity, if they are prepared to go to evening classes, to the local college to get some technical qualification. Mechatronics, or electrical or just mechanical - depending on the area of the factory they are working in. They would have the opportunity to go to college, they could then move into the technical route, through what we would initially call a trainee-repairer who works on the production line, repairing the videos when a fault is identified. They would then move into the Repairer structure itself, and eventually into the technical area. If someone goes and gets a HND they can move right through the structure.

**How does Mitsubishi ‘eradicate fear’ to induce TQM commitment?**

Yes. When I first joined Mitsubishi that is what I was asked to portray to prospective candidates, and be the key issue within Mitsubishi - which we have continued to do. The company was growing very rapidly in 1988, in any company it is good to see expansion, investment and growth. But that never goes on indefinitely. Although we would still say that security is something we are keen to portray, personally I don’t portray it as keenly as I have done in the past because of the changing situation within Mitsubishi. Not that we have ever discussed the possibility of redundancy, but, business is tough. We are not making huge profits in this factory. Video recorders, as they stand at the moment, has only got a certain life - we are now talking about the next generation product. There is an element of uncertainty. Managing Directors come and go, the General Manager when I joined, who became the Managing Director and really built up the company - he is no longer here.
know that the current Managing Director, who is just going back to Japan in a week or two, has not portrayed that same security aspect. Different senior Japanese managers have got different priorities - they portray things in a different way. We have just got a new Managing Director, I don’t know what his views are on portraying the security side of the business, because we are going through a tough time. Who knows what might happen; but is important to the company.

Does an effort bargain exist amongst Mitsubishi employees or are levels of commitment to the company of a higher order?

Our employees are committed to Mitsubishi and work with our systems - we don’t really have effort bargains.

Do you have specialist R&D employees?

No but this may shortly change, you are better raising this with Alan Gemmel (Plant Manager) or Allan Sneddon (Production Manager).

What is the ratio of direct employees to indirect?

I have got different definitions for indirect from our production. What I view traditionally as direct would be all of the people who are directly involved in assembling the video recorders. The production department would include all of the indirect people who work within production - so all of the technical people, all of the supervisors, and any other people working around the production line. On my definition we are about 60% direct employees.

Can you describe the management structure at Mitsubishi?

We have a duplication in some respects. We have Alan Gemmel who you know is the Plant Manager. The General Manager is Japanese. I think in the organisational structure the General Manager would be above Alan, whereas in practice, in the day-to-day running of the factory, the Japanese General Manager does not really have a hands-on approach. So if you take Alan as being the senior manager, we then have a number of other management posts - both Japanese and local one level below - these are functional posts: myself in Personnel, Production Manager, the Materials Manager and accounts Manager who is not just responsible for the accounts he is actually responsible for three sites (Haddington televisions, Livingston Air Conditioning and Livingston videos). Directly reporting to Alan would be the Materials Manager and the Production Manager. I report direct to the Managing Director as does the Accounts Manager, but we obviously have a functional responsibility for the plant.
We then have a number of other Japanese senior managers who basically are senior technical people or sales and materials. The reason we have these Japanese staff is because we still have a close working relationship our Japanese mother factory in Kyoto, and it provides a direct link with our parent company. The Japanese tend not to be involved in the day-to-day managing of the operation, that tends to be passed to the local manager because of cultural differences in man-management. The senior Japanese staff may be looking at particular projects, may be technology transfer from Japan to here, or materials procurement (many of our suppliers are other Japanese companies, whether in this country, the far east or Japan itself).

Do you employees feel a mutual obligation to you? Is Mitsubishi paternalistic as an employer?

We are probably a parental company, we are bring young people on board. We are in some ways giving them experience of life, we are guiding them through life, and we are trying at the same time to keep them involved within the company.

What motivates your workforce?

Production would measure motivation within the nature of the production process i.e. all of the operations which go to make up a video recorder, result in certain time standards - they know that picking up a screwdriver and inserting a screw takes five seconds - that can be measured dead easily to show efficiency and motivation. From a human resource point of view the measurement of indicators of motivation are absence levels and turnover, probably a third would be disciplinary problems (are we spending half our day if not formally disciplining people, counselling them.

Do you have a ‘rate for the job’ payments system?

We have reward bands rather than set rates for the job.

Do you operate a single-status plant? What does this mean for Mitsubishi?

It means that we treat everybody equally, everybody matters and is treated with respect.

Does Mitsubishi believe it has changed the sons and daughters of workers used to a conflictual model of industrial relations into a co-operative workforce?
We recruit people who come without pre-conceptions. OK, their parents may have worked in conflictual situations, but it is difficult to relate to a father who has worked down a mine, in a heavily unionised environment, the conflict that may have taken place at various other plants compared to working at Mitsubishi. It is like night and day. This is not something which has come easily, but I think our recruitment procedures over the years have helped. Once people are in here, they don’t know what to expect - we have got to develop things from there. One of the things we do, which again I think is traditionally Japanese, is that we try and keep employees informed as much as possible about what is going on. We communicate much more in Mitsubishi than in the four or five employers I have worked for. Every morning, before work starts the Supervisors in all our areas will address all of their employees, to keep them up to date with what is happening. Specifically, on a daily basis on their own work area: what problems did they experience the day before, what action needs to be taken in the day ahead, any other information. On a weekly basis, a senior manager in each of our three buildings will address everybody that works in that factory every Monday morning to keep them up to date with the broader issues of what’s happening within the factory as a whole, how things are going from a business point of view, important visitors who may be coming, details of changes. We also have Consultative Committee which is made up of elected representatives. We always try to be up-front with employees. We always try and tell the truth, if we are going through a bad patch we will tell them. We won’t late it until things get so bad that the first people hear is, “You might not know this, but we have been struggling for the last six months, and we are making you redundant.” We will tell people when things are happening about the situation within the company.

MITSUBISHI AS AN ORGANISATION

Does Mitsubishi organise control of work using technical processes or attitudes of employees?

We are a production factory - our main aim in life is to produce video recorders. That’s what we have to do. What we need to do to achieve this is in effect secondary. We have got to achieve that, OK - how do we go about it? We need to set up the factory to operate in a particular way, and as efficiently as possible. But we can’t stand over people, or chain them to the work benches, or use whips. We have to build on the knowledge that they may have when they join and build some team working - this is important to Mitsubishi. We do not build the production process into small individual teams, but people need to be prepared to be working closely with a number of other individuals. There are very few jobs where people actually go away on their own and just work away at their own pace, doing whatever they need
to do. Everybody is really working along with groups of other people, so they need to get on well.

It is suggested that Scottish workers may have a greater degree of organisational commitment than Japanese workers. Do you think this is true?

I have never been to Japan, so anything I say has come via the Japanese and I know that has to be viewed through their own perspectives; they have done particularly well, this is how it is done in Japan, they would probably say they have few commitment problems because they provide a job for life. I accept to a certain extent that this is their view. This is not a particularly Mitsubishi philosophy, I think that is a Japanese big company philosophy in general. The Japanese would probably say that we do not have the commitment that they would have in Japan. I think in some respects we are talking about different people, a different type of people, because in Japan in the Kyoto factory for instance, it is a huge factory, though they have certainly scaled down a lot in numbers. My understanding is that you cannot look at the two factories and compare them directly. For one thing, everybody that works in this factory is a Mitsubishi employee, whereas in the Kyoto factory there is a large proportion of sub-contract company employees within Mitsubishi. You are really not talking like with like. We as a company are trying to replicate as much as possible the same philosophy, but I don't see you are ever going to be able to achieve that, because there are cultural differences. It is all very well, for want of a better word - indoctrinating our people, we can say we will provide a job for life, we will provide you with development along the Japanese model. This works in Japan, because it has been developed in Japan over the years, not just within Mitsubishi but within other companies. Whereas they see their workmates working in Motorola or in other companies that work in a completely different environment, so they are not going out and still seeing that same culture from friends and relatives. So we are never going to achieve the Japanese culture here - we can only do what we can within the four walls of the factory. When people go outside, or other companies go out and recruit people with particular skills (there is always turnover).

What attitude does Mitsubishi adopt to ‘risk-taking’ amongst employees balanced against the needs for predictability in your processes?

We don’t allow a lot of risk taking, we do listen to people and we do change things. But before any changes are made we need to be convinced that the changes are going to work. I don’t think we would do it is there was any significant element of risk involved. A production line, where the Supervisor heads that up. If somebody went to the Supervisor, out of the blue, and said
if you do this a bit differently, we can do the job twice as fast. The Supervisor on his own would not say let's try it and see if it works. I think what would happen is that the Supervisor would make an initial judgement, he would then pass that along the line before some decision is made. That's indicative of Mitsubishi as a whole, things don't tend to happen very quickly. Unless there is some major disaster and we need to do something, these small changes are not likely to happen over night.

One thing that we do is that all of the people out on the production lines, all our operators and technical people are split up into teams, in the same work area or production line. We call them Quality Circles, different companies use that term differently. My original view of Quality Circles from a previous employer, was groups of people doing similar jobs who got together basically to brainstorm: how do we do this job, is this the right way, would a different way be better? These were the people on the job with the most knowledge about how the job could be improved, and quite often could come up with good ideas for improving processes. In some ways this takes place within our Quality Circles. But we are actually just reviewing the role of the Quality Circles. What happens is, we have a Quality Circle campaign, which might last three months. During that period, it is nothing to do with quality, but we will monitor the absence level of those employees within each of the Groups against set targets. If they achieve that then they have been successful in that part of the operation. Periodically, the Supervisors in the area will go round and do a house-keeping audit, just to check how clean and tidy the work area is, and if they achieve a particular target for that they will be successful in that part of the it. They will also at some point during the campaign, stop production completely and the Groups will get together to brainstorm around the particular jobs they are doing, and hopefully come up with some recommendations for improvement. That would be a formal document they would submit to the company saying on this particular job we feel can be done better. That will then be passed to the Supervisor, who will sit down with the technical people to go through all of those suggestions. If the suggestion is a good suggestion, or is maybe not clear from the submission what is required, then further investigation takes place. If one or more suggestions are accepted in the duration of this campaign, then there is a prize awarded to the Group. There is a carrot and stick. We set continuous improvement targets, hoping the Groups will help us achieve them - nothing stands still.

MITSUBISHI HUMAN RESOURCE SYSTEMS

Some people comment that single loop learning impacts upon the individual, but double loop learning occurs when the organisation is prepared to re-structure itself to implement new
Appendix One:
Interviews with Inward Investors

knowledge. Is Mitsubishi prepared for double-loop learning? How fixed is the structure?

Absolutely, in fact this happens frequently, we have a very fluid people structure, the fixed parts are in the technical processes.

What strategic opportunities for innovation and technological change do you face?

Our opportunities for improvement are both people-centred and technology-centred. A lot of our changes are technological, this tends to be driven - at this point in time - to be driven by Japan. Changes in technology which have taken place over the years have made the manufacturing processes much simpler. As you know we are amalgamating our three units into two - we can only do this because of the technological changes. I would say the majority of changes are technologically driven. But, through the Quality Circles, and other improvement campaigns there are people-based improvements.

What constraints do you face in taking advantage of these strategic opportunities?

Our big constraint at the moment is the absence of research and development on this site. Nor can we re-design the product at the moment. We are hopeful these matters will change. Japan is still ahead of us, they are still introducing the product before we manufacture them. However, if we highlighted a problem, we would refer back to them for re-design. We are looking to increase our design capability, but at this moment in time it is not significant.

INTERNAL KNOWLEDGE SYSTEMS

Is this a ‘learning organisation’ - constantly generating, transferring-in, accumulating and socialising knowledge?

I think from the fact that we are continually looking to improve our processes and systems yes we are a learning organisation. Kaizen and continual improvement are on-going to us, not just intermittent.

A learning organisation transfers knowledge in from outside. Can you give an example of Human Resources in Mitsubishi doing this?

Yes. We very successfully transfer products and processes developed in Japan into this plant.
A learning organisation is generates its own knowledge - how does the Human Resources contribute towards this end within this plant?

No. We take templates from Japan and introduce them here. Within teams people come up with ideas. But although we have been talking about teams, apart from in the Quality Circle, looking at people and saying they are in this particular team is something we don’t go out of our way to do. Unless it is a whole production line which may be thirty people working on a particular production line. That is a team. We would not look at that as a particular team. Their knowledge and expertise is all in that particular part of the production process. They won't have the same knowledge of a different stage of the production processes. The link to that would be our technical people who could be moving from one production process to another. The operators on the line would not have this inter-changeable knowledge unless through time they have worked in different production processes; which a lot of them will have. But, they would not look at a particular stage of the production process which they are involved in and say well “See if some earlier stage in the assembly process, this was done differently, this would help us when it got here.” It may be possible but I would think unlikely. There is not significant interchange of ideas between operators in different parts of the factory.

CONNECTIONS ALONG SUPPLY & VALUE CHAINS

Some people suggest that Japanese plants in Scotland, without local R&D facilities, and are therefore only a limited technology transfer. Do you agree?

Yes. People use the term ‘screwdriver operation’ as a derogatory term. We are creating jobs, people actually have to do jobs, whether it is a company involved in the research, development and design stage right through to the ‘screwdriver’ assembly operations, there is always going to be people who will be doing a screwdriver type job. Whether that is done in isolation or done as part of a company or a factory that is involved in the wider processes, I think in some ways is irrelevant. OK is you can get the complete package you are providing jobs for different groups of people, but, the fact that a company may be an assembly operation is providing jobs for people with skills and capabilities. It is also providing jobs for other ancillary services. OK it might not be research and development aspect, but they are jobs that people need, and need doing. You could not say that Scotland is only going to attract research and development opportunities. People forget
that the 'old' factories such as the BMC also had a significant amount of screwdriver work.

In the early days we would fall into the category of very few assembly operations - all of the main assemblies were done in Japan and brought over to here. We did a few assemblies, put it into the chassis, put a "Made in Scotland" label on, and it went out. We now make everything in this factory. But, that in some people's eyes still makes us a screwdriver-type operation. I think we accept that we don't have the capabilities yet to be involved in all aspects of the operation from research and development to assembly. It is an area which is being developed, and we are moving into that, and I would think that there is not that many companies that will move every stage of its operation at once from day one: it is a continuing process.

**Big manufacturing plants in Japan are said to benefit from access to employees in the supply chain - either their ideas, or as a source of recruitment - is Mitsubishi here disadvantaged therefore by the lack of such supply chain linkages?**

We do send people out, and we have had suppliers in - this happens quite often. We do have some local suppliers (when I say local I mean non-Japanese suppliers) who may be for the first time we are dealing with - who for the first time have got a foothold into supplying a Japanese company. We have had groups of people from these suppliers coming in to see what a modern Japanese production facility does. It is quite enlightening to some of them. We will also send people out to our suppliers because our philosophy is from a supplier point of view that once we make a decision (it may take a while to make a decision to use a particular supplier), having made that decision we want it to work. So we will work at improving or providing technical assistance to the supplier company to build up their knowledge.

**Have you ever offered human resource assistance to local suppliers to Mitsubishi?**

From a specific human resource point of view there has not been any specific involvement. I may talk to some of our Japanese suppliers occasionally about some general human resource matters for example holidays - there is one company in the north east of England who do work for us. We have factory holiday periods, so they want to co-ordinate with us. They may seek information about our terms and conditions of employment.
Appendix One:
Interviews with Inward Investors

MITSUBISHI - PROCUREMENT

John Peters, Materials Manager at Mitsubishi Electric, was interviewed at the Livingston plant on Wednesday, 5 February, 1997.

Mitsubishi Electric UK Ltd was established in Livingston in 1983 to produce VCRs, since 1990 the site has operated three units: PCB assembly, mechanical assembly and final assembly. Recent product re-design has re-engineered production into two units.

MITSUBISHI PROFILE ON PROCUREMENT

What is your annual value-added?

If we look at current condition then value-added in terms of the product we sell as a corporate group basically maintains our place in the market. To be honest, if we look at the consumer market, and particularly video-recorders, then we are up against it. There is an argument to say, why are you even producing? As a factory, it is very difficult for us, at this moment in time, and probably for the last two years, to show any real benefit in terms of profit. In fact we don’t show profit. From the corporate point of view perhaps we do, because unless we are in the global game of supply, in terms of audio-visual, if you pull out a key area (for instance C-TV) then if there is not C-TVs or you are not producing C-TVs then nobody is going to buy your VCRs. Nobody is going to buy any other audio system. So basically we need to be there as a global entity. Historically, the plant has had considerable added-value, if you look at the added-value in terms of the vendor base which we have locally, and the impact which this has had on local infrastructure. But to the company as a whole, in isolation as a manufacturing plant then now our contribution is very limited, because we are not diverse enough. We are producing a product within a very competitive market, already reaching saturation levels, and hence the difficulty we have in creating value. The pipeline from conception, through design and production is starting to fatten up, but it is still in one direction; it is not fattening up and going within a European base, because this base is not competitive enough. The big worry, is fine if we can combine as a glorified entity within Europe, and we talk together and we control it together. I have my doubts whether we can actually succeed in doing that. The other concern is the minute we take the barriers away around Europe and let every man and his dog come in with video-recorders etc i.e. drop the tariff duty import rates, then we have got a problem: not just Mitsubishi, and not just in the audio-visual market, but anybody in the
electronics and auto industry - they may be buoyant just now, but take the tariffs away and we all have problems.

**On an average day what might be the value of WIP?**

We probably carry a week's worth of work in progress if you define WIP as sub-assembly levels within the factory, in terms of the pipeline of production from initial to final assembly. This is not a high level. At this moment in time it is not a concern in terms of the profitability or sell-ability of the product we make. The impact of a week's WIP, when you compare that to the shipping date of the final product and go back to the conception of the product, a week is neither here nor there. In terms of stock that we have running through, if you look at WIP between each sub-assembly it is considerably less than a week. Between parent assembly and all of the other sub-assemblies effectively there is a week. Basically, this is because production needs to balance their manning levels. It may well be a commercial decision which stabilises the continuity of our labour to get the quality of product and quality of sub-assembly out. Therefore, we could reduce our WIP level, but the impact may be a start-stop situation with the labour force. Bear in mind we are batch producers, this is not flow-line, people think of us as a flow-line operation we are not. We are batch production with builds of anything from as low as 50 up to a maximum of 2000. That is not flow-line principles. In addition to that, we are looking at a model mix of between 50 and 60 individual models, albeit that these are hybrids of perhaps six parent models. But there are variances, and there are major variances at sub-assembly level. So do I worry about on week WIP, no, what I worry about is the component level we are holding, the supply pipeline work-in-progress, and the lead time from order to delivery. Actually work-in-progress can benefit these matters, so in terms of being a service to the customer (which our business is all about) particularly when there is reducing lead times and pressure to reduce them further, because nobody wants to hold stock. Our WIP is reasonable, it enables us to supply to the customer far quicker. The stages in front of it are the key issue, and that's where the money is, not in the week's inventory. The conception in a Japanese company with all the JIT jargon is different, that's an argument that can be put in terms of component level coming in, but you still have a WIP to suit the production facility you have got: both in terms of manpower and machine capacities. You need to build WIP to suit the commercial viability of the organisation. It is a happy medium to suit the commercial viability of the organisation. Theoretically you could reduce the WIP level by introducing shifts, you could reduce it to almost nothing: but only at the cost of more manning and investment in more machinery. It is a fine balance, particularly with a product that is at saturation level, and does not make money.

**What is your procurement strategy for Mitsubishi?**
Mitsubishi have embarked upon a localisation of procurement strategy. Localisation is not the critical issue, for procurement the critical issue is the cost at component level. You have basically an ‘air-fix’ kit of component parts that you require, and there is an amount of money that effectively can be spent on these components. At component level the material content is probably 75% of the cost of a video recorder: that in itself gives you where the emphasis should be. In terms of localisation, our definition of localisation is getting the hell out of Japan and going anywhere else globally which gives you the best price. It is a locus of decision making, rather than a source of components. Effectively, in our area we have localised by taking on the responsibility of buying each individual part, via an approved vendor base, wherever that may be. Be it in south east Asia, in Japan itself if need be, the US or wherever. So Mitsubishi’s localisation has passed on that responsibility on to our shoulders - whereas previously it used to come in boxes in an ‘air-fix’ kit, with a label saying “There you go, stick it together.” There was a high cost involved in that. We can no longer afford to do that. So over the last three years, we have dramatically reduced the dependency on the mother factory to supply ‘air-fix’ kits to the extent that 98% of what we buy, we now buy under our control.

Can you describe the management structure for procurement?

I as Materials Manager effectively have the procurement responsibility. I report to the General Manager and effectively below me, I have a senior buyer and number of buyers (including technical buyers, doing a procurement job with some technical knowledge) and below that some administrators. It is not a large number of people, it is a slim operation.

We deal with 200 vendors in total. Key vendors are below a hundred, and that is tending to reduce. We are looking at all sorts of methods for cost advantage for instance, is it possible to go to individual vendors in Malaysia. There is a huge vendor base there, do we go to them individually? Or do we look to focus our attention on a buying agency, or put our people over there, where the vendors are, and effectively control procurement by thinning the pipeline?

The traditional Japanese tiering model is still there to some extent because of the approvals process. If you go to the C-TV factory [Haddington] it is slightly different, where they have more autonomy within the site because of the design facility they have. Where you don’t have design that pipeline is always going to try and encourage the traditional Japanese model. We are restricted by that. We are even more restricted when you look at a global market place of 50 million videos per annum. Probably in the region of 50% of these are produced in Malaysia by the big boys, all Japanese, perhaps
with Phillips in beside them. Where you get such a localised volume of manufacturing base for one product, the vendors move to the same location. Because it is predominantly Japanese manufactures in this AV business, then it is predominantly Japanese vendor base, and they have moved with the manufacturers. These vendors are supplying huge volumes in a very localised area. Therefore, if you are in Malaysia you get huge cost advantage. Geographically where we are you would think that is less of a concern, but when you look at who the vendors are, and who our approved supply base is, then effectively that is where we have got to go. Firstly, because of the cost advantage if we sit beside our sister company and get the economies of scale advantage as opposed to sitting in Europe and looking at European vendors with producing additional tools, having limited capacities, not necessarily the production facilities as it stands, and even the likes of our friends in Austria and Germany - the Phillips of this world - they are importing. And more and more they are going there for higher level assemblies. It is going more away from component level to higher level assemblies. That’s the predicament that we have got now, because effectively we have invested in transferring technology, all the key manufacturing processes are here - we are unique in VCR manufacturing - nobody else is doing that, not even Phillips, but the key vendors are in Malaysia. We need the design facility also here. But would the design facility give us the ability to procure locally, within Europe? I would suggest not. Secondly, as you know Alan Gemmel and I have recently been over in Hungary, Czechoslovakia and Poland to consider the benefit of supply from Eastern Europe. There could be benefit in Eastern Europe if we set up greenfield sites, and it was competitive for products. As a manufacturing base here to look at component level - no. To look at sub-assembly - possibly. When you consider the wage rates, the cost of labour and the cost of manufacture - take Poland because that is one of the cheaper areas - we considered it and we costed it. There is potential in Hungary, it is technically a very sound base, and certainly more competent than a Polish base, but it is only a matter of years before Poland come up to that level. If you invest with engineering support and capital equipment, or even transfer of capital equipment then could get advantage, as long as you put your overhead technically over there to support. The problem in doing that is effectively, if you look at costs of manufacture in Poland or anywhere else in Eastern Europe, and compare that to south east Asia, south east Asia is better. Then you take shipping costs into account. It is considerably more expensive to ship sub-assembly or components from Poland or Czechoslovakia or Hungary into Scotland than it is shipping from south east Asia.

There is always the possibility the dominance of Malaysia will change, and it is likely to change into China - that is the biggest area to give Malaysia competition. Will the Japanese be particularly fast in moving into China? I would suggest perhaps not because the cultures and historical heritages
stand between them. In saying that there is huge investment in China. We are already, through our supply pipeline, going indirectly into China. The Korean manufacturers are much quicker going into China - they have already invested heavily. Phillips, Thomsons have already invested there, and a lot of US companies. But in terms of VCR manufacture it is very much restricted to Japanese companies or Phillips or some Koreans. Five years ago almost no Korean, three years ago they started to make some impact, now a big impact. That's why our market is saturated. So China may challenge Malaysia, whether they will move lock-stock and barrel I don't know. The product as it stands has hit a plateau. If there was room for that huge expansion in the market for VCR then video-recorder companies may move into China to increase their market share. The Chinese want tomorrow's technology, not yesterdays - whereas the Japanese model is step by step - it would be a steady transfer rather than immediate transfer of the latest products.

Could you categorise Mitsubishi's procurement budget in percentages for:

1. formal supply agreement
2. informal supply agreement
3. spot purchases
4. other

We make no spot purchases other than consumables. Direct material for video assembly is an approved supplier chain, and is based upon volume - it can be a global arrangement for price within the Mitsubishi group. We can have options where for certain component levels we may have four potential vendors that we can use.

Can you categorise Mitsubishi's procurement budget by amounts from:

1. single sourcing
2. multi-sourcing
3. competitive sourcing
4. spot sourcing

Primarily arising from product design we single source; we have a thinned supply chain, some direct involvement of design by vendors for key components for example controlling ICs for the main board etc. That is done in conjunction with the vendor, there is no choice on these parts, you must go for the designed-in part. There are other common parts which every manufacturer of VCRs will use, and effectively that is where we have a choice of vendors from which we single source. This commonality of parts, the
design of the video which reduces the parts all reduces the size of the supply chain. Generation by generation, I started with Mitsubishi seven years ago, then we had a parent level model - around the mechanical assembly would be various functionality (from an electronics point of view) that fitted on. But the parent level model went by mechanical assembly. That has gone through four stages over seven years - sizeable investment each year. The last step, last year to this year, has reduced components by 15%. Primarily this is because circuit board design has created a mother circuit board rather than several circuit boards. They have modified and simplified the mechanical assembly itself.

If you look at the sales price of our product, year by year in terms of look-alike model you are looking at a reduction in real sales price of about 10% per annum. In some markets, for example France the reduction is 18% on look-alike model over the year. So basically what we have gained in terms of design is already away. We can’t hide from this, and it will continue as the product cycle for videos which are now passed their sell by date, they have matured as a product. We have not got additional technology to ramp up balancing cost savings.

NON-CUSTOMER KNOWLEDGE TRANSFERS

Can you give an example of how Mitsubishi has improved its capability for procurement from contacts with from outside?

Related to procurement, I would say willing help yes, but impact no. If you look at outside help in terms of support for training, plant expansion and development of the organisation - these are a different matters. Specifically for procurement a minimal impact. Why? The pipeline: design, conception through to manufacture. The time-scale for this is roughly about ten months to a year from the initial conception. When you look at from drawing to final production this is about four or six months. If it is a new vendor base that we are looking for, because there will be parts that come up on a bill of materials that say “Hello, I’m a new part, I haven’t got a vendor. Please help me.” When we get that in effect, can local organisations support groups help us. No - the lead time is not there. If we have the design stage sitting next door to us, that might help. Jointly we can have design with Scottish Enterprise groups or whatever. We really need support groups sitting beside us designing parts.

Do you belong to any trade association which helps identify suitable suppliers?
Scottish Enterprise have tried to be helpful. The biggest irony I see is that the manufacturing base is actually adequate to produce things. If you say to them "That's actually what we want you to make, there it is, there is a prototype sample, please make them." They can do it. If you have a concept in your mind and try and get design all the way through to production of prototype, no. You get laughed at. They simply can't operate within the time-scale acceptable to our product.

Have your competitors ever helped you find a supplier. Can you give an example?

No.

PROCUREMENT POLICIES

Within this Mitsubishi company who takes a 'make or buy-in' decision?

There is a responsibility on Mitsubishi to help create a supply chain where it is a commercially viable decision. To be honest with you, for reasons I have hinted at even if we invested the time, the effort, the overheads and support - even in terms of capital equipment along with a vendor locally, the cost advantage would not be there for the partner. Why - because of the basic cost centre base: how are they going to compete with vendors in south-east Asia. There are parts where we have done that, and invariably they will be heavier, bulkier parts. Even then we have looked around and it is a "Make or buy decision." This is only in recent times. Do we go to a vendor to produce a plastic moulding for a bay chassis and pay him added value, for doing it? Whereas if we invested in the equipment to do it we have already got the overheads here. By employing one more person or two more people are we going to hugely increase our overhead costs? No we are not. So effectively we are more and more looking at making parts in-house. The emphasis in Mitsubishi's considerations is now thinking about this. There are a lot of vendors which Mitsubishi took on years ago, when they initially opened the factory and started to grow, and a lot of the vendors grew with them - because of the investment in time and equipment which Mitsubishi spent with them. But now we are on a plateau; vendors are going to get very reluctant. The vendors who we have brought with us are going to continue to grow, as they take on more business. Partly, but not wholly, because of the advantages they have had in working with an organisation such as ourselves. So we will get senior people within Mitsubishi saying, Mitsubishi are losing money, but our vendors are making money. There is something wrong. I disagree with that, because effectively we have made our money in the past, and may be the vendors did not make that money in the past. It is the product that we produce which has that impact. If I go over the road and produce air-
conditioning units, then effectively there is huge potential in terms of having an adequate mark-up, and return on your investment. In ten years time, the same cycle we are in will impact upon that product.

Does Mitsubishi actively seek a win-win relationship with suppliers, or do you emphasise more competitive sourcing?

In Asia OEMs produce huge volumes and the investment being made by suppliers in that area is still rising. This is because the volumes are there. And to a degree there is more and more volumes going to Asia at sub-assembly level. So more and more European or Japanese domestic manufacture is going over to Malaysia or south east Asia and effectively they are producing circuit boards, they are producing deck assemblies, drum assemblies - it is now almost going back through a full circle to a screwdriver operation.

Mitsubishi are different from some inward investors who have stayed as screwdriver operations. You still need talent and expertise to effectively carry out such operations. An assembly job is one thing, but getting it right is another matter. The local workforce here has had an important impact - they do the job well, and it's not easy. Our organisation is different because it is the Japanese model, step by step: screwdriver, know the product, then effectively “knock-down-assembly” - so you go further and further down to the extent that you are putting every component in that unit. In addition to that we are actually manufacturing components as well. We are going along this route, but can we survive? Only with the right product, with our product we have hit a plateau and I would suggest that in the longer term the cycle is going to begin again. We will go back to screwdriver assembly and build up again. Or, we diversify, which is more likely.

What influence do EU directives on local sourcing have on your sourcing policies?

Legislatively there is none. Effectively there are limited arrangements which would restrict us from increasing our content of material from outwith Europe. In saying that, I don't think we are particularly concerned. When you look at the added-value content of our product, regardless of where we pull the components from - it is huge, and the investment has been huge as you have seen. On average something like three and four million pounds per year. We operate at around 40% added-value. So from that point of view, if you look at Phillips as an organisation, and they are probably the closest resemblance to Mitsubishi (not all Japanese makers, but Mitsubishi for VCR) we would actually sit beside them, and lobby with them on the basis of what about all these companies that are pulling in all these major assemblies from south east Asia, and we are producing everything from scratch and we are
getting no advantage. So we would lobby the EU to restrict the importation of higher level assemblies. We would be delighted if they did this. Because not only are they restricting the full box coming in, and maintaining a 14% duty tariff, but we would like to see them pumping duty tariffs on every key assembly for that. They are not going to do it, but that would be nice. Mitsubishi are much more of a British maker than many British companies. In our product you will not find a localised manufacturing set-up anywhere else in Europe. We have been to the major Japanese makers in Europe, and they don’t do it the way we do. Even in the UK, they are importing higher level assemblies, and it is screwdriver assembly. In Europe, for example Phillips, who will lobby very strongly for importation tariffs, what do they do - they are using their geographical advantage and they are doing screwdriver assembly in main plants, but where are they buying their sub-assemblies: they are buying from Eastern Europe, because it is on their doorstep. They are getting that cost centre advantage. We have already looked at that [reference to a recent visit around Eastern Europe] and there is no advantage to us. It is cheaper and more advantage for us to go to the vendor bases in Malaysia, because of transit costs. Also important is what you touched on in terms of lead times: it is only sixteen days from Singapore to here. It would almost take you sixteen days for you to get a truck from Poland to here.

What discretion exists locally on sourcing policy. Can you give an example of a change you have made?

One thing that happens is they provide a drawing, and list of four or whatever approved vendors, and we go through the approvals process. So we can impact on that, where we are restricted is the lead time. So we may have a vendor that can supply at a competitive price, on paper. But we would need samples from them, we would need to test these samples locally. We would then need to forward them to the parent design office for them to verify acceptance or not, for the approved vendors list. However, the vendor approval could take as long as the product re-design. This is one of the biggest frustrations we have.

But to a degree, I have got to be honest and say less and less now (I'm painting a very black picture here). The opportunities from a local vendor base, other than very restricted areas - where effectively they are in there anyway - is leaning towards the economies of scale argument in our products. Our situation will be similar to others, but unique because of the product that we make.

Do you expect suppliers to conform to Mitsubishi protocols. Can you give an example where a supplier has changed to meet your requirements?
Local supplier have had to take on some of the Japanese methods, in terms of the philosophy of continuous improvement and costing for re-engineering - probably these two key issues. The majority of them have been able to progress, as Mitsubishi has progressed.

Mitsubishi as an organisation do not tend to dictate terms to suppliers - it is a partnership relationship. So we would tend to have a wee bit come and go. We understand the need for small companies to receive early payment, we are standard payment terms. Our protocols are perhaps not that different from other purchasers from local suppliers. I would not say that in these matters we have made any particular changes to what local suppliers will be familiar with. Lead time for delivery......we may have led them through the way of becoming more experienced with short lead times. But possibly little different to other companies. We are not pioneers in these areas at all, I think in some respects we are pretty archaic.

Ethicon are an example of a local company which is much more adventurous than ourselves. Other American companies I don't necessarily admire. It is horses for courses, at the end of the day we have to make VCRs - our market place is a lot different from some of the other larger manufacturers in West Lothian.

We have a globally standardised product, some the main inputs to which are globally available. We have 70% of our components exactly the same as our sister company in Malaysia, the other 30% will be spread across country-specific, cosmetic, the IC being the major one (oh how we'd love ICs to work off standard systems over the globe, but they don't).

**Do you have examples of direct JIT deliver to the line without buffer stocks?**

Very little at this moment in time. If you want (and this is a personal viewpoint which may be at odds with other parts of the company) I would put this question back to you: what actually is the advantage of delivering direct to the line? In terms of bulk product we are basically in that process, because we are tending to rationalise our three factory units into two. This has acted as a catalyst to look at some situations where a direct line feed would benefit our operation - basically because we don't have the space. If we had the space, would we consider it, or would we be looking at it seriously. Yes if there was commercial advantage. My argument is to question the commercial advantage i.e. we transfer the stock to the vendor (because he is still going to have to hold the stock), we transfer the frequency in deliveries to the vendor. Is the vendor going to do it for nothing - no, the vendor quite rightly, is going to add to our costs to recoup on that. Or he looks at re-engineering the
component he supplies. Now, the evolution is such, over the last ten years or so

How important is the expectation of continuous improvement from your suppliers?

Certainly this revolves around cost, the total cost, not necessarily the unit cost. You can look at the total cost in terms of the service they provide. So in terms of room for improvement there is that issue which has a cost effect. This kind of detail is what we are looking for, and what we get.

Are there examples of tiering of suppliers located here in Scotland. Can you describe one?

Where we have this relationship, and I would honestly say if you look at the European vendor base that we have had, then I would find it difficult (over the seven years that I have been here) it is the first vendors when we first came on the scene that have maintained a relationship with us both in terms of the growth they have had and the content within the units of our product range for their competencies. So, it has happened, whereby the local vendor has progressed both in terms of his input in terms of design and the evolution of that (because it has changed over the past ten years), and they have had some input - if you want - on their supply range. Very few vendors have fallen by the wayside because of design-out. There are a very limited number of vendors locally, who have fallen by the wayside because of poor performance. This is good when you look at the strength of the local vendor base which has built up and been supported.

LEARNING ORGANISATION AND PROCUREMENT

A learning organisation transfers knowledge in from outside. Can you give an example of your supply chain doing this?

We have a supply base that has off-the-shelf component-level standard products. They will approach us on the basis of “We have a product, give us volume and we will give you advantage.” That's one area of our procurement. Advantage can be price advantage or added-value. For example, we have had discussions with a vendor who will say they can give us cost advantage, we reply so can everybody else, we know the market and that prices are going down; we ask what makes you different from the other three vendors on our approved list? Sometimes that vendor may come forward with some innovative advantage to us. In the main, in this group of suppliers advantage to us is cost based.
Another group, a minority, are making components specific to video recorders. This group are split in two. One will sit back and wait on our approach with a cost-down programme, “How can you reduce the cost of that part?” They may come back with re-sourcing, re-engineering, they may suggest a complete re-design outwith our drawing. The other vendor group are more pro-active. They say right out that our drawing is behind the times and immediately make re-design suggestions which create cost-down. These are in the minority. Many of these have been with our organisation for a number of years, so the Japanese model has rubbed off on them.

This latter group are not more likely to be outside Europe. The two immediate ones which spring to mind are UK based, and they supply to consumer VCR, C-TV, audio manufacturers, and predominantly to the Japanese maker.

**CONNECTIONS ALONG SUPPLY & VALUE CHAINS**

What is the scope of your supply chain in terms of geography by value from West Lothian, Scotland, EU, RoW?

Our major 113 vendors in 1996 broke down as follows: 22% Japanese sales located within the EU, 10% Japanese in Japan, 37% European, 11% Japanese manufactured within the EU, and 20% south east Asia. In terms of value sourcing in 1993 was 32% locally controlled and 68% from Kyoto. These figures have dramatically altered under the localisation programme and are now 15% Kyoto and 85% local control.

How extensively to Mitsubishi use vendor rating of suppliers? What performance indicators does vendor rating include?

Very basic. It is weighted to the matters in our suppliers guide [see attached]. Weightings are towards matters affecting production process and quality. If you have a rating out of 100, they will take 80% of them. It is only used as a guideline, and we talk to vendors on a quarterly basis about it, we are not too uptight about it.

We don’t use competitive vendor ratings because in the majority of cases we are single sourcing. Although we may have opportunity to select from four vendors on the approved list, we don’t split up our volume - administratively and cost benefits are there. In no instance have we ever used competitive vendor rating. Vendor rating is a tool for discussing with the vendor, to inform a relationship. It is the relationship not the ratings which matter. We tend to be relaxed about ratings because we value the relationships. Clearly things can go bad and end in divorce. Marriage is a meaningful parallel of growing
together. Our propaganda is to seek a marriage with suppliers, but in real circumstances, you have to keep some independence because relationships may go wrong. Supplier relationships are built on trust, but this has to be mutual, and built up over time.

We have suppliers in hear and say, "There is our schedule for the year." There are suppliers like that and they know our schedule as much as our Production Manager.

What routes do you use to transfer knowledge to you suppliers for example by staff loan, joint development, equipment loan, financial support.

All of these but only one for financial support. This was a small local business, we were a major part of their turnover, we re-adjusted our payment terms to pay almost in advance to begin with. Now it has settled down. We still supply them our equipment to this sub-contractor (we regard sub-contractors as vendors) we supply our technical expertise which we don't charge for. It is like a hand-over exercise, it is the learning curve. We take on that responsibility, pass it on.

We are also now bringing sub-contractors into the building to effectively get them using our equipment here rather than transferring our equipment out. He looks after a sub-assembly process in-house. There are limits on how much this can grow for us. I would see this as limited now, it was much higher five years ago when our product sales were rapidly expanding. Now it is very limited on the basis that if such work has to be done, we do it ourselves and employ the labour. Where we would use the sub-contractor is to stabilise our manning levels so that we don't take on unnecessary labour - 99% of our labour force are permanent employees. This is unlike some of the local US companies. We don't employ casual labour. The sub-contractors we use to stabilise peaks and troughs, get regular steady work from us, and from other makers. We believe this is a win-win relationship with the sub-contractor, not us using him; his business is sub-contracting.

MITUBISHI’s TRADING WITH LOCAL SMEs

Of the suppliers you use who are located in West Lothian which would you are the most satisfactory and why?

A sizeable number on our approved vendor list are located in West Lothian. If you look at value this would be quite high: DS Smith over the road, EPS next door who supply plastic mouldings, our sub-contractors Fir-tronics are local, Livingston Precision. Our immediate neighbours are suppliers. These
are bulky products therefore they start to add value. I would say an average of £3 or £4 per video comes from these companies.

The number of our vendors located in West Lothian is small but the percentage value if sizeable. Outside of West Lothian the proportion starts to increase. There is little contribution from the rest of Scotland outside of West Lothian only a few companies in Midlothian and Ayrshire - the central belt.

May be 40% of our supply base is from Europe, but some of this is indirect procurement. Two examples: one Japanese company called Alph in Milton Keynes actually manufacture in Milton Keynes, these are a European supplier although they have a Japanese parent company. Panasonic UK make nothing, anything we buy from them, they don’t produce within Europe, it is actually produced in south east Asia: so basically it is a buying agency for a distribution centre. So this 40% figure needs exploration. I would say half of this or over would be European source with a country of origin beyond Europe.

Actually made in the UK I would say on average about 10% of the value of a video - certainly no more than this.

LOCAL NETWORK

Knowledge networks may stimulate innovation, improving competitive-ness. Are you part of one?

We are looking within Mitsubishi as a whole at upgrading our network. Its success historically is only limited. Our corporation is so big that it finds it difficult to communicate from one specialist area to another. I don't think this is unusual with a corporation our size. Big is not beautiful in this respect, it has its drawbacks.

If you look within our audio-visual group, because we have had a number of overseas clients, the pipelines I mentioned are funnelling supply that it is creating almost this buying agency dimension, encouraging this dialogue between overseas factories and the vendor base. We are currently looking at a cost comparison of what we buy just now going individually direct to vendors, and looking towards almost an extension of our factory procurement in Singapore, and having a group of people in there acting on our behalf, consolidate all these deliveries and vendor bases into a centralised warehouse, and effectively start to reduce that pipeline, and reducing inventory because of that. We are suggesting that our depot in Singapore might take the 'hit' to a certain extent but the cost advantage available in that would benefit us.
This would not reduce our 'design for manufacturing' advantages because we have an agreed vision, where we have invested in engineers of our own who know our systems and products. When design is re-located to Livingston this can only increase our ability to gain advantage from centralised sourcing of common components. We are dictating the ground rules to the purchasing organisation, and it is up to us to specify procurement as an extension of this factory, but in Singapore. We might pay salaries as overheads, not percentages. We would be calling the shots.

It may be that one of our first acts upon becoming a localised procurer, is to centralised procurement. I have looked at all ways around this. I started off in steel making, and old established industry, good industry, market leaders which lost out to cheaper imports from people prepared to invest. We are starting again, what’s happening now is no different to what happened twenty years ago in the early seventies. Too many makers of the same things creating centralisation, or people drop out. Mitsubishi are not going to be the one who drops out, we will maintain our level in terms of VCR, knowing fine well that we need diversity of product. We can’t survive on VCR, the corporation knows that, the corporation knows how good an operation this is, and how good the people are. It is not just the management but also the capabilities and availability of employees - this has been proven. I would argue when you talk about the Japanese model (I worked in the private steel industry) it was similar. Only the loose management structure within a Japanese organisation, better industrial relations and the level of investment are the key variances: I don't see them as being any better than the industries I have worked in before.
MITSUBISHI - PRODUCTION

Allan Sneddon, Production Manager at Mitsubishi Electric, was interviewed at the Livingston plant on Thursday, 6 February, 1997.

GENERAL COMPANY PROFILE

What is your job at Mitsubishi?

I am Production Manager at Mitsubishi Electric video-recorder plant in Livingston. My responsibilities include production, plant and equipment engineering, production engineering, quality control engineering some general responsibilities within the management team. I report to Alan Gemmel the Plant Manager, but also for some matters to Mr Morisada the General Manager. The management group is fairly small and meets formally once a week, but on a project basis continually. The Production Manager in this Company is a different role from the British companies I have worked in - the role is far wider, especially for product quality.

What is your annual turnover and expected gross margins?

About £70 million with terrible gross margins at the moment; about 1%.

What WIP do you carry?

We carry around a week, though this varies because of seasonal demand.

What is the production strategy for Mitsubishi?

Production Strategy overall is to improve the capability of the production department. What I mean by that is maximise people's potential. Basically there are a number of targets flowing from this to improve our production capability: knowledge, control capability, performance - in parallel with meeting commercial demand our objective is to improve capability. Last year we made a major design modification in our product this necessitated re-design of parts of the manufacturing process and verifying its accuracy. There was some slippage in this and it could be argued that targets were not met. I would argue that the best benefit to Mitsubishi was not the product change we delivered was that production core staff learned an enormous amount in a short time. We improved our core capability. Remember we don't go out and poach expertise from other companies we find that we bring people in they bring baggage with them. Our philosophy is
to bring in young people and grow them. So we constantly have to upgrade our people as other move up and around the organisation. So you can imagine why last years production results were less than target.

**Can you describe the management structure in production at Mitsubishi?**

We have a Plant Manager and a Japanese General Manager who collectively manage the plant. There are natural overlaps or groupism between the Sales Company, the factory between different parts of this plant, different management disciplines. An example of this is Engineering providing Purchasing with technical assessments - I would not say that's not my problem. I would also sit with Personnel to discuss recruitment policies, actively contributing. We share the management command.

Collective management probably takes up about 15% of my time. We formally meet every week, we meet other management groups on a continuous basis really - sometimes management projects are hot so we meet on a daily basis, for others we meet on a monthly basis. If projects are live in terms of their design or if there is a need for policy review we meet on a regular basis.

The Production Manager from an line point of view in this company - I have been a Production Manager in British, US and Japanese companies - the Production Manager's engineering responsibilities in Japanese companies more wider and more varied. These days a high quality product is a prerequisite for doing business. Everybody claims that everybody has a responsibility for quality of product. That's true. But, structurally it is centrally the responsibility of the Production Manager. There is a Quality Engineering Group which have some Quality Control inspectors in it, which report to the QE Manager, not me. But essentially they are policing quality systems, as opposed to building quality in.

What is important is what management does. During our talks you have seen that I spend most of my day measuring, monitoring, looking, listening - walking the job. I have the odd meeting during the day. At night I try to get reports and calculations done. In traditional factories management spend all day in meetings. I sit in an office in the middle of everybody else.

**What systems are used to organised work at Mitsubishi?**

All of our systems are continuous improvement and quality focused. The main systems we have are to improve the skill and knowledge base of the workforce. But remember, don't let the systems set the targets, they are there as servants of people - systems are easier to change and people.
What are the main technological processes you use?

Five percent are batch producing, 5% working on trial production, 90% are working on mass production.

For example, large batch production. We are the only UK manufacturer of VCR drums. This we do at a less than 1% defect rate to tolerances of plus or minus one micron, in a temperature environment controlled to one degree, on a £4.5 million machining centre which includes seven robots. A mass production example is PCB insertions. These are done with an automatic insertion machine operating at 1,920 insertions a minute, followed by a manual insertion line for difficult components. We have a variety of processes operating here.

Do you use of target costing and value engineering (Kaizen costing targets)?

Yes all the time.

How do you decide on appropriate type of process choice? Can you give examples from within the factory?

Mass but customised runs could be seen as large batch.

Which element would you say drives productivity improvement at Mitsubishi, technological change or changing people processes?

The drive to improve efficiency at the moment is really led by consumer pricing. In the globe just now there is over-capacity or insufficient demand, all of these products are reliable. Which means prices are highly competitive. The best way to solve that problem is by design improvements to reduce process cost, or alternative an improvement in product design reducing inputs. Logistically this gives problems of continuous improvement programmes which are under pressure for strategic reasons are now under pressure for commercial reasons. This is a very nice environment to work in when you are under pressure to implement new products, it is a whole different ball game for young people when the pressures are commercial. It is tough going for some of them.

The atmosphere now is more serious than it has been for a long time, but it is still a positive one because I find that the greatest motivator on earth is knowledge, and I find that young people under pressure come up with innovative ways of doing things - whether this is intellectual or skill based.
If you take IIP as an example they said to us, a lot of your stuff is not as structured as some companies, but you meet the IIP philosophies well. Sometimes I would like to pay our people more, or say don’t work so hard, however, commercial pressures are real, and we are turning these youngsters into very competent engineers, supervisors and planners - they learn a hell of a lot here. Mitsubishi will remain here, head office is determined to continue manufacturing in Europe, what we will be making in ten years time is a different matter - nobody knows. That's the technological drive, driven by the consumer: our role is to adapt to the technology. Mitsubishi Electric is one of six corporations in Mitsubishi, and it employs 180,000 people. It is a big company, and not ready to withdraw from any major markets.

How many permanent and casual employees do you have?

We don’t use casual workers, and we employ 850 staff.

Do you have skill categories, if so which?

Our basic categories are operatives, engineers and management.

How is employment structured? Is it single status?

We are a completely single status plant.

Describe the teams or cellular manufacturing you use?

Risk assessment is my responsibility to assess risks from changes before they are made. Target setting comes from the Group engineers. If the targets don’t suit my plan then it is my problem and not theirs, providing I think their assessment of the targets are reasonable. Often I will question the method they use to assess targets be it to increase or reduce the target.

How do you judge the flexibility of the workforce, and how do you create flexibility?

Quite happy. In seventeen years in production management I have never seen a workforce which is as flexible as this one. The work ethic is here, and a demanding one. People are motivated into learning and taking responsibility.

What role does Production play in the recruiting and improvement of employees?
Appendix One:
Interviews with Inward Investors

There is a limit to the amount of cash I can give people. But what I can do is
give them the opportunity for them to express themselves and to learn. So I
spend a lot of time giving away bits of my own job. There is no job
descriptions you see. The problem is this system creates a high aspiration,
some individuals think they are better then they are. You need continued
expansion of the pool to fulfil the aspirations of the people. For us now that
the VCR has plateaued, we need a new product to do this. Otherwise we
may lose people through frustration.

From a process point of view we are the most productive of any Mitsubishi
Electric plant in the world. We make videos, as do other plants, and we make
them more efficiently than our sister companies do. We educate other parts
of the corporation in process improvement ideas. Industry in Japan is under
tremendous pressure, and to some extent we benefit from that.

What motivates your workforce?

Not salary levels. It is learning - the opportunity to aspire. I had a great
engineer who had been here eight years but was talking about leaving. I
asked him why. He said that he could not do what he wanted here, but was
being offered a challenge elsewhere. He said he was being offered more
money, a fancy job title and more responsibly. But he admitted it was a con,
he really wanted to stay. He wanted a new challenge, a different role.

My duty as a manager is to maintain consistency of production - to watch and
measure and improve where necessary. The difficult job for me is when I am
making up a budget plan, I have to get that plan accepted. Often my bosses
don't like it - they want to squeeze costs. Once the plan is accepted, and put
into targets then the key is “Don't fail.”

The down-side for me is that Japan is still mostly the old guard. Youngsters
have yet to take-over. The standard of living there scares me; one of the
richest countries in the world and people live very poorly. I worry about the
control towers at the top. Sometimes there is no win-win, just lose-win for
those at the top. I am half Japanese now, it's difficult to think of moving even
if I wanted to. I worked at Hughes Aircraft Corporation and made major
changes when I came here. Now I have turned Japanese. But who wants to
work until 60. I may not get a really important position until I am 56. This
pace of work is alright at 37, but will I be able to do it in twenty years time. I
don't want death to be the thing that slows me down.

I went to Japan and was presented with a plastic train for being promoted
faster than anyone in this part of the Mitsubishi corporation.
What is the relative weighting you attach to price, quality, time, continuous improvement?

Mitsubishi runs by giving 100% priority to each of these.

What strategic opportunities for innovation and technological change do you face?

Our major strategic opportunity will the transfer of a new product to this site. We hope to secure at an early stage development and design of the new product. Decisions are still being made in Japan around this new product.

What constraints do you face in taking advantage of these strategic opportunities?

We need the right decision of new product to come from Japan. Our other constraints are the downturn in the market and intensity of competition from Malaysia.

KNOWLEDGE GENERATION WITHIN PRODUCTION AT MITSUBISHI

What staff, budgets and time do you allocate to product research, development, and product design?

At the moment we have no R&D facility on this plant, but hope that the new product will give us this.

Can you give an example of how and why a process innovation has occurred?

The re-design of the VCR product, using simpler mechanical systems and more advanced electronics has allowed us to shift production from three to two factories. This total process re-configuration will secure for us cost down from process innovation.

Does process innovation arise from a planned and conscious strategy or respond to events and opportunities?

I recently visited IBM, they were on about Taguchi design experiments and all sorts of fancy ways to problem solve or to measure things. They were wanted to know how we did these things in a Japanese company, they were looking for more fanciful methods. I just said, if we have a problem it is either man, machine, method or materials or a combination. Try to find the problem and
then try to sort it out, and monitor the solution to improve it. The IBM people were looking for some magical Japanese solution, they would not believe me. It is our people rather than our systems which give us competitive advantage.

It is true that from a method point of view we tend to measure waste differently. Target setting is also interesting, we don’t set top-down targets - it makes them unachievable or too easy. Sometimes the people with the easiest targets in the US companies are the ones who get the medals, not those who try hardest.

Has information technology stimulated process innovation?
Not really, though it helps in keeping contact with Japan.

Does design-for-manufacture system in product innovation? How are you consulted at product design stage?
The compression from three into two factories has promoted opportunities in design-for-manufacture.

What drives process innovation at Mitsubishi? What stimulus comes from customers and suppliers?
Price is the driver of change in the VCR market: prices have dropped by around 18% in each of the last three years, and their continues to be over-capacity of VCRs world-wide. So, process innovation for us is customer rather than supplier driven.

How influential is the mother plant in driving process innovation ?
We are in competition with all Mitsubishi Electric plants for new investment, Kyoto is central to decision making on these matters.

Does benchmarking within the Mitsubishi organisation result in continuous improvement being implemented here?
Yes this is important to us. Over recent years, as our product has reached maturity, we have been able to leap ahead of sister plants - this is the most productive Mitsubishi VCR plant in the world.

NON-CUSTOMER KNOWLEDGE TRANSFERS
Can you give an example of how Mitsubishi has improved its capability for production from contacts with from outside?

We are in an international business. The average punter in the street does not understand what being in a global business means. Some Government policies towards inward investors are working very well for us.

It is not the money, once you are here, the great advantage of the UK system is what local and national government do after we are located here. Training grants, linkage to other inward investors and suppliers is an important relationship which impresses the Japanese.

Scottish Enterprise have had forums in the past - a number of invited guests of major corporations go along and it allows Managing Directors of small local companies to fire questions at them. This is a learning exercise. West Lothian Council runs similar forums. The subjectiveness of these thingsannoys me. The media reporting also annoys me. Why does it always have to be a posh hotel and an expensive lunch. We learn very little from these events.

CUSTOMER KNOWLEDGE TRANSFER

Can you give an example of customers making suggestions which have improved your products and/or your processes?

The customer feedback from a product point of view comes through data systems which are well established, so I can tell pretty easily what is happening in my product field. We have a Mitsubishi Sales Company in most European countries which we meet on a regular basis, so we can identify what is happening in commercial trends.

How much easier is it to know what the final user of products wants, than to know what an intermediate customer wants?

Of course it's easier when you know what the final user wants - we get regular feed-back from the Mitsubishi marketing organisation.

How does the marketing arm of Mitsubishi influence both product and process innovation?

At the moment feedback from the customer is more important than input from our suppliers - the customer is driving the price of the product down, which could kill us. Historically it is the technology which is the driver of change. Our problem is that the next generation of digital videos will be bought by
people who are only seven years old today - there is no point asking them their requirements. If you ask the technologists.......that can be dangerous.

**LEARNING ORGANISATION FEATURES**

Is this a ‘learning organisation’ - constantly generating, transferring-in, accumulating and socialising knowledge?

In Mitsubishi these are all evolutionary. The way Mitsubishi do it is they establish a sales network somewhere in the world, they then localise the manufacturing capability, then localise the design capability and eventually the R&D capability. So we will go through all of these stages. We initially transferred knowledge from Kyoto, we then socialised that knowledge, we then generated knowledge by improving on it (we are better at continuous improvement than the Japanese). We will originate knowledge when R&D from Japan transfers to here. Last year we set up a an R&D facility in England and in Germany - that’s our European R&D facilities.

We have started a design localisation programme. That will help me tremendously in manufacturing, and it will have boom effect on the opportunity you speak about of local companies to supply to and learn from this company. If you look at any large company anywhere in the world there are two poles for supply networks: where the design is located and where the manufacturing is located. We have got a supply network around us in Europe, and the design capability in Japan now has a supply network around it in east Asia. When you transfer design, even although we are a global business the natural effect will be for a lot of that supply base to transfer with the design capability. That will happen, and ideally in this plant.

It will be both Japanese and east Asian suppliers setting up here and some will be local companies. I can understand a local guy with a small company worrying about a sophisticated Japanese company building a factory on its doorstep. The difficulty right now is that we are constrained by our Japanese mother factory at design stage and the timing which flows from that. This is not a Japanese factory it is a Scottish factory. Young people are like Mitsubishi - they are international and see room for everybody in the market, but local control makes a difference.

**Is Mitsubishi a learning organisation? Can you give an example?**

You die if you are not a learning organisation. Looking back in my past, I had immense frustration when I was told to do my job without thinking, as defined in the job description. It is inhuman and it does not help companies develop
because they don’t innovate - they only maintain. The beauty of Mitsubishi’s organisation, because of the technological transfer and the market transfers is that it lends itself to people development. When we transfer design we will originate knowledge. This starts with continuous improvement programmes and modifications to existing designs, but eventually it will be origination and that will transfer into our network around us.

**A learning organisation transfers knowledge in from outside. Can you give an example of production in Mitsubishi doing this?**

This is part of the Mitsubishi’s corporation’s strategy. Timescales are difficult because they are affected by consumer pressures - these real time effects will determine the speed of our development. For example, exchange rates in the past and the future will impact upon how locally we localise procurement or change the plants receiving investment. So there are global effects dictating the direction and speed of corporate strategies.

**A learning organisation is generates its own knowledge - how does the production function contribute towards this end within this plant?**

We have a committed workforce just waiting for these opportunities. Some don’t fully comprehend complex issues - you have to take a long term view. There is some negativeness arising from disinterest or our inability to get the message over. I would say that a third of the workforce here, the core group at every level of the company, are ready for this change. It takes so much time talking to people to keep them up to speed with the potential. You spend time keeping people on board, the problem is the individualism of some people who want to be powerful in the Group. We need to coach people to play for the team.

**A learning organisation accumulates knowledge. How do you ensure that lessons learned in production are not forgotten and become part of Mitsubishi’s knowledge base?**

We talk, we hold group and factory sessions, and we formalise procedures once improvements are identified.

**A learning organisation ‘socialises’ knowledge - ensure that those who need to know do know. How does this occur within the production function at this plant?**

We hold regular Group meetings, regular team leaders meetings and run the top-down quality programmes. Once Production establishes a new procedure we make sure everybody knows it through training.
How do you plan for the new knowledge necessary to introduce new products?

This is what the Japanese companies are best at - taking the time to plan every detail of a new product: the technology and the systems. This will involve months of interchange between us and Japan, and plenty of movement of people between here and there.

How do you plan for the new knowledge necessary to introduce process innovation?

Just the same as for a new product or expansion of existing product range. Remember, Mitsubishi is an engineering company, it takes pride in its engineering skill base - nothing is left to chance, the company makes sure that people are equipped to do the job, and the right equipment is there.

Do you use project teams to implement product and process innovation?

We run on project teams. There are no fixed departments here, people are often part of six or seven projects at the same time.

In production at Mitsubishi is ‘learning by doing’ more important to Mitsubishi than learning from formalised training?

Both are important to us. We encourage all of our people to reach their potential, and this often involves training course such as Mechatronics. But ‘learning by doing’ is also important - not just in groups doing operations, but in engineering and management.

SUPPLY CHAIN CONNECTIONS ALONG SUPPLY & VALUE CHAINS

How far does procurement limit the potential for improved productivity in production?

Our supply chain is not all that different from that of our mother plant at Kyoto. Now you have Mitsubishi Electric plants all over the world. They all tend to buy the more complex ICs out of the states, they all tend to buy memory ICs out of east Asia, they all tend to buy plastic parts out of east Asia, and they all tend to buy the more value-added parts (other than ICs) out of Europe. That’s the way it is typically just now.
Do you regard your suppliers as partners? Give an example.

Of course, particularly in sub-assembly. We work for years getting vendors round to our way of doing things. This means a close interface between Production, Engineering and Procurement.

MITSUBISHI's TRADING WITH LOCAL SMEs

How satisfactory are your relations with West Lothian suppliers to Mitsubishi?

I would say very satisfactory, of our 190 local vendors, we have only every lost the one I mentioned earlier.

The difficult these companies face is getting started and establishing trust with such as Mitsubishi. Once trust is established they could go on to supply other big companies and other parts of Mitsubishi.

We work closely to help local companies understand our needs. We've even helped one out financially, we've loaned equipment to other, and with all of them we lend our expertise - by having them in here, and our engineers visiting them to offer advice and support.

What bad experiences of local suppliers has Mitsubishi had? Can you give me an example?

There was a local firm, where the guy had a problem which he kept from us, and this let us down. But, by and large we have good relations with local suppliers.

How much of a constraint on this Mitsubishi plant is the supply chain you use?

Scottish Enterprise were in here yesterday, because I want them to give me some support to bring design capability over here. There are aspects of it that can go anywhere. He asked me what this would cost. I said I don't know, but I want to send positive signals to Japan. I was talking about training support, equity, facilities not simply cash. The government needs to support inward investors after their location here.

How different are production arrangements here than in a plant with a similar product in Japan?
Japan is really split in two: the traditional Japanese person is self-sacrificing, the young people think differently. The work ethic is better in Scotland amongst young people than in Japan. In the US people work more hours than we do, but in the Mitsubishi plants there less effectively. The pace of work in Mitsubishi plants in Japan and the US is lower than it is here. In Malaysia it is higher.

**What do you understand lean production to mean?**

You have to be careful in being too general about Japan and it's manufacturing systems. In my view there is no general model that can be picked up and transferred, but there are lessons. Lean production is having a customer-focus combined with minimum inputs into the manufacturing process. In this sense we are lean producers, but that model can go a lot further. For example, we don't use direct to the line JIT here, though we might in future.

**Should local SMEs set out to learn from Mitsubishi?**

Of course, they should try and pick up points from everybody. We’re very open and have lots of visits from local companies, and some organised by Scottish Enterprise. But some people come here looking for magic solutions. Instead they should look for practices which suit their businesses, not somebody else’s.

**LOCAL NETWORK**

Knowledge networks may stimulate innovation, improving competitive-ness. Are you part of one?

We network a fair amount locally. I go anywhere I’m invited, even though most of the time there its more ‘give’ for Mitsubishi than ‘take.’ But we participate in the JET club, and quality forums.

**Is a knowledge network amongst West Lothian-owned manufacturers an achievable goal?**

It may be but the Mitsubishi’s of this world can’t be expected to put in more than others. We’re an international company operating in global markets - our business is entirely different from many small local companies. Sometimes they forget that Mitsubishi has been going for over a hundred years - it has taken us a long time to get where we are, and it will take other companies a long time.
From a knowledge network what sort of knowledge would this company find most useful?

A network has to have a use. For example, EPS Moulders next door: they supply to us, and so we work closely with them. We go on joint golf outings, meet at the football, as well as work on joint projects. There is substance in our relationship, that’s what would be needed to make a network real. Remember we source globally, so the challenge for local companies is not to be able to provide for us, but to be able to provide for the industry.

PUBLIC POLICY SUGGESTIONS

What could the local authority or the government do to improve the institutional framework facing West Lothian-owned manufacturers?

After-care is important to us. Its no good bring inward investment here unless the after-care is there. This means training, meeting our needs environmentally - particularly in energy, water and transport. In my view these after-care services could be improved by focusing more on our needs, by coming and asking us more often.

How adequate are West Lothian training providers for your purposes?

OK in the main, but we have to be active in shaping their courses to our needs. We support local efforts to re-do the West Lothian College of Further Education in a modern facility in Livingston.

NEC - HUMAN RESOURCES

Maidie Cahill is Human Resources Manager at NEC Semiconductor (UK) in Livingston and was interviewed on 11 February, 1997.

In corporate philosophy “NEC strives through computers and communication to help advance societies world wide towards deepened mutual understanding and the fulfilment of human potential.” The Livingston plant (which was established in 1981) manufactures, assembles and tests integrated circuits including a four to sixty four megabyte DRAM range of

1  NEC Semiconductors (UK), company brochure.
memory chips for supply to European OEMs manufacturing PCs, printers, cameras, calculators and microcomputers. Advanced technology on the site manufactures 6 inch wafers in a 0.15μm filtered cleanroom. The plant sells £139 million (1993 figure), covers 537,000 square metres and constitutes an investment of $800 million.

COMPANY HUMAN RESOURCE PROFILE

In your opinion why did NEC locate this plant in West Lothian?

I think for a variety of reasons: access to the European markets would obviously be a major one, the high opinion that the Japanese have of the Scottish education system as opposed to the rest of the UK they tend to believe that the Scottish system is generally better and produces better graduates in the main - I think Edinburgh University in particular has a very good reputation. Also, and I don’t know the details of this, there are historical links between Scotland and Japan going back to the sixteenth century, there is some linkage there that makes them pre-disposed to Scotland. Obviously other things were important also like the supply of labour, and the general level of environment in this area.

Does NEC have a Human Resource strategy. If so what is it?

Not in the sense that I would have been accustomed to before coming to work here. I am thinking of some differences between here and Unilever where I previous worked are; one major difference the volatility of the market for semiconductors which I think complicates manpower planning because as you know we are in a massive dip at the moment, and a regular UK company probably would have been laying-off over the last twelve months. NEC don’t do that, I guess they have a long term plan in that once they make up their minds to do something they will stick with that and they do think very long term. So from that point of view, yes there is, but it is not without difficulties to plan human resource policies - development of people and so on - because the opportunities may not be there, depending upon what the market does. So this is somewhat different to Unilever where I suppose we were is much more steady markets and it seemed the human resource function had more of a structure, whereas here it seems less so. NEC is entirely market focused, Unilever was probably less market driven.

Do you have a model new employee profile? If so what are the main characteristics?

For operators we tend to take someone who is early mid-twenties, maybe at most had one other job, usually if they have had another job they will have had a good track record there (very good attendance, time-keeping and
references), and ready to adapt to what can be a quite different environment and can be quite a strange culture. It used to be the case that we recruited 'virgin labour' we are gradually changing this. When I first came here [1993], and for the previous ten years, that tended to have been the case, that profile is gradually changing, and I am glad about that. We are trying encourage that change. There was too much of an imbalance. Our turnover is stabilised at about 8% - much lower than used to be the case. I feel that to have such a young workforce it gives all sorts of problems which you don’t experience with a slightly more balanced workforce. I think it is good for the factory to have more of a balance.

**How many employees do you have: permanent and temporary?**

We do not use temporary labour, and avoid doing so at all costs. We employ 1,450 people employed here: around 800 are operators, 400 engineers and a couple of hundred support and clerical staff.

**What is the ratio of direct employees to indirect?**

We are deliberately avoiding this categorisation here. It is something that Accounts keep trying to use, and I keep saying what do you want me to understand by those terms, and I will use it. But these terms mean different things to different companies so I deliberately don’t categorise in that sense in any of the information that we put out. I think it is an accounting principle essentially, and if I don’t understand what the Accounts people are going to do with it, I won’t give them the information. Other companies I have worked in used these ratios a lot, but I have never fully understood what it means other than in accountancy terms for books.

**What is the gender profile at NEC?**

Sixty: forty male to female.

**Do you consciously use an internal labour market model i.e. low points of entry, high levels of training and internal promotions rather than external labour market recruitment?**

We still do this to a large extent. We have got people here now, probably at junior management level that came in as operators and worked their way through. That will continue I think. But, as we are getting bigger then we are tending to bring in more people from outside at more senior levels, we are not just growing our own, we are also importing external people - whereas ten years ago it would probably be all home grown.
We are very committed to training. Mr Nakamura, the Managing Director has this theory that you should be able to bring someone in as an operator and they could get to become Managing Director. We have an option to go from operator to (say) setter (technician) and from that role to go to engineering. Once you are on the engineering rung, effectively you can go up, and up and up. So in theory it is possible in here. Mr Nakumura advocates this, and he would also like to see the clerical staff to see a path through, it is more difficult obviously on the clerical side. In theory these routes are open, in practice we have still got people who start as operators who do very well and you can see them moving fairly fast, but not as fast as they probably would have done when we first opened [1983] so that people could hit Manager after ten years, I think this is unlikely now - that would be longer.

How does NEC ‘eradicate fear’ to induce TQM commitment?

I think very much so, an example of this was when we had the mega-market dip towards the end of last year. It got really bad, and the place was absolutely awash with rumours about what was going to happen? Where we going to close? I got together with the Directors and talked about it. They were very anxious that such fears were allayed very quickly. So we put out a letter from the Managing Director to all employees, basically saying: yes we are having a difficult time in the market place but we are committed to long term security of employment, that has now changed. So yes we are going through a hard time, we have got to tighten our belts, we have got to watch our budgets, got to watch our costs - so please support us in all of that - but the long term security of employment remains intact.

I know there are organisations where such a letter would be misinterpreted or disbelieved, but quite the reverse here. People were delighted to receive this letter. I think it depends on the organisation and on the credibility of the MD. This particular MD is seen as a man of very high integrity, he does not say a lot but when he speaks it has meaning.

Can you describe the management structure at NEC?

The structure...............I guess fairly hierarchical I think. Probably still too many layers - think we need to look at that, and eventually I am sure we will have to. Style is fairly - I would still call it command and control - although I am sure that some of my management colleagues might disagree with that. I think is still gives that impression. It is very functionally based categorised by Production, Engineering, and Administration - they are the three major categories.

What motivates your workforce?
I think with the youngerster probably they have a high level of disposable income, especially since a lot of them still live at home, and I think they find that a very attractive proposition. I think they like the - it may seem somewhat strange - but they like the shift patterns (the four on and four off scenario), again this is something the young people tend to like, and even some of the older people. I think the job security element is important, people come here and the message they get (often from their families) is go and work there because it has a reputation for long term employment. We never have taken temps - we pride ourselves on that - we do not have a 'hire and fire' lay-off scenario which can be associated with some of the other inward investment companies. We have deliberately avoided this. Even down to for example the summer (remember we run this plant 24 hours, 365 day a year) we split the holidays so that half the factory goes on holiday at one point, and half at the other. What we have been doing is to bring in cover, but even the people that we bring in we carefully adjust the numbers to ensure that we don't take on so many that we can't then afford to keep them on. So we have been very careful to do that. Even in the canteen, we might use students during the Summer to help out, rather than temporary labour - students are only looking for summer employment.

**Do you have a 'rate for the job' payments system?**

This has changed in the last twelve months because we have grown too big for individual rates for the job, when it came to the annual pay review and appraisal time the situation became a nightmare. So we are moving this pay review towards a more traditional, or at least recognisable, salary structure. It will no longer be entirely individualistic rates of pay - we are now of a size where this is too difficult to manage.

The new scale will be Operator 1, 2, 3, and 4. Setters 1, 2, 3, and 4. These don't necessarily follow-on but overlap. And clerical 1 to 3 and engineering 1 to 3. Each of these now has a clear salary band, and what happens is there is a salary structure which shows the overlapping, the mid-point and top of the band - it is becoming more of a regularised salary structure.

I prefer this, from the point of view of explaining to employees come pay review time, I think having an understandable, recognisable structure is good. People like to see where they are and where they are going, and the company avoids upwards drift in pay; we have ended up with some people on very high salaries just by the gradual increases - it has gone too far adrift in certain areas - though clearly we are not putting existing salaries down, we are putting more capping in.

**Labour flexibility is important in mass production, how do you motivate flexibility?**
Labour is very flexible here, the like of which I have never seen before. People who may be operators train as setters, doing what would be considered engineering jobs in any other company - there is no real demarcation. We do have job level descriptors for scales, but they are not prohibitive; they indicate the tasks that people may be involved in. I think it is fair to say that there is no demarcation other than where there is a concern about safety.

**How is kaizen organised and rewarded?**

There is no financial recognition at all for any of the continuous improvement systems. We do it by programmed activities essentially. Some of it is top-down driven, and some of it is bottom-up; so there are two systems in operation at the moment. The top-down system is probably more structured dealing with bigger issues, Jim Weir [Production Manager] will talk about this forever, because that is his favourite topic. The ZD programme, (zero-defects, quality circles - call them what you will, it is just another name for the same thing) that has to be much more bottom-up......it is just people encouraged to take part in them. I suppose the reward is if they do take part they get lots of support and encouragement, they have weekly meetings where the teams can present to senior managers, twice a year we have big conventions, the best team will go to Japan and present in Japan, and maybe a team will go to America and present at the conventions there. So it is more about recognition than financial reward, we have deliberately avoided financial reward. What we do for the best team is they will get the trip to Japan and do the presentations there, and everyone gets gifts; little things like cameras or calculators or stuff like that - everyone that takes part gets a gift of some sort, which vary slightly in cost depending on number two, three etc. There is no financial reward.

**By what criteria do you judge the success of continuous improvement programmes?**

Our participation rate of production staff is around 70%, that is lower on the engineering side, and unfortunately far lower amongst clerical staff. It is very much a production driven issue primarily because the champion of it is Jim Weir the Production Manager - he is mega committed to it in his own area. Therefore he has really encouraged it in his own area. For example, for someone to progress through from (say) operator to Group Leader (the first rung on the management ladder) they would have had to have been participating in continuous improvement programmes, they have got to show commitment. If someone cannot show commitment to continuous improvement, then although they may otherwise be a good Group Leader, it would inhibit their development and progression. We have been very up-
front about this indicating that cumulative small improvements are what make a better factory.

What in your opinion turns the children of conflictual miners or BMC workers into active participants in NEC programmes?

This is a difficult but interesting question. I truly don't know the answer. I guess many of them have seen their parents in situations where militancy has resulted in unemployment, particular in West Lothian. But, may be this is too contrived an answer and people don't think like this. Most of our people have little or no experience of unionisation, so that is not an issue with them. I often wonder, because we take people straight from school and you can see uncooperative traits, but later you see the same young people doing presentations, and they are brilliant - often so enthusiastic and proud of themselves. This is a complex question. At NEC we treat everyone with respect and go out of our way to offer recognition and encouragement. Some of our people have left school with little or no qualifications, we do SVQs in our training, people are proud of these certificates. Our production management are very much the push behind this.

How geographically diverse is the external labour market NEC operate in?

I would think 90% of our operators live in West Lothian or very close. Engineers tend to split between a catchment areas further east and west and a few from over the bridge, but not many. Clerical will again tend to be mainly West Lothian people.

Do NEC employees feel themselves part of a Japanese lean production model?

It is not a term that we ever use, at least not that I have heard. I don't know......it makes me think of working with the minimum manpower in all circumstances, and I don't know that we necessarily do that. May be the term has other meanings. We work with the minimum work in progress and stock, I suppose that is very 'lean'.

Do you think there has been a paradigm shift from an old Industrial Relations model to a new Human Resource model. If so is NEC part of that shift?

We don't use the term industrial relations here. We have an employee relations section in my department which would probably be industrial relations in any other factory. May be your distinction is more academic than real.
Would you say NEC here has a West Lothian culture, a Japanese culture, or something else?

We are a Scottish factory but blending aspects of Japanese approaches.

What investment in training does NEC make? How do you appraise the return on that investment?

It is difficult to give a precise figure for the percentage of our budget going on training. It is going to be mega at the moment because of the investment in the new 256 megabyte DRAM capacity costing £530 million. This involves a huge investment in training. Forty of our people at a time are over in Japan - those kind of costs are phenomenal. I could get you precise figures.

It is probably too generous to say that every employee receives some training each year. The majority will get some kind of training every year. Whether or not they would recognise it as such is another issue, particularly when it comes to on-the-job training, and whether people interpret that as training. Particularly engineers would not see training as training unless it is done externally. But in the broadest sense, yes, all of our employees receive some training every year.

Which area will give NEC the greatest additionality over the next years: investment in technology or investment in people?

I think employees see investment as a massive vote of confidence in the workforce, and that is an enormously encouraging factor. Against that background people will strive to improve, because they know that this £530 million investment was between us and the United States and another Japanese plant. And we won it based upon our productivity levels. This has been made very public, and we get very clear messages from the Board that we are the most productive plant in the whole of NEC. Those kind of comments are obviously very important, so I think the investment drives the enthusiasm, people see it as building a future for themselves.

There is an element of people liking the investment in technology but sometimes resent the organisational readjustment which comes with it. People sometimes don't want to move. This factory have extended in a ribbon development along our site, people sometimes like to stay in its original parts.

NEC AS AN ORGANISATION
What label would you give to the organisational form of NEC here?

This place is different from anywhere else I have worked - it has differences that other places don't have. The Scottish-Japanese combination is extraordinary and very powerful in its way.

The Japanese who work here see these differences. They see our young people are more confident that youngsters in Japan. But they also see a lower level of discipline. I have no difficulties with Japanese workers here in terms of formal discipline.

Some of the young Japanese guys say that things are changing as far as work ethic and discipline is concerned in Japan. The job-for-life scenario there is now breaking down.

Does NEC organise control of work using technical processes or attitudes of employees?

Control is exercised both by the technology and by people systems. On the engineering side the technological is a powerful discipline is absolutely important because the processes are very rigid. On the production side it is more of a combination, probably more the moulding of attitudes than the actual technological processes, some of the operators don't always appreciate the technological parameters. They often recognise the importance of doing something, without knowing why is it important.

How does NEC try to stop involvement in the organisation being least at the lowest levels in it?

It happens to a degree but there is still central control. Let's say an engineering group came up with suggestions to re-format work, this would be put to engineering and production management before implementation.

You perhaps know that the American Etzioni categories organisational forms as being coercive, utilitarian or normative. Can any of these labels apply to NEC?

If you look at the production side of NEC - there is a huge amount of form filling and documentation. One example of what you might call coercive is we tell people that these documents have got to be filled in and in this particular way. These are basically process control sheets. I don't think that the operator would always fully understand the details of what they are and why, only that they need to be done. The tendency has been in the past either for people not to do the checks or to make up the results. As a
consequence you can lose large values of product. So in this area we have come down extremely heavy, and said that anyone who falsifies documents or doesn’t fill them in (not being forgetful - that would be OK) then we are saying, “You’re walking.” Even if they have a clean record, it is just too important for our business. We have put this message about clearly, and we have acted on a few occasions. So I guess that is fairly heavy handed in that sense. And we have certainly had Tribunals where we struggle to explain to the Tribunal the importance of what to some Chairmen is a ‘little bit of paper not filled in correctly.’ We have said, that little bit of paper makes the difference of millions of pounds to the company. Another company may not be so concerned, but because of the nature of our product we have to be.

**By what criteria does NEC judge commitment from its employees?**

I think a good example was last Christmas were we (the words I would use are) buggered everybody around to an enormous degree. We planned to work a particular pattern over Christmas. Because of the market situation we knew that if we proceeded to work that pattern we would end up with basically producing product we could not sell and stock-piling. So we didn’t want to do that. But what we had also done in order to encourage this particular pattern had been to offer very enhanced premiums: quadruple time for certain days over the period. We thought - this is crazy, we are going to pay quadruple time for product we don’t want. Within four weeks before Christmas we turned the tables upside down and said to employees, “We know we promised this, and if you absolutely insist on working then you can do. You might be cleaning the windows or doing the lawns. But if you really want to come in we will still pay you what we promised. But, we don’t want you in here. And we are going to work hard to dissuade you not to come in.” And probably across the whole factory about half a dozen people insisted on coming in. The message we gave out was, we don’t want to do this, it arises from the market situation, we are not laying people off, and we know we are buggering everyone around, but we really need your co-operation. People co-operated - I was amazed.

**Does this commitment stretch into the social lives of employees?**

No I don’t think so. I think that is different. A recent example is, we have car stickers on all vehicles coming into the plant. Some employees get really up-tight because the world at large can see NEC stickers on their cars. I don’t think it is because they are ashamed of working for NEC. I don’t really know how to explain why people want less obtrusive stickers, but this did come up at one of our communications meetings. I’m sure that most of our people are quite proud to work for NEC.
Do you find that commitment given to NEC by its employees arises from team working?

I think it is very important at the production operator level, probably more so than anywhere else. Because that’s the focus of their recognition then its really very important to both the employee and the company. The engineering side is much more performance driven, very clearly performance related to an individual: that engineer, that process needs to be working, that machine needs to be fixed.

I have never heard comment within the factory about fear of the team depending on the individual. Generally team working here is viewed positively, not from a dependency view point, we don’t go in for the Motorola model of the team being responsible for discipline, the team being responsible for recruitment. We have not gotten into any of that and have no plans to do so. So from that point of view our team working is not as extreme I suppose.

NEC HUMAN RESOURCE SYSTEMS

How would you describe the Human Resource structure at NEC?

It is a fairly traditional structure. There is myself heading up the department. We have an employee relations section, recruitment section, salary administration, occupational health, training - a mirror of other large organisations.

With what systems is Human Resource work organised? How sophisticated is the IT for example?

It is underdeveloped. Unfortunately we have been very dependent upon manual records for a long time, we are only just getting computerisation - probably in the last two to three years that has become an issue. We are quickly becoming much more sophisticated. The people in the department generally have had low level IT skills and have been very nervous about using them when they had the skills. The systems have not been in place anyhow. It has been difficult. It is now gradually changing to become comparable with other large companies.

Describe HR’s role in forming and structuring teams of operators?

If a new team, as in the new fabrication plant, where we had to bring in new labour then we would be heavily involved: in the original meetings deciding
on manpower, determining the breakdown of the manpower, and then planning the recruitment schedules for that manpower. We would do the bulk of the interviewing, passing through to second interview for the production guys to conclude on. So fairly heavily involved in constituting new teams.

Within the existing workforce, increasingly a view would be taken by us: what is the impact of doing this, can we do this, what are the consequences? In any change of substance these discussions would take place between production and ourselves.

**What extent of devolved power exists at team level?**

For example, task distribution within teams is very much a Supervisor’s decision. There may be some very limited flexibility as in shift swapping if someone has got a football match or something. But generally decisions are made by the Supervisor.

**At a personal level what do you think is NEC’s greatest achievement in training?**

The high profile fancy stuff is important, for example the Mechatronics courses; all that is good for the company and also good for our external image. But that was really started off by demands from the market place and we were part of that process.

I think probably bringing school kids and having them turn out as managers is our greatest achievement. There is one particular young kid - he is not a young kid any more - he is probably about 32, he would have come in here (and his wife) straight from school. You can see that both have grown and developed at NEC, and both are now running very substantial departments. You don’t see that too often nowadays, I think.

The sense that people are seen to have done that does create that sense of loyalty that possibly would not exist if all the senior appointments came from outside.

**NON-CUSTOMER KNOWLEDGE TRANSFERS**

**Can you give an example of how NEC has improved its capability by contact with non-customer, non-supplier organisations?**

I don’t know that we would say we have learned a lot from such bodies. NEC certainly make full use of such bodies which is somewhat different. So we tend to know and make a point of finding out what is available whether it be
through support or whatever. Developing things like working with the local College and so on........I think what we see is that such organisations generally want to be involved with big inward investment companies and therefore they have advantages by being involved with us, and we have advantages by being involved with them. I think it is kind of mutually beneficial. We certainly maximise our position in relation to these bodies - that is not just financial, but in every sense, whether it be through support or whatever. We use West Lothian College, but when we use West Lothian College, if we want things done in a particular way, we try to ensure this way is accommodated.

CUSTOMER KNOWLEDGE TRANSFER

By what routes can your customers influence your product?

I am not sure of the answer to this, but I think that the answer is that feedback from customers would generally go back to our sales division in Düsseldorf and be relayed to us via that channel. Our Sales Manager, David Johnston may tell you different. I don’t believe there is a lot of instant feedback, other than at a very senior level, where for example the Directors would meet with an entertain senior people from our customers.

However, if there was a problem with our product our customers would not be long in letting us know.

INTERNAL KNOWLEDGE SYSTEMS

Is this a ‘learning organisation’ - constantly generating, transferring-in, accumulating and socialising knowledge?

On the specifically technical side our knowledge is almost all transferred from Japan.

On the working methods (or process) side then very much we self-generate knowledge. We have been more successful than our American counterparts because we are good at generating knowledge. In California the NEC plant experiences none of the success we have experienced. This may generally be true of Japanese owned plants in the States and particular true of California - I guess there is an antagonism which does not exist here. Also in fairness that was not a greenfield site.

Is there any research, design or development done on this site?
Not to any degree, no.

**How much is the template that the mother company seeks to transfer implementable within this site, or does it have to be customised?**

It is interesting because we recently had a discussion about this very point. We were talking about how we operated the plant versus some of our Japanese counterparts. Basically what tends to happen is that there is a broad template (for want of a better phrase) about how things should be. But what tends to happen is that each site will may be go off at a tangent in a particular way. And what then happens is this information is fed back to the other sites so we hear of good things that are happening in Sagamihara, so we think may be that works there may be we should try that there. Likewise, they would hear of things hear and would try it there. We have a lot of physical exchange of people. Loads of our engineers and operators are often back and forth to Japan, so they can see lots of things that are going on there and think “Oh that looks like a good idea, may be we can try that.” Similarly they will think of things we are trying here.

Just a silly example not on the technical but on the personnel side: the new data system that we introduced this year. Our MD was over in one of the Indonesian plants and was talking about it. They were wildly enthused, got on the phone, and asked us to explain what we had done. So there is that kind of exchange, it is not all one way from Japan it goes both ways. Particularly with the semiconductor plants we do talk to them a huge amount, and they talk to us and we will be constantly exchanging ways of doing things, and machine modifications, process modifications.

**A learning organisation transfers knowledge in from outside. Can you give an example of Human Resources in NEC doing this?**

There is no formalised network between NEC semiconductor plants. This is something which has never been encouraged at all. However, literally in the last few months a new guy from Japan has come to work in my department and he is very anxious that we as a department in Scotland develop strong relationships with the human resource department in Tokyo. He feels that will benefit us as a site and I think our department specifically, because we are very much trying to build the department and build the credibility of the department within the organisation, that kind of linkup he is now trying to foster. So I will probably spend some time over there this year. We have already invited some of their people to come and spend some time with us. So that is starting to happen, but it is very much with the NEC head office, as opposed to the semiconductor factories.
A learning organisation accumulates knowledge. How do you ensure that lessons learned in Human Resources are not forgotten and become part of NEC's knowledge base?

I think on different levels this operates. On the absolutely practical level there is a meticulousness about documentation here the like of which I have never experienced in my life before. So processes, ways of doing things........the production guys will talk about ‘one point lessons.’ That's a good example, they have learned to do something, they find it works, so it becomes a ‘one point lesson’ they document that, and it is reality available in these ‘one point lesson’ manuals of how to do. So thing like that are fairly common place. So I think we have a very strong documentation base is important to cumulate learning.

In our own function, this has been avoided. But as we are getting bigger, we are finding that if we don't document procedures and regulations people don't know what to do and we get a real muddle developing. So we are becoming more concerned to document things in the human resource department. In the past this was resisted, and probably rightly so, but we are getting too big now to remain easy-ozie I think.

A learning organisation ‘socialises’ knowledge - ensure that those who need to know do know.

We don't use team briefings as in the Industrial Society model, we don't use that at all. But there are localised team briefings - they will vary enormously depending on the particular style of the manager; it is probably more prevalent in production and less so in engineering sections. But is very much left to each department to do things as they will. Some do nothing, others do a lot.

How important is the wider NEC as a stimulus to knowledge generation for here?

I think that is probably too enthusiastic a description. I think a lot of people who have never worked anywhere else probably don't see that. I think people who come in from outside who have worked in other places, see it much more. And that's why I think it is quite important to have that balance: people who have just known NEC believe that our way, is what happens everywhere. I think the balance of people improves that.

For example some people here think that all of the positive benefits at NEC are available everywhere - they don't know when they are well off. People complain about wearing the jackets, the shoes, not having coffee in the
offices: it is all about the cleanliness we need for the product, but some people see it as major infringements upon their personal lives. People get hooked up on unbelievable trivia, and see those as being real negatives. We have very fixed break times for everyone, the Director will be hurrying down the corridor along with the rest of us - this is to avoid bringing coffee into the workplace. People don't realise how lucky they are.

CONNECTIONS ALONG SUPPLY & VALUE CHAINS

Some people suggest that Japanese plants in Scotland, without local R&D facilities, and are therefore only a limited technology transfer. Do you agree?

We don't have a mother plant as such. There is a plant that does all of the research, design and development but they are not really a manufacturing plant, so we are no different from Huchu or Hiroshima semiconductor factories because they are themselves, as we are, manufacturing units. So there is, if you like, an R&D section out there, but if it was situated in this country as opposed to Kyushu it probably would not make any difference. The other plants are as dependent on the gain of technological developments from Sagamihara as we are.

Have you ever offered Human Resource assistance to local suppliers to NEC?

No. The only connection human resource here has with suppliers would be in the broader sense with the Central Scotland Human Resource Group where we may discuss relations with customers or suppliers, but generally not.

It is good to get information from this Group on conditions and benefits, it is a Group which tends to be open and honest. They have a good relationship with each other and it works very well, it is of value to us.

How important in the pecking order of internal politics is human resources?

A good question. I think, when I came here four years ago I was really disappointed to find where the department sat in relation to others. I was not used to things happening in factories where I worked without me knowing about it. I felt out of things a bit - uncomfortable. I have made a deliberate attempt to change that because I felt that it limited my contribution. I have worked really hard to turn that around, and I believe that now it is slowly starting to change. We now have much more credibility. Relationships now
are much better, we were too parochial and reactive, I think other managers would now accept that we play a more positive and useful role. As human resource staff changes I look for experience rather than new graduates - more credibility.

**What relationship do you have with vendors who come on the plant as contractors?**

None. If contractors get into bother the problem is one for their own employer not us. We did have a problem once of a contractor of a contractor who had not been paid, they picketed our plant. We went out and explained to them that we could not help - their problem was with the main contractor not us.

**LOCAL NETWORK**

Knowledge networks may stimulate innovation, improving competitiveness. Are you part of one?

I am involved in a small group in West Lothian, the LDC got it going. This is a lot more low key than the Central Scotland Group, a lot smaller group so you get to know them a lot better. So from the formal networking point of view I actually prefer that, it is much more relaxed. I have got to know people on a personal level and feel you can pick up the phone to exchange information and ask questions. In the main these are all big companies. The Central Scotland Group is only large companies - you have got to have a certain number of employees, and certain things in place to be allowed in.

I don't think NEC has a lot to learn from local smaller companies from an human resource point of view. I have worked in lots of different companies over the years and I think I won't learn very much from talking to small companies. If I want to make some change or know something I am more likely to talk to someone in Rover or Unilever - any benchmarking for us has to be against similar sized companies.

**Most of NEC's operators live in West Lothian, but NEC creates global products. Is there any way in which you see NEC as a West Lothian company?**

I think because NEC has been here fourteen years lots of people have come here, worked here, met their husbands and wives here........I think we are seen as being a fixture now, a permanent fixture: we are growing and growing here, people can see that. I think NEC is an integral part of the culture of West Lothian because but I am not part of it myself.
However, I find it surprising that people here really don't have a conception of NEC other than as NEC Livingston, and even within department (we were having a discussion last week, because there was something from Tokyo about environmental audits outlining what NEC was doing world-wide) and I thought this was fascinating. What became evident when we started to talk within the department was that what is happening in the US or Indonesia did not connect to our people. There is a very strong parochial view here. This is the least international, international company I have ever worked for if that makes sense. In other companies you are always very aware of the internationalism of the company, that was always a constant feature, here it feels like a Scottish-Japanese company. It does not feel like an international company.

People don't relate to the markets we operate in - the stuff is made and it goes. If you talked to our operators about where products go, even the fact that our product is always shipped out through Dussledorf and then on to the world, people don't know that.

For example, when we were building the new fabrication plant we sent a large number of operators to Japan for a month at a time. I remember when they were leaving, they gathered in reception; people were distraught because girlfriends or husbands had never been separated before.
NEC - PROCUREMENT

David Johnstone is Manager for Planning and Purchasing at NEC Semiconductors (UK) Ltd, Livingston, and was interviewed on 11 February, 1997.

NEC operates in 35 countries, the Livingston plant selling memory DRAM and ASICS (advanced applied specific integrated circuits) mainly to Europe, but also to Japan and the United States. Livingston has recently received a £530 million investment for semiconductor fabrication and assembly. NEC is the second largest semiconductor maker in the world gross sales being £5.6 billion - over 5% of this is produced in Livingston.2

NEC PROFILE ON PROCUREMENT

What is your annual turnover annual procurement budget?

Three and four million pounds a month. I report based on all orders placed in our systems. There may be certain commodities, for example power which does not go through the purchasing system so that would not be recorded. So this is Commodities or services that we place orders for. This includes consumables, direct materials, services and spare parts.

What is your annual value-added?

NEC does not compute value added since we work on transfer pricing.

On an average day what might be the value of WIP?

This is not a figure I would know, only production management could answer this question.

What is your procurement strategy for NEC?

Our purchasing policy is to buy at the best price from whatever source, and preferably local if we can, but we buy internationally from any source which meets the QCD criteria [Quality, Cost and Delivery - NEC's core business values] then we will purchase. By local we mean within the UK.

Can you describe the management structure for procurement?

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2 NEC Semiconductors (UK), company brochure.
I have a Japanese senior manager and I report directly to him. I am the Assistant Manager, below me there is a Purchasing Supervisor and four buyers, we have five in a clerical team. The buyers and myself are technically qualified.

**With what systems is work organised in procurement?**

Our IT systems are very limited at the moment, we are using a NEC system presently. I am working on a project at the moment to produce a new system.

**Could you categorise NEC’s procurement budget in percentages for:**

1. formal supply agreement  
2. informal supply agreement (no contract)  
3. spot purchases  
4. other

The majority are informal.

**Can you categorise NEC’s procurement budget by amounts from:**

1. single sourcing  
2. multi-sourcing  
3. competitive sourcing  
4. spot sourcing

We try and dual source for our major consumables and direct materials.

**Does this involve competitive vendor rating?**

We obviously look at the technical specification first. If we wanted to introduce a second source for a commodity, then we would look at indicative benefit in costs initially. If there was a benefit within that, then we would ask engineering to support us by evaluating the second source. Then we would follow through by detailed negotiation.

**Implicit in your answer is that you would take a closer look at sourcing a raw material input to the plant than a consumable?**

Because of the nature of the building and the manufacturing process, most of the materials that we use, including some consumables, directly affect quality. So we have our quality policy which defines the criteria that we must meet. We cannot change specifications on certain commodities or introduce new materials without them being evaluated.
Do you establish within this plant a list of approved vendors or is that done in conjunction with NEC corporately?

Yes to both. We have a list of approved vendors from NEC corporately, and we also have a list of approved vendors which have been vetted here locally. They are both to the same criteria.

Taking a very important input like silicon wafers, you could recommend an additional vendor?

We have guidelines from our corporate headquarters technical department. We are now autonomous in that we can source on our own decision so long as specifications are met, and evaluations made. If our technical people, seeking some process improvements, define a change in the commodity, then again we could seek a new vendor.

Do you find that in practice you end up using the same vendors as other NEC semiconductor plants?

Yes and no. We do use similar vendors and also subsidiary companies of those, we also buy from European suppliers who may not necessarily be suppliers to Japan.

Is there a cluster of suppliers in a geographic location to which you are drawn?

I have been with the organisation since day one, fourteen and a half years, and at the outset the infrastructure was very poor for the supply of materials and a lot of commodities were sourced via the headquarters in Japan. Now we source materials ourselves, and have done for about eight or nine years. By doing that it means that the infrastructure within Europe is much stronger, there is a large semiconductor environment within Europe and the infrastructure from the services and equipment manufactures for example are now located within Europe.

NON-CUSTOMER KNOWLEDGE TRANSFERS

Have you benefited in procurement from contacts with Scottish Enterprise, Locate in Scotland, or Lothian and Edinburgh Enterprise Ltd.

I think it is limited. There have been workshops set up by West Lothian Council - we attended one of them but we didn’t really get a lot of benefit out
of it because of the technical nature of our business. It did introduce us to some service companies.

Apart from that I know that Scottish Enterprise do have publications that we can get access to, there is also a help desk. We tend not to use them.

INTERNAL KNOWLEDGE SYSTEMS

What constraints do you feel in carrying out the procurement function given that the R&D product development is located away from this plant, and that therefore product in effect when it is transferred here has implicit within its design perhaps, already vendors in mind?

If research technology changes, especially in Japan, and that is transferred across here then there will obviously be a heavy technical input from the centre in Japan. We would take advice from that centre. Having said that, we are approached by many companies for business opportunities on this site. So they tend to come to us rather than us going our seeking them.

How far is your procurement IT led in the sense of data banks of potential vendors, or is it too specific for that approach?

We have a suppliers master file, but it is only used for company’s addresses it does not give details of commodities and capabilities; this is one the developments the new system aims to offer.

Have your suppliers stimulated innovation of product or process?

Mostly the technical companies, the companies that supply process materials and tools will give us some value-added engineering opportunities, where they will come up with new ideas - whether we take that on board or not will be a technical decision. It is one of the activities we encourage with suppliers, that we are constantly looking for cost-down, we are looking to them to work with us in getting cost-down. Part of that can be new processes or new materials: cost-down goes beyond merely price.

We expect prices to be competitive, and are constantly looking for improvements in unit cost. The type of business that we are in, the market trends are based on product technology, and as we introduce new product and phase out an old one, then prices will drop on the old material. So we have obviously got to try and maintain or improve our efficiency, so therefore we are looking to our suppliers because the nature of semiconductor business to do likewise, in that they look for process improvements and
improve their efficiency to introduce cheaper materials that will not be detrimental to the process here. So there is a lot of interaction between ourselves and our major suppliers.

PROCUREMENT POLICIES

Are you re-visiting some of your ‘make or buy-in’ decisions?

We tend not to make our own commodity inputs. We don’t have the technology to make these commodities. If you take the processes we have here, we started with testing, then we developed our fabrication one and fabrication two which is the step before setting tests. So we are basically buying all the raw materials in order to build the semiconductor product. It would be unlikely that we would go into the ‘make’ decision - we tend to buy all the commodities we use. I think the only development we would have is moving away from OEMs to distributors or indeed to alternative manufactures for parts and working all the OEMs at the moment looking at “Is your business supplying machinery or is it supplying parts?” If they are supplying machinery then we work with them to look at alternative sourcing of parts. We would never, I believe, look at taking a “make” decision because we don’t have the technology.

To what extent is a procurement plan stipulated from NEC’s mother plant when product is transferred to Livingston?

There are no constraints on us other than the technology requirements: the specification has to be standard world wide. So as long as we can purchase to that specification and have followed those requirements, there is no constraint on us.

What influence do EU directives on local sourcing have on your sourcing policies?

I am not really sure what these directives are.

Does NEC operate a policy of partnership sourcing? What does this mean in your case?

There has been a change over the last six to eight years in that we have a larger supply base within Europe. So there is more competition now whereas previously we were very tied in to buying from the same source. Now there is a wider range of suppliers available. Therefore the competition element is an important factor. Also it is not just the pricing, it is on availability of technical data or support they give us.
Do you expect suppliers to operate with NEC standards and protocols?

I think the business activity that we are in and the size of our own organisation means that we are part of a bigger corporation and it is important for suppliers who do business with us that they understand that we are part of a bigger group and within that larger group there are business opportunities, for example for European suppliers who need to develop their business relationships with NEC. And similarly for American or Japanese or far eastern suppliers then they are probably interfacing with the corporation.

Clearly delivery time is important to everyone, how sensitive is this NEC plant to delivery time compared with price or other criteria?

I think we are looking at everything, I don't think you can apportion the price as a primary consideration against delivery time, we are looking at the overall picture. Specification is number one, if it doesn't meet the specification then everything stops. Then we look at pricing and delivery aspects of it, then we negotiate on these criterion.

Do you have examples of direct JIT deliver to the line without buffer stocks?

No. Everything comes through our warehouse and we hold materials in stock. Certain suppliers have satellite stocking facilities off-site because we don't have the space to hold it. So what they do is hold a transit shipment for us and we call in on a JIT basis as required.

An example of this is our process suppliers of gases and chemicals have local storage points adjacent to the site and as part of our negotiation deal request that they have 24 hours, seven day access to those commodities to bring into the site. What we do is we basically call in and we hold a maximum of four days stock on site of these commodities and materials. This illustrates both cost-down, and shows we have a firm supply-chain, in that we can get materials when we need it so that they are holding a buffer stock off site under their ownership.

Do you have any parts of your supply chain where you do not hold buffer stock?

It is very rare. Our engineering departments hold supplies for commodities for machinery reasons which are critical. For major spend items they would probably insist that the suppliers would hold that for us, and call it in as we
need it. All our direct materials we hold stocks, and major consumables - we hold buffer stock and then there is the satellite depots off-site.

Which is the most critical part of your supply chain?

A major air strike for example, such as during the Gulf crisis, we have to put contingency plans in place for routing some commodities by sea. I think this is one of the major things that has ever happened to us. We do import a lot of materials from the far east, Japan and America. That we be disruptive to us.

Malaysia and Singapore are important supply bases for us.

Does NEC here use the 'ideal type' Japanese model of tiering the supply chain. Clearly you will figure in other companies tiering. From the point of view of your own supply chain is it tiered?

We don’t buy sub-assemblies, only raw materials and consumables so the tiering model does not apply to us.

LEARNING ORGANISATION AND PROCUREMENT

How much knowledge appropriate to the competencies of this plant comes in through the supply chain?

I would say there is an active transmission of knowledge. This is one of the discussion points we have with our vendors. We tend to find that most of our suppliers will bring ideas to us - it doesn’t happen all the time, but it is part of the agenda for our relationships with them.

A learning organisation transfers knowledge in from outside. Can you give an example of your supply chain doing this?

Even when suppliers are not sub-assemblers these ideas come forward, there are changes in the environment of raw material and consumable suppliers which can have a bearing on our business. If we talk of process materials, these come to us constantly looking for better more efficient ways of improving our materials. If that will give us a higher yield for these change (it is not just about base-line cost) if the commodity we get improves yield then that has a far greater impact on our efficiency than a cost reduction. We tend to find process material suppliers will come forward with ideas, and occasionally you get machine manufactures coming forward with new technology - this equipment can do this at a far greater rate, or with ‘x’ waste reduction.
Can you give an example of how NEC has learned from its suppliers?

The wafers are an important raw material. Beyond that we have a number of chemicals and gases as process materials, which are used in the process. So these companies in particular will look for new ways of developing their commodities to improve quality, reduce inefficiency.

**CONNECTIONS ALONG SUPPLY & VALUE CHAINS**

What is the scope of your supply chain in terms of geography by value from West Lothian, Scotland, EU, RoW?

This is difficult, we don’t have any day to day structure that can split things up in this way. It is very hard for us.

Would you say that your relations with suppliers are adversarial or co-operative. Are these relations bi-lateral or via a network of suppliers?

We enjoy both bilateral and network co-operative relations with suppliers. Historically we have probably got information from certain suppliers and that would then develop our enquiries to other vendors. Latterly we have become very pro-active in working suppliers on cost-reduction. Part of that is off-site stock holding, cost-downs, analysing the costs in detail, working with them to improve some of their indirect costs involved in these commodities. Looking at, for example when we change vendors, what are the risks associated with that, even though it may not have a bearing on price. We even look at competitiveness within the NEC group world-wide and compare our prices with our sister companies - all this helps us to move forward.

Over the last year or so we have developed quite a formal monitoring network with our sister companies. Information between us is now much stronger than it has ever been, as result of that we are now actively building up this network with the sister companies.

How do you respond as a procurement team to what might be quite a technical proposal from a supplier?

Nine times out of ten we are probably the first point of contact for a potential new source. What we would ask them to do is supply us with technical data to back up their claims. That technical data would be passed to our engineering departments and then we would get feedback from them. If
there is any technical interest we would set up a meeting and promote
dialogue between technical, commercial and the supplier. Based on the
results of that we may move forward looking at indicative pricing and detailed
knowledge of the vendor.

So it is quite a common occurrence for the production technical
people to be involved in dialogue with vendors?

Yes.

How far does NEC seek partnership agreements with suppliers?

We see vendors as partners. Obviously we are very strict with suppliers, in
that we have to maintain a very high level of quality and service, if they do
step out of line, then we are tough on them. But we tend to work very closely
on partnership agreements.

How extensively to NEC use vendor rating of suppliers? What
performance indicators does vendor rating include?

Vendor rating are used loosely by us......they are not as tight as they could
be. In the formal recorded mechanism it is basically non-conforming
material, we don’t measure at this moment in time delivery performance for
example. But there is a new system which will allow us to monitor variables
other than non-conformance of materials.

It is important to us that conformity is seen as an ‘order qualifier’ and not a
bonus; our job is ensure QCD. If there is quality problems them we have a
formal process, and if external corrective action is needed then our Quality
Engineering department will deal directly with the supplier. If there are
delivery issues then we would take that on, we don’t have it formalised at the
moment, but we tend to respond very quickly if it is a particular delivery issue.
We can’t jeopardise the site, so we are very tough in our dealings with
suppliers on that. Obviously pricing we negotiate with the suppliers and they
agree the price of their product, so pricing does not tend to be an on-going
issue.

Knitting production and procurement depends upon robust
production schedules, how reliable are these schedules in this
plant?

They are reasonably firm - it depends on the type of commodity we are
manufacturing. Our major business as you know is memory product so our
plans are six months to a year ahead and they tend not to fluctuate. The
difference being at the moment that we are ramping up our new fabrication
line, for example. We are not in a stable environment with that yet, so we are still on a major learning curve. So there are supply fluctuations. But our major commodities we plan, we usually give six months flow forecast, if during that six months anything changes we inform suppliers.

**How would you respond to a vendor that came offering cost-down but we are offering R&D partnering to your benefit?**

Vendors would not approach us in that way. I think they would come saying we have done this or this is on the cards and you will benefit. I don’t think they would ever come to us and say we intend or are planning to do this. I have no experience of a vendor trying to offset future commodity improvement against current price.

**Are many of your vendors are companies of similar size? Is the quality of the partnering relationship different with larger vendors as opposed to smaller ones?**

Yes and no. There are many small companies who work with us, but also a lot of multi-nationals.

The differences in relationships may be more apparent than real. Obviously the large multi-nationals may have dealings with other NEC sites, they operate world-wide so they tend to know the environment much better. Smaller companies have a large learning curve to go through in dealing with multi-nationals and dealing with the semiconductor technology. But having said that we do develop a number of smaller companies, we have a lot of local companies in Scotland that we do business with.

**How pro-actively does NEC feel it has a responsibility to put knowledge back down the supply chain?**

This is actively worked on. Our technical people have a lot of dialogue with our main suppliers or technically orientated suppliers. This dialogue is at all level of our business: process and maintenance. So these companies that are working to develop their business with us know where we want to go.

**Can you give an example of a process innovation which arose from a supplier stimulation?**

There is company based in Scotland who manufactures a process tool, and they suggested developing new types of materials, which has reduced cost and improved processing. This sort of thing has happened.
NEC's TRADING WITH LOCAL SMEs

Is it fair to say that NEC's decision to locate here was not based upon local supply chain connections?

I think the major policy decision was based on supplying commodities to our customers within Europe.

Of the suppliers you use who are located in West Lothian which would you are the most satisfactory and why?

We probably trade with 50 or 60 companies in West Lothian. A large proportion of these are service, and others which we would designate as service and design where we have specific tools to be manufactured and we will work in partnership with that supplier.

Also of course one of our major suppliers is based in Livingston. [Shin et Su]

Does proximity of suppliers breed a richer relationship: how for example do West Lothian suppliers compare with Asiatic suppliers?

One is not better than the other, though they can be different. It depends on the dealings which we have, the commodity or services which we buy.

Do you have any commodity suppliers within this locality which are indigenously owned?

Yes.

Service companies are on the same vendor approval lists as non-service companies?

Yes.

Can you give me an example of a West Lothian company which has actively sought out the needs of NEC and made efforts to meet those needs in order to obtain business from you?

The company I referred to earlier. We have design requirements. We ask them to build either tools or equipment not machining equipment but support and ancillary equipment. They have designed this for us based upon their technical competency.
Local companies sometimes complain that they can meet ‘Q’ and ‘D’ but not ‘C’ how do you respond to this?

We are not in the business of squeezing smaller supplier. But we have to work within a budget within the site, we work with suppliers to ensure that we get a fair price. We are tough negotiators but not heavy handed, at the end of the day we have to make sure that we can work with suppliers. I can probably count on one hand the number of suppliers we have taken off our list. We tend to deal with suppliers over lengthy periods of time, unless it is one-off projects.

One of the points that we do make clear is that the type of environment is cost-down. We are very high-tech, we are constantly bring in new generation products on line, so we will have phase-in/phase-outs. When we are in phase-out mode then we have to be competitive with our sister companies and with our competitors. This is central to being part of the semiconductor business. So we are constantly looking for best price.

Can you think of an example of a Scottish-based company that could have become a supplier to you but failed to do so because it was unprepared for the investment in equipment or time to come along side NEC?

I can't think of any example of this. I can't really quantify any such failures. It is not that we deal with everyone who approaches us - the end of the day we are looking for QCD. If they can't meet that then we move on, and I think they understand that, but we will give a fair crack at our business. I can't think of a company that could have done better, or could have done business with us.

LOCAL NETWORK

Knowledge networks may stimulate innovation, improving competitive-ness. Are you part of one?

We only network with our sister companies.

We don't network with our competitors for example. We are looking for a competitive edge, the nature of materials which we buy and they buy are technically the same, but the specifications may be different. Those specifications are designed by NEC in partnership with these suppliers in order to give us additional benefit over our competitors, so if you look at our major process material and direct materials it is unlikely we would go into any detail with our competitors. We did try with one of our competitors before, but it started to become a bit technical, and we backed away from that.
We never attempt to explore our competitors technical specifications with our vendors - they would not give it to us anyway. We would not expect our suppliers to disclose our specs to competitors.

You mentioned the specification of designs from Japan, do you often come up with ideas to improve upon their design?

I don't have enough knowledge of this, but I do know that our process engineering departments are very keen to work with our technical people in Japan at the semi-conductor R&D headquarters. We do a lot of information sharing, and ideas are exchanged both ways. But I could not really quantify this.

LOCAL KNOWLEDGE NETWORK

Does NEC have an aspiration to create a local knowledge network or suppliers?

I can't comment on this. It is something I have not thought of and I don't know that the company would be happy for me to comment on it.

I don't know how this could work, and how it would interface with our corporate procurement strategy.
Appendix One:
Interviews with Inward Investors

NEC - PRODUCTION

Jim Weir is General Manager of Production at NEC Semiconductors (UK) Ltd, Livingston and was interviewed on 11 February, 1997.

Livingston NEC produces large scale integrated circuit memory chips and ASIC microprocessors shipping 20,000 four inch wafers a month of product. Currently it is expanding its non-stop wafer capability up to 64 megabytes of DRAM in a £530 million investment. NEC at Livingston is widely recognised for its commitment to team working and has received a number of awards including the prestigious National Training Award and TPM Excellent Company Award. This is the most advanced microprocessor plant in Europe.

GENERAL COMPANY PROFILE

What is your annual turnover and expected gross margins?

Our turnover is in the region of £250 million a year. We talk in transfer prices rather than margins, you would have to talk to our accounts people to get these figures.

From an operation point of view we operate on transfer pricing for our product, and we have a budgeted figure which we work to, based on a six months plan. That transfer price is subject to fluctuations in the market. We are particularly going through a bad spell at this moment in time on transfer prices. Prices for memory product which we manufacture has tumbled from $9 to around $1.75. So we tend to bill against transfer prices. It is a simple arithmetic sum: the number of units against the transfer price, and that's our sales. Then we make up the normal profit and loss documentation after that. We don't talk about margins and such in the factory, but no doubt other people will talk about margins. Questions like "what is our value-added" are meaningless to us.

What the production strategy for NEC?

Our strategy is to formulate a six month business plan. And that business plan has to fit into the global business plan, in as much as the Managing Director will visit our head office and present our business plan, and that has to be agreed. That is agreed by the senior management group. From a strategic point of view, being a global organisation what this factory can make has got to fit with what other factories can make. So there is no waste and
duplication. Our business tends to be related to the capital equipment that we have; clearly different products require different production equipment. We are geared up and recognised as a memory production line making DRAM. Once the business plan is prepared and agreed by the Board, it is broken down into a monthly plan, broken down into daily plans.

**What are the main processes you use?**

We operate by family of product. We do our business in total numbers ('x' amount of million) that is then broken down into product by lot. It is a process broken down into lot by lot.

**How long are runs once lots are set up?**

How long is a piece of string? When we have set ourselves up to do 4 megabyte DRAM, we just keep producing the same product so long as the market is there. Four megabyte DRAM can have 300 process steps, to be followed in a pattern. It is not a question of predetermining an output number. We have been running this product for four years.

The memory business cycles. When I started in this company we were producing 16K, then it went up to 256k, and then it went up to one megabyte - so product is constantly improving. Our new fabrication plant is preparing for 16 megabyte, then on to 64 and then to 256 - until the design line is so fine, we can't do it any smaller.

**Do you use of target costing and value engineering (Kaizen costing targets)?**

Yes. It is universally recognised that the semiconductor business is very very competitive and you can never stand still. It is even more competitive now that the Koreans and Asian countries have started to take a substantial slice of the market. If you consider the semiconductor business in total, whether it is Samsung, or Motorola or any other semiconductor company we tend to use the same equipment. So competitive advantage doesn't come from the equipment where the fundamentals are the same, we have to be competitive from the point of view of up-time. So therefore we have to have excellence in operation. Yes the package comes with continuous improvement build in.

**What range of technology is employed?**

Most of technology is pretty hi-tech. If we look at two angles. From a science point of view it is hi-tech. The fabrication could not run without qualified honours degree engineers. So we have the science side where we are dealing with chemicals, gases, splitting gases into ions and electrons - that
type of technology is science based. No one person knows it all, because there are so many specialist fields.

Then we have the equipment side, again which is very technical, processor controlled, and in fact the operator cannot operate a piece of equipment other than through a computer bar-code. When you are manufacturing a wafer you cannot tell which process you are on because the layers have a natural thickness to them. So that is very hi-tech and technical.

Then when you come to the operator........the operator is given what we ask them to do - loading into or taking out of - in fact we prefer the operator not to touch the product at all because of the quality implications.

So there are three features: the basic feature where we have the operator loading and unloading, then we have our equipment guys who are going the mechanical things like pieces of equipment that have to go up and down, and the arms have got to move (just like in the auto industry). Then you have the equipment itself which is very hi-tech and then the science of producing an integrated circuit out of a piece of silicon. It is a three tiered range of technology.

You drew a parallel with the auto industry, how different are the production problems in this and the auto industry?

Not so different. We have equipment related problems that will affect the process; and that can be an arm doesn’t come up to the right height, or crashes into something. If you were working in the motor industry, working a lathe the same things could be said of a tool coming in at the wrong time. That side of it is not so different.

It was said to me as a young man when I was studying management that a good manager could go and work anywhere: as long as he has a fundamental understanding and experience. But he could apply management principles in any organisation.

What motivates your workforce?

Small team activity. Just yesterday I presented a paper at the SemiCon, the biggest event in the semiconductor calendar; they are held throughout Europe. This was the tenth meeting. I presented a paper on focus of teamwork. We have many small group activities in our plant. Our major ones being ZD (zero defects, other companies would know them as quality circles) and TPM (total productive maintenance). I have been primarily responsible for running these for nine years now (I joined the company ten years ago, as an experienced manager). What I came into was a relatively young,
inexperienced work-force who were in a ramp-up situation. We had many production and quality problems. The way we took to overcome that was really to get to basics and teach principles of quality control. I did that through ZD. I am often asked when visitors come in and often requested for visits to come and see what we have - "How do you manage to sustain it." Before I start any presentation, because we have got to be kind of modest, I normally say "What I am going to present to you today is what has worked for us. It has worked for us, I believe, because I have studied the environment and I created something that is compatible, that suits the environment. For it to be successful for any other person, I would suggest you have to look at your need. And create what is needed to suit your environment. ZD might not be what you need, you have to try and understand that. And TPM is similar." They normally go away gobsmacked.

The motivating factor, the catalyst is the team. But that has to be managed. I often hear people saying that ZD, production groups and quality circles are spontaneous: I don't subscribe to that. Tacitly, of course, you can encourage - that is not our approach.

To manage that I have a steering committee, which is an informal organisation, but formal in that people on it are identified, it is not a separate organisation; it is an organisation within an organisation. We meet with the leaders of the small groups on a weekly basis in a rota, but on a weekly basis. They present progress on their activities. We can encourage and direct them. Twice a year the best groups will present to the senior management group. That's really quite a big thing, they get a gold award, a silver award etc. That has been happening for nearly nine years. In fact our last convention was our sixth. We are recognised as exemplars in this field, now we can call our internal convention and international convention, because we have visitors from our sister companies in Singapore and Ireland and Roseville - we encourage this networking for exchange of ideas. I think it would be true to say that we have encouraged this English-speaking network around small group activity.

What is the relative weighting you attach to price, quality, time, compared to continuous improvement?

Continuous improvement is as important as the other three. I have a saying "Continuous improvement means sustaining change, but how to change is more important than what is changed." I continually preach how to do it. Continuous change and improvement is a feature of all fields of product management, it is not just about the operator. Too many companies focus on the operators, the operators are important, but it is the people as a whole, the total which delivers. We have got to encourage managers to ask themselves, how to deliver, how to change.
Management can’t announce a top-down change strategy, and not get their hands dirty in implementing it. My last company [Honeywell] were an excellent company. I am, mainly what I am because of my twenty years with Honeywell. But they had flaws. Like all good American companies they put a lot of money into training and I benefited from that as a younger person. But they had this trait of taking the flavour of the month. As an American company they were continually looking at Japan: how can Japan be so successful? Japan were famous for zero defects, and I can remember the boss taking all the senior managers, and we went to the Peppercorn in Eaglesham every Monday for about six weeks, and we were ‘brain-washed’ if you like. I can remember saying, “Zero defects, do you realise what you are asking?” At that time we were producing millions of components, “You are going to have zero defects, we were told.” I decided to shut up and toe the party line. So we had the videos and all the usual paraphernalia. We sent young leaders on a weekend course, but it failed within about six months. What really was wrong there - the boss did not understand what zero defects meant. He didn’t understand it from this point of view. Japan doesn’t say that it has zero defects, Japan says we are trying to achieve zero defects. So they start by achieving zero defects in small fields, then the field gets bigger and bigger. Often senior guys take something and have no idea of the essence, or the needs for their own company, as I mentioned earlier. Or will it suit their environment? But they throw it out, and they throw it out.............I make another analogy when I am teaching. OK, I’ve got to hold a party at my house, and I will provide the drink and food. It’s all on the house, would you like that? Yes! But I’m not going to tell you where I stay. Now, unless I tell you where I stay, you have very little chance of getting there. But if I give you directions, you may make one or two wrong turns, but because it is a good party you will make an effort, and you will get there. Business is the same: if we throw out the party invitation, without the direction (and that’s what a lot of particular UK managers do) then that’s when we get this flavour of the month scenario. There is no bigger turn-off for a lot of folks. I’ve seen it - just-in-time, ZD, quality circles, corrective action - all the books are there for us. Other companies send out the party invitation, without directions. I believe nothing turns off staff so much as this.

What strategic opportunities for innovation and technological change do you face?

We have no constraints, we are ever-upward, limited only by the rate of market expansion. We have a fairly open style of management; we have a hierarchy - I am the General Manager, we have senior managers and managers - but we have very few closed offices. My desk is in an open office. I have offices which I can use for private meetings, but we are very open. We believe through small group activity that everyone has the right to generate
improvement activities. But as I mentioned earlier, teaching is a natural day to day activity, not an add-on. Young people, new people come into the organisation - that's what they see.

I remember when I was in Japan the first time I visited, many years ago, after I joined NEC. I thought I was going to see all of these wonderful Japanese things when I came in here by the way. The Managing Director at the time was very profound, he said, we are too young, however Jim you can start it. Anyway, when I went to Japan I asked the question, "What percentage of your operators are involved in ZD." I never got a straight answer. I thought it was strange, may be I am being too direct. But I soon learned that the question was alien. There was no question, they just took it for granted. I would say here that everybody participates somewhere along the line, but at any one time.......I would say at the moment we have around 55 active ZD groups and 72 active TPM groups. There are about ten people in each group. It is a big proportion of the work-force.

What is it about NEC that has turned the sons and daughters of conflictual miners and BMC workers into committed participants in creating what you describe here?

I am asked that question often. Let me first of all answer in this way. We do not see ourselves as a Japanese company. We are a Scottish or a UK company with our head office in Japan. What's made it unique, and I hope I have played a prominent part in this........We have taken the essence of what I believe is good from the Japanese management and moulded than into what is good in UK management or our teaching of it. It is often said that there are cultural differences, and of course there are. But I don't see them as a barrier as such, what we look for is the common ground - there is a lot of common ground.

It is management's responsibility to take a talent, the talent here being our staff - which I am very proud of - and our staff is the UK staff, and nurture them, teach them the principles and practice of management. So to do that you have to be able to speak at different levels - like in a family, to talk at the level that each member of the family understands from the baby upwards, and as the child grows you alter your approach.

If I look back, when I joined NEC initially, there was somewhere in the region of 300 employees, we were at that time an assembly plant. The first wafer fab was just in the process of being opened. So there was a big migration of the current work-force in assembly technology into the new fabs, and there was a lot of new people came in. At that time the average age was round about nineteen. The Group Leaders and first line supervisors were more or less school-kids, they came in as operators - fairly intelligent - and we started to
turn them into managers. If you can just picture these nineteen year olds, twenty year olds as Group Leader (first line supervision), very immature in terms of management acumen. So we have grown that, we haven’t hired so many of our current managers from outside. The biggest proportion are home grown. Of course there have been times from a strategic point of view that I have gone outside and drawn some complimentary talent into the organisation, but it has grown. We have not by and large bought-in. May be I can make the parallel that some other semiconductor companies who are springing up, their kind of style was to hike up the rates, and poach. That is not NEC’s style - I speak often about these matters with Motorola’s management. In fact we have established the National Microelectronics Institute to try overcome these problems. These other companies tried to buy-in, but it is like a football team - you can spend many millions of pounds and still go down the drain. If you can grow and buy, then may be you have the best of all worlds.

LEARNING ORGANISATION FEATURES

Is this a ‘learning organisation’ - constantly generating, transferring-in, accumulating and socialising knowledge?

We are a hybrid of these, all are important to us.

We are not a screwdriver plant. That’s a misnomer. It is not unusual for us at the beginning for people to think we make videos, TVs or cars - we have even had this said to us by people at interviews. We are the opposite, we are not the Compaqs of this world - they are the screwdriver plants - setting up assembly lines.

Our process knowledge comes Japan, there is not question about that, initially. Much more so when you are in your infancy. For example, we are opening our new fab, so it will be new product, so the research and development is carried out in Japan, and the product is primarily produced in Japan, so all the pain (sometimes that is fortuitous for us) has already been experienced in Japan. Then we can take the product direct from Japan. Of course, that does not mean to say that we don’t have scope for improving the process, but the fundamentals are transferred to us. That’s really because we don’t have research and development; the product is qualified and tried before we get it. We have then to qualify our product from a customers point of view, so we have our testing and all the rest of it.

Is NEC a learning organisation? Can you give an example?
The learned skill base here was without shadow of a doubt the reason why this plant won the competition within NEC for the £530 million investment in the new fab plant. NEC like any other organisation is constantly comparing one part against another, so if I have the best plant for turnaround time, people are asked to visit here to learn our secrets.

I mentioned earlier that ten years ago, when we were in our infancy, we weren't recognised as such an excellent company, but it was always my objective and the company objective to lift that reputation and make us the best. As such we have an excellent reputation. We have had many prestigious awards (it's OK telling oneself about excellence, it is another things when you are recognised externally), we have been awarded the National Training Award three times, Investors in People, and we have had TPM Excellent Plant Award - the only UK company at that time. These are the results of a six year programme. So through this continuous commitment to improvement, we could then say to our parent company that the staff in this organisation had the potential, but also the desire, to be excellent. We have proved that we could handle situations, turn things around, better perhaps than some of our sister companies who were in the running for investment. I would like to think that the new fab plant is testament to what our local staff have achieved.

Do you regret the fact that you don't have R&D facilities within the plant?

It would be nice to have an R&D, but again R&D is such a costly item in the semiconductor business. I would like to think that somewhere in the future we could have some aspect of research and development, but at the moment we are quite happy that it is generated in Japan. The IC market is globalised, it would not be cost-effective to localise R&D, it might be the demise rather than success of this plant. Companies are beginning to realise that even the 'so-called' competition between the semiconductor companies involves a lot of waste and duplication in R&D. We could perhaps forge better partnerships.

A learning organisation transfers knowledge in from outside. Can you give an example of production in NEC doing this?

We work fairly closely with the University of Edinburgh, they are playing a much bigger part in the semiconductor business: more from a defect analysis point of view, of course, then you have to have the harmony with the equipment manufacturers, because they have got to appreciate our technologies and our processes when they supply us with equipment.
What knowledge is transferred into this plant from public agencies such as Scottish Enterprise and universities.

I would not say this is significant. I would say it is getting better. Scottish Enterprise's Scottish Electronics Forum is certainly come a long way. The SEF is split into sub-groups; some are looking at training, some the environment. It is a fairly complex set-up and I sometimes have difficult trying to rationalise it. But spinning out from that we now have the National Microelectronics Institute, of which I am the Board member representing NEC. The NMI is dedicated to semiconductor manufacturing companies, whereas Scottish Enterprise or the SEF is looking at the whole industrial, including screwdriver plants (if we call them that), to IC manufacturing plants. So they are getting better, and I believe that they can contribute a lot more. But again, for Universities to contribute they have to have a lot of funding. Edinburgh, for example, has a small clean room, it cost an awful lot of money but the longevity of the equipment is about four years.

In the initial stages of the National Microelectronics Institute we were talking about setting it up, having it as a clean-room, and all the rest of it. But really that didn't get off the ground. It is a virtual institute that we have, because the business is changing all the time anyway. To put bricks and mortar and create a clean-room and all the rest of it - really we thought at the end of the day would not be appropriate, because it would have deteriorated very quickly as the technology changes.

Does NEC here accept the title, "learning organisation?"

Yes. I would say, to use your terms that we are committed to knowledge transfer, its socialisation, accumulation and generation. There are no secrets in this organisation, the objective for any new product is to get the knowledge out to our local base as quickly and as efficiently as possible.

Can you indicate how the transfer of knowledge from Japan is non-linear?

I used to wonder why NEC would send me and other people over to Japan to learn - it costs a lot of money. It is quite simple to understand. You have to envisage the networking in Japan. We have our head office in Sagamihara, which is prefecture of Tokyo. That's is where the R&D is carried out. It is a massive plant of 6,000 people. Within a short distance there are other factories. The fact is they are run in a different fashion! Go down to Kyushu, the Kyushu islanders speak a dialect which makes it hard for the guy in Tokyo to understand what he is saying. People don't visualise this, they put Japan in a box and believe everything is the same. Don't believe this for a minute: there are different cultures, climates, histories. When I go out to
Japan I find that each plant is run differently. There was a common thread, because of the overall corporate strategy. But the ways of doing things, and the ways of management were different. It is back to the personalities. So when they are transferring a product over here, they expect us to customise how to do it, and bring the personality of the local environment into the product.

This is of course constrained by the parameters of the product. A four megabyte device made in the UK should be exactly the same as a four megabyte device made in Japan. The only different would be in the packaging - the circuitry should be identical. That's the beauty of this kind of transfer of technology, because design rules and customer application is world-wide, and he is not really interested whether it is made in the UK or in Japan: he just wants to make sure it is compatible the rest of his output. It is the ultimate global product.

How then can one NEC plant become more productive than another?

We must not oversimplify the nature of the production process. Process variation can offer the plant a lower yield, a gas leak on a line can alter the profits. The actual processing is very complex in its nature and the good factories are those that can have the perfect wafer. Let's assume that on a wafer the maximum you can get is 250 good circuits, you are lucky if you get a perfect wafer. But the good factory is the one that can get the biggest yield on a wafer. To do that there is a myriad of activities of improvement, monitoring, checking, in-process inspection etc. So if you have got an apathetic work-force or an engineering group that is not so diligent and energetic then you will go down. OK you are still manufacturing product, but your cost per chip is high. So to answer your question, there is a whole host of internal activities which differentiate plants.

The transferred production process comes with prescriptions on actual technology to be used. Some of the process engineers on the science side may have some frustration at this, but I don't feel it. Where we do get frustrations is when we can't get pieces of equipment to produce to the specifications that the manufacturer sold it to us. The equipment is down etc etc. Remember this equipment is international: Japanese and American. The kind of equipment we have here Hyundai will have, Motorola will have. May be one plant will go for an Hitachi implanter and another go for Enelwa, but supply and demand is also a consideration. Also, it is not always a good idea to have all your eggs in one basket and be tied into only one equipment supplier. There are some small UK suppliers, but very small.
How do you interface with your colleagues on the procurement side?

We have, at senior management level, we have a system were we approve as a group an investment, any investment over a certain amount. The engineers and the persons involved have to make a justification of return on investment. They have also got to make a comparison with a variety of vendors and they will score it against quality, reliability etc etc. So there is a value judgement there. The senior management group will see that value judgement, and may ask them to go back and re-look at it.

CONNECTIONS ALONG SUPPLY & VALUE CHAINS

Do you have any network involving local (West Lothian) companies?

We have encouraged companies who feel they have something of mutual interest then they come to visit us. We can easily and often do, make such arrangements.

Our collaboration is really with our vendors, we visit each other. You see them working all over the factory with a vendor's badge on. Our reputation point of view - we don't go and ask Motorola if we can visit them, but if there was anything of interest to us we would do so.

Is NEC in Livingston a lean production plant?

Yes. Lean production to me is a general term, people tend to think of a small head-count, but it is not. People talk about just-in-time, but it is not. Lean production is a total concept which really means minimising costs. The understanding of your need is what is important - if your have a quality problem, address that need, rather than operate on flavour of the month management. There are a lot of consultant books, and this disturbs me, particular in concepts like TPM companies pay a lot of good money and it fails - this is just counter-productive. And it can harm the reputation of perfectly good management techniques. It is often management looking for the easy option of bringing a consultant in to answer problems they should be answering.
Margaret Henaughan is HR Manager at Seagate Microelectronics Ltd., Livingston, this interview was conducted on Wednesday 30 April, 1997.

Seagate is located in modern premises in the prestigious Kirkton science park in Livingston. It is part of the massive vertically integrated Seagate corporation which produces disc drives. The Livingston plant is the only Seagate operation fabricating chips.

COMPANY HUMAN RESOURCE PROFILE

In your opinion why did Seagate locate this plant in West Lothian?

The company was started in 1984 by an American, it was British financed and it was British owned, it was a British company. Come the stock market crash of 1987 the British finance people pulled the money out of the company. At that time 75% of what we produced, we produced for Seagate. Seagate could not second source the parts, so they just decided to buy us out. So from the first of December 1987 we became Seagate Microelectronics. So that is why Seagate decided to come here.

Why did Integrated Power Semiconductors establish here? I would think because of the locality. Livingston is very well placed between Edinburgh and Glasgow. I think they had done their homework, there was a lot of unemployment at that time in this area - we are talking thirteen years ago. And, I think the grants were good as well. The Livingston Development Corporation and Scottish Enterprise (was it the SDA at the time?) played a part in that.

Does Seagate have a Human Resource strategy. If so what is it?

I am not quite sure. HR is Seagate plays quite a big part - they are listened to. I know that this is not the case in many companies. HR plays a big part here. The HR strategy is changing and it comes from the States. It is very much team and training focused. We have a new General Manager who is very much team focused. Even today we have people off site team training.

Do you use an internally labour market preferring to ‘grow your own’ rather than externally recruit key people?
We grow all of our Operators - we train them internally from butchers, bakers and candlestick makers and make them into Operators. As long as they have a good level of education - they have to have a minimum of maths, arithmetic and English O' level. We have taken quite a number of women returners. We find them very good and very stable, and they have a stabilising influence on younger people. We don't take sixteen year olds, because we work a shift system, and I personally feel it is too young for them to work shifts, and management here back me on that. So we don't tend to take them at sixteen.

Technicians we grow our own as well. We also do some recruitment of technicians and because we are smaller than the bigger companies we can't always grow our own, although we usually have about five or six coming through at one time - so we do grow some of our own technicians. Some of them, in turn, then become engineers.

We are taking on more graduates now than we have taken on before, we don't take a great number, but because we were smaller we took less in the past and are now training up more graduates than we did before.

**What staff on the plant do you have who are wholly dedicated to R&D?**

Yes. We have design and R&D here. The R&D group are about five, we tend to count design and R&D together making around twenty people - about 10% of the workforce. This group is growing. These are all graduates.

**How would you describe the management structure at Seagate?**

It is a very open structure. Seagate has what we call an 'open-door' policy. All employees are welcome to come in and talk to any manager, so long as the door is open, at any time.

The management structure is quite flat. We have a Managing Director, and then we have a top level of management. That includes HR, Technical, Quality, Facilities, Finance, Production, Training - eight altogether including the Managing Director. We have just taken on a buyer, most procurement was previously co-ordinated by the Facilities Manager. In fact the buyer only started a week past Monday.

**Is this a single status plant?**

Yes, very much so.

**Can you give examples of the importance of training to Seagate?**
Seagate's target is sixteen hours per employee. It does not always work that way, but, Seagate will pay for any training that any employee would like to do that is work related or that their manager identifies that they are requiring. So we actually pay out quite a lot of money in training - I can get you the figure.

**Since you invest in training it is important that you retain labour, how do you do this and where do you recruit from?**

Operators - we have a few from Fife, but that's because there was a wafer fab plant in Fife which closed down just as we were opening up, so some of the first Operators we had came from there, and they are still with us. Otherwise we tend to recruit very much local people. We go further afield for some people.

Turnover here is very low - half a percent. This is a good indicator of commitment. We have been looking at this closely because it is so low. It is very comforting. People keep asking us how we achieve this.

**What does team working mean here in Seagate?**

We have a new Managing Director, who only joined us last November - this is the way that he wants to go. The Training Manager is focusing upon team working at the moment. It is really important to us. We are hoping to expand shortly and the first thing we have done is get a Project Team together: we are working just now on training the Project Team. So that's is how important it is to us - this project is really big to us and that's the first thing that they are focusing on is training the team.

**At an Operator level what degree of autonomy is there in the team?**

No. We don't have self-managed teams.

**How would you label Seagate as an organisation?**

We take corporate ethics very seriously, and I would describe Seagate as a normative organisation. In this particular plant of Seagate we are very much commitment driven. We have to perform well to continue. When Seagate bought this plant over I am quite sure they did not have it in their mind that it would still be here at this moment in time. They bought us over because they needed us at that time. Five years later the Chief Executive Officer of the company came here for the first time, and he made the point that he had not been before because he didn't think we would still be here. We have to compete with all of the other chip suppliers to Seagate, and we have to
compete on quality and service. And we repeatedly come out at the top and that's why we are still here - because we are good at what we do.

What is it that makes the sons and daughters of conflictual examiners and BMC workers into committed employees of Seagate?

May be they have watched the closure of the pits, for example. May be they remember having to open up soup kitchens in Whitburn not all that long ago - while I was working here that happened. May be they remember the closure of the BMC, and I think they recognise that the electronics industry has a future.

NEC told me that a third of the people turning up for interview thought that NEC made cars. Do the young people here understand how technologically based a company Seagate is, and its role in global markets?

No they don't. People come here and think of Seagate making disc drives because that is what Seagate is famous for as the largest disc drive company in the world. Anybody that knows Seagate knows them as a disc drive manufacturer, certainly not as a semiconductor manufacturer. Some of them thing it is to do with boards, wiring boards and things like that. The people from outside, that have never been, that don't know much about electronics don't tend to know what we do.

How much of the knowledge that exists in your products has been created by people here, as opposed to being transferred in from outside?

It has all been created here. We were a British company to start with and there were five designers came over from the States at that time. Now we don't have any Americans here, apart from one who we have brought in - nothing at all to do with Seagate. All of our knowledge is created here.

How do you socialise knowledge on good practices around the plant?

The management team see that this happens. We make a big thing about things like that at team meetings. We also have a European newsletter (there are American ones as well) and we spread these things about. HR Europe are playing a big part in all of that. We actually communicate monthly, and if somebody has come up with a good idea we pass it on. I would say we are more an exporter of knowledge than an importer.

How do you relate to the rest of the Seagate Corporation?
Remember, we have a lot of autonomy here as a Seagate plant. I am responsible for the plant in Irvine who do distribution of disc drives, and is absolutely nothing at all with what we do here. We are the only part of Seagate manufacturing microprocessors. This company was set up as a separate company and they have allowed us to run that way. We have to adhere to a lot of Seagate policies, but none of them bad. We are quite autonomous.

**Does Seagate see itself as part of a cluster of Microelectronic companies in central Scotland Silicon Glen? If so how do you network with other companies?**

Yes we do. We attend the Scottish Microelectronics Forum. We are part of the HR network group. At the moment we! have three groups of people looking into the image of the semiconductor company. I am on the Image Committee, Brian, our Training Manager is on the sponsorship committee, and Adolf Belcker, who is our Technical Director chairs the Curriculum Committee. It was decided that it probably should be someone from one of the universities who did that, but then we were not sure that they would push it through, so Adolf was given the job.

**Is this network real and alive and of benefit to Seagate?**

Yes, most certainly. I often lift the phone and speak to people in other companies about personnel matters, and they do the same.

**Is your network primarily of other foreign owned or inward investing companies, or does it contain indigenous companies?**

I have never thought too much about this. If a locally owned company wanted to join they could do so. But I can’t think of any at the moment. Russell Athletic are part of it, but I think they are US owned.

**Do any of your local suppliers approach you for HR advice?**

Not with suppliers, our suppliers don’t tend to be based around us. But anybody would be welcome to ask us for advice. I found when I joined the local Personnel Group that most people respond to questions by offering their phone number. New members often ring me, we all try to help each other.

**Is Seagate a learning organisation, and what do you mean by the term?**
Yes, we are a learning organisation. There is always change at Seagate. We have had a change of Managing Director, which means you have to re-think all of your ideas - you have to re-learn. We are all being stimulated by this. You jog along a while, and someone new comes in at the top and they always have different ideas from their predecessor. I think we are all re-learning because the person at the top has different ideas. Everything can be improved upon.

How are you influenced by the rest of the Seagate Corporation?

My direct line management is to somebody else in Seagate, and I have a dotted line to the Managing Director here. In practice this is not really how it works. Seagate does not constantly interfere, they have left Scotland very much to get on with it. We have proved that we can run ourselves. Not just in HR but in other functions, they leave us very much to get on with it. This is abnormal within Seagate. Scotland is left alone because we are doing all right.

Why does HR count in this plant and may not in other companies?

Maybe because I am stubborn! I have always been in the management team, so we are always included, and we are always listened to. I think Seagate cares about people, and that means HR is central. Managers here are always concerned to look after our people. Our people are treated well.

Our terms and conditions compare well with other companies, we regard ourselves as above average for the local labour market. This is reflected in our turnover at only half a percent, and absenteeism at a low three and a half percent (compared with 5% as an acceptable level elsewhere). A few long-term sick people takes the average up.

Which public agencies have assisted Seagate, and how. Could the public infrastructure be improved?

I personally was sad to see the Livingston Corporation go because they were always helpful. I am sure the West Lothian Council will be helpful in future. I worked for ten years with the Corporation.

We put all of our Supervisors through NEBS courses at West Lothian College of Further Education. Some experiences have been poor. But our involvement in the Mechatronics course has been very positive.
Bill Sommerville is the Facilities and Purchasing Manager at Seagate Microelectronics Ltd., Livingston, this interview was on Wednesday 30 April, 1997.

Seagate is located in modern premises in the prestigious Kirkton science park in Livingston. It is part of the massive vertically integrated Seagate corporation which produces disc drives. The Livingston plant is the only Seagate operation fabricating chips.

What are you job title and functions within Seagate?

My job title is Facilities Manager and Purchasing Manager. Facilities Manager - looking after all the property and real estate maintenance. Just recently we have set up a our purchasing department. Before that each individual department head had been buying their own material. What we are trying to do is say, we are getting to a size now where we actually should have someone co-ordinating the effort, so that we are all using the most beneficial supplier in terms of quality, service and price; instead of half a dozen of us each buying individual pieces. This is quite embryonic, it has only been on the go for about a month.

What is your procurement budget?

Procurement budget is around $8 million per annum.

What is your value-added and WIP figure?

Value added to materials is a figure which the finance guys can give you; we start off with raw silicon and output the processor product. I don’t personally have this figure. For a WIP figure you should ask the production management.

Why have you only recently specialised the procurement function?

Although we now have a large turnover, we started off as a small company, like everybody else. It has grown and grown. We have a Facilities Manager, we have an Engineering Manager who looks after the equipment, and we have a Manufacturing Manager. Each were responsible for their own individual areas. In the early days it was a combination of technical expertise and background knowledge being tied into and using Purchasing. It was never thought - based on our overheads - that we would justify a specialist
purchasing person. With our current turnover, a good purchasing person will more than justify their own salary.

**With what systems is work organised in procurement?**

We use a Seagate standard or an industry standard purchasing system; it is called a Man-man system which is used as the basis for raising orders and running orders, we have a secondary system which we use for our stores and stock control. Again that is not a fully automated system.

We do not purchase on a corporate basis controlled by Seagate centrally. We source and buy all of our own materials.

**Could you categorise Seagate’s procurement budget in percentages for:**

1. formal supply agreement
2. informal supply agreement
3. spot purchases
4. other

My own department relates to about 30% of the spend in the company. I would say that formal agreements form a very small part, we have tended away in the past (on my side of things - facilities) from formalised agreements, excepting one or two very high usage items for example filtration for the ultra-pure water plant is on a contract basis, bulk gases are on a contract basis. The majority of the other stuff is basically trying one supplier off against another, the quality of one against the other. For instance in electrical goods, like cable, materials, lab equipment one supplier will be able to supply a certain amount of material at a better price than another supplier. These are areas in which a senior buyer works for us.

This system is a bit quaint, but it has worked well for us, and what we are trying to do is make it better. We have not wasted money. We have always been a company that has recognised cost savings and cost reductions. We are now extending this thrust into our procurement.

**To what extent does this company gain new knowledge to incorporate into its products from suppliers, customers or by internal generation?**

The majority of our knowledge into our products is internally generated.

**What new knowledge becomes incorporated into your products through your supply chain?**
We do get knowledge coming in from outside, but I'm not sure exactly what sort of level it is at. I am sure that we generate most knowledge for our products ourselves from our own technologies.

What knowledge comes in from customer feedback.

Again, the Production Management know more about this. They work on internal quality control and audit systems. We do get feedback from our customers in Seagate world-wide where we have had problems.

How does R&D and Procurement interface during the development of a new product?

Once a product has got to the stage where it is going to be a runner i.e. after R&D have established that the product is technically capable, and can be sold then during design for manufacture when specific orders are in place from customers, we will then be involved as scheduling from production requirements into procurement.

The nature of our product - in effect based upon a blank wafer which can be used for a number of products - but depending on the types of process used, then there are different materials which are used within that process, different steps, and different equipment.

The majority of the materials we use, from a manufacturing point of view are similar unless there is a major process change in future.

How much of a driver for Seagate's future is continuous product innovation?

This is a hard question, because there are some technologies in here which when I arrived two and a half years ago were said to be dying, but are still being produced as volume products. Tomorrow technology or the requirements of the Seagate corporation might change, and they might say there are none of our products required. We face the same technological uncertainty as the rest of the micro-electronics industry.

By what process do you take decisions on sourcing once a new product has been designed?

Take silicon for example. In general terms we have a number of silicon suppliers, probably one primary supplier with a number of secondary suppliers. Each of these have materials qualified for our usage. In the past what has happened, is we have gone out and looked at the individual
suppliers, the quality and volume of material they can produce, based on our schedules, and a deal has been done on that basis say for a twelve or eighteen month period. Within this overall agreement we would vary our particular requirements. This system may be modified as we review it just now. It is an area that has really been driven by Production Management.

How is your procurement budget dispersed geographically?

It could be 50:50 or 70:30 between Europe and the rest of the world. From the UK we source a lot of consumables and services. But this is difficult, even when we source raw materials from within the UK, they are often merely shippers from a plant in the US. Some of these figures are meaningless. Consumables are 20% of our procurement budget.

So the knowledge based, value-added materials you use are sourced from outwith Europe, and virtually all of your product is exported?

Yes. We supply into Seagate Corporation who use our product throughout the world. None of our sales go direct to Europe, we sell to Seagate in the US. Our product goes out to Singapore, China and Malaysia; at which point components are assembled and set into boards.

Value-added procurement such as bodies of the semi-conductor are sourced in the far east, there aren’t any UK suppliers. Singapore and Malaysia are our main sources of supply.

Partnership sourcing emphasises the transfer of knowledge from suppliers into products - continuous improvement and innovation - can you give examples of this from your own supply chain?

Most of our supply chain is raw materials rather than value-added components. We do get suggestions. For instance recently BOC came along with an idea to generate one of the gases instead of producing it in bulk, we have run with this and saved 60% of the cost. That was a 50:50 arrangement, we asked them to look at it and they came up with the suggested solution. Some of our other consumable suppliers are doing the same thing. We have had one or two approaches from suppliers to our Facilities who also sell to our Production; we believe we can combine this and get a contract offering better terms, better back-up etc. Electronics is a business where a lot of people are saying it’s not going to go out as wide as we once thought, let’s consolidate on the people we are currently supplying, and make sure we don’t lose their business.
Is Seagate part of a cluster of microelectronics companies in central Scotland?

Yes, I would say so. We are unique in the Seagate organisation we are their only semiconductor manufacturer, and we are based here. There are a group of us in central Scotland based around labour supply and the universities.

If we were to be working with anybody probably it would be Motorola, National Semiconductor, NEC - we are all really in the same sort of business. We don't do any joint R&D with these companies. We are not in the overall same product range, we manufacture a product specific to our semiconductors, whereas they manufacturer memory chips - a much broader range with a general market. We are reasonably unique.

What networking arrangements are you part of which have proven of value to Seagate?

We are working with the Scottish Microelectronics Forum at the moment. This is at a fairly early stage and is being handled through one of our other Directors. As far as my position is concerned this network is not of great use, it is more for technology development and development of manufacturing facilities rather than purchasing. The Scottish Microelectronics Forum is properly established and will expand its range of activities. It is not primarily for purchasing but it will get there eventually. There are load of other issues, in relation to the training of staff, the development of staff, the availability of the right calibre of personnel to keep the industry going, which are much more at the forefront than purchasing.

In the past, because there was a feeling that engineering was dying, there was too much of a push in the school system towards the arts. But engineering was not dying, it was taking a different track from the old heavy industry. Seagate are proud of interfacing various disciplines within the workplace. The title 'engineer' still conjures up working in overalls. We have extremely well-qualified and motivated staff engineers - whether they be design, electrical or mechanical engineers. They suffer the same low status, much of the education system still has an old-fashioned view of what engineering is.

We can never compete with Singapore on low wages, it has to be on the quality of our people - their ability to innovate.

Is Seagate a learning organisation?
We are a combination of both learning and teaching. We are constantly evaluating what our requirements are and where we need to go in the future. This has been demonstrated ably by our human resource and engineering and our training departments, and the recognition we have had over the past twelve months for example in the Mechatronics course - which was developed in conjunction with NEC, Motorola in this area. This is producing specific engineers for our industry.

You have a remarkably low labour turnover rate here of 0.5%, reflecting a high degree of commitment, how is this created?

There are two things. One is because we are a smaller company, smaller in comparison to National Semiconductor, Motorola and NEC, we have a broader range of responsibilities. We don't have guys that are driven by tunnel vision down a specific line - there is a lot of cross-functional discussion which helps improve the benefits to others. Engineers are talking to designers, who are talking to production personnel and getting feedback on the problem - there is a broad range that everybody is involved in, and we try not to slot people into their own little lines and say that's the future for you. Big companies tend to do this because they have so many people they can afford to button hold individuals and say "That's your job." I think that people think, if that's all there is to life, is it worth it? Whereas, in a smaller company like Seagate...........take for example my own position, how many Facilities Managers out there actually look after purchasing.

How are teams constituted and how do they work?

Team working is real at Seagate and involves out of work social activities as well as information transmission and ideas generation within the work. Cross-functional teams are in constant use to secure efficiencies and drive the company forward. We do not offer specific incentives to these teams. The danger is that one cost reduction at the front of the line results in higher costs at the end of the line. Teams here include MIS, Production, Testing, Technicians and Procurement - where we are looking at ways and means of saving money or improving efficiency. Production Operators may be working on the systems using finance, other teams may use quality or output as targets. All the time we look for cross-functionality, not button-holing people saying you are a Production person or a technical person. People get a buzz from working outside their own job, in a cross-functional team, working with management grades. Within the team nobody is special, status doesn't count - every can disagree with the others, everyone is involved towards the end product of expanding our capability and capacity.
Does Seagate trade with locally owned companies?

Remember these can be the local offices of companies situated elsewhere in the UK or the world. We buy bulk gases locally because a local supplier suits for flexibility of delivery.

We use C-Select (a major electrical contractor), Thermal Transfer (who have done a lot of work for us), and Deans Engineering. We use these local companies but not simply because they are local - they have to be able to provide the right quality, the right service and the right price. The quality of service and back-up is just as important to us as price.
SEAGATE MICROELECTRONICS LTD - PRODUCTION

Alan Spiers is Director of Manufacturing at Seagate Microelectronics Ltd., Livingston, this interview was conducted on Wednesday 30 April, 1997.

Seagate is located in modern premises in the prestigious Kirkton science park in Livingston. It is part of the massive vertically integrated Seagate corporation which produces disc drives. The Livingston plant is the only Seagate operation fabricating chips.

Can you describe the management structure in production at Seagate?

Basically we have myself as Director of Manufacturing and my group consists of four shift managers - one for each of the four shift which we operate seven days, twenty four hours, working a four on, four off pattern. Underneath the Shift Managers on shift is a Shift Supervisor looking after the wafer fab area and a lead Operator looking after the test area. Wafer fab have twenty five Operators in it, and the Test area has five (four Operators plus the lead Operator). The Shift Manager is also responsible on shift for the engineering community, which is process engineering, equipment engineering, test engineering and facilities. The Production structure is very shift focused, we don’t have a large group of day-shift people, they are all out on the shifts where the revenue comes from. We have taken as many layers as appropriate out of the day-shift management and transferred that resource out on to shifts. We are in the process of hiring a Test Manager to look after test as a whole - it has only just grown to a size to warrant this. That is really it.

Do you compute a value-added figure?

No. Our monitor of performance and value-added is in terms of recoveries: where we get a certain amount of money as it passes through particular stages in our manufacturing processes. For example, wafer fab is split into four blocks, each of the block points accrues us a certain amount of money - value is added on to the product at each stage. There is then a recovery from Test, from the probing of the wafers. We have these four arbitrary points, and there may be more work in one block than another, it is really just to split the value-add for the fab. We mix this system with activity based costing. We don’t as some companies do, do a cost recovery per move - that is very common in the industry to compute recovery. Our system is more value-added, but it is not based on recovery per move.
Are you a lean producer, and what do you understand by the term?

Lean production can mean working with fast cycle times - yes we do this. Also we are lean in producing to order rather than for stock. Lean, in terms of working with the actual minimum of people to perform the tasks, I would say we are not. We are not over-manned, but it is not one of our key measures in terms of head counts. In terms of inventory levels then yes we are a lean producer. But the term lean production has a hundred applications.

Do you have to run with more slack because you also perform the R&D function?

The R&D function being here drives your culture to be lean in terms of fast cycle times and low inventory items because that is exactly what the R&D group need. They design a chip, they don't want to wait on a fab cycle time of 2x, when if you change your culture around you could have it down at 1x. That's where a lot of focus has been on taking the inventory down and turning what you have a lot faster. Rather than say an older style, where you would have a large inventory but it would be moving one and a half times a day, we are trying to turn our inventory maybe two or three times a day - because that is really driven by lower risk of scrap, and because that is what the design group need; quick turnarounds on “does that thing work?” We have to run it through the fab very quickly for them so they get feedback on their design.

Does prototyping or interfacing with design interfere with optimum production outputs?

It does have an impact. We run production under normal production rules. What we have is a specification that says we will have up 15 non-product batches on a line of 50 which will be termed as workloads. They will receive non-standard process and will go first through everything. Machines will be held waiting on these batches arriving. That does interfere. How much it interferes? Well.......at the moment non-product is about eight or nine percent of my activity - not producing revenue. So for every ten operators down on the line one of them is doing nothing as far as making product that is going to put money back into this plant in the short-term. Say a figure of 10%, because we have a lot of products in design stage which are not therefore revenue products. This is a big impact from non-revenue generating activity.

Also the fact that you are dedicating processes, holding processes waiting for one of these fifteen batches coming through - this is the number we feel we can cope with without having a severe detrimental affect on the overall activity of the plant.
The fact that we have a design group here which do have requirements other than the standard processes does mean that they are constantly challenging us to update our processes to find ways of making a smaller transistor here or more accurate matching there. They are driving us to develop the processes we have, and that is an advantage - it can be a pain in the neck from a production point of view - but it is an advantage rather than a disadvantage overall, because they are constantly putting challenges to the manufacturing organisation mainly through the engineering organisation.

Where does the knowledge embedded in your product come from? How is it balanced between transfer from suppliers and customers and internal generation of knowledge?

We run two lines. We run a bi-polar technology - I would say that the majority of that knowledge was developed internally. The bi-seamless, the newer technology we have, was a technology partnership with another company - SGS-Thomson (a French-Italian company). Because of that I would say that the majority of knowledge in our process was brought in from SGS-Thomson. Since then a lot of development has occurred internally, but I would still say a lot of the knowledge came from there. Five years from now, you will probably find that so much of that process has been manipulated that it is now almost our own process. At this stage I would still say that the majority of our knowledge was brought in through that partnership. Because of the size we are, and because of the leverage we have by being part of Seagate Corporation, which buys hundreds of millions of dollars worth of chips from SGS-Thomson and National Semiconductors etc - that's the type of leverage we need. We are not big enough to develop everything ourselves. We need, by hook or by crook, to get those innovations in here, and using the name of Seagate (the ten billion pound corporation and the buying power they have) let's us import that knowledge which would be a big task for us to develop on our own bi-seamless technology, but now we have got one in - piggy-backed on their knowledge it is now here. So we are now making money from that technology which would have been difficult for us to do ourselves. We need to use any advantages we can, and the Seagate banner gives us some real advantages.

Have you had any knowledge transfer from your customer Seagate?

Seagate itself is not a chip company, we make chips, we are Seagate’s only chip company. Seagate Microelectronics in Livingston is Seagate Technology’s only chip company. Seagate’s core business is to make disc drives. Chips are part of the disc drives, it is not there core business. So we will not get transferred knowledge from Seagate. There is joint design
between our design group and Seagate's design group in California, that chip will then come in here. There is a chip on line just now in development stage which was not even designed here, it was designed in California - again it was a joint design between Seagate and actually SGS-Thomson. Seagate's co-operation was in designing the chip with very specific application needs. So we may get chips from them, we won't get process knowledge.

How networked are you with the other micro-electronic companies in central Scotland?

Quite well networked but most effectively through the backdoor rather than the front-door through other contacts often with companies I have worked for - and if you look around you will find many people with similar backgrounds. There is no official seminars on technology exchange and frankly in our lifetimes I don't think there will be. But there is a sharing of information: if a machine goes down at 3 o'clock in the morning, if you find that for some reason you don't have the spare part, then as often as not we can phone National who will put it in a taxi and it will come over here. We will do the same for them, and we will do the same for Digital. So a lot of that goes on. There is a lot of benefit from having the mass of industry here. That carries through to the suppliers, because they have all got bases in Scotland, they would not have them just for us. It is that infrastructure that the number of companies has created which benefits us all. In terms of technology exchange you are not going to get much of that. We each have proprietary processes. It is more on the equipment side of life that there is systematic networking and sharing resources.

We are part of the Scottish Microelectronics Forum. I attend the forum on behalf of Seagate. They are far from tokenism. There is no question of technology exchanges. What the Scottish Microelectronics Forum does is give the industry a large enough voice to make representations. One avenue is trained labour supply. There has been discussions with the universities to incorporate microelectronics into syllabuses - that is working well. There is a getting together for the Mechatronics course - that was not one company, but the strength of a few. Approaching our friends such as Scottish Power, to try and get a better service off them - one of us meeting is not as effective as a united voice. This is one of the problems we have - they tend to measure 'power-outs' in minutes, but ten micro seconds and we are down for hours. So it is the strength of representation to outside bodies with one voice rather than one company which may give different views.

These examples of networking are of external advocacy for the industry rather than information exchange within the industry, is that the aim of Scottish Microelectronics Forum?
These examples are all outside advocacy of the industry rather than internally exchanging technological information. You have to remember that a lot of the information we have is proprietary information - it is why you would buy from Seagate rather than buy from National. I don't think that this information is going to be exchanged.

**How much of this knowledge is procedural and how much is tacit knowledge?**

You speak of procedural knowledge. That is where you may have a chance of exchanging best practices. This is where companies can be open. We have been down to Digital and tracked a product through the line - no problem there. They have an advanced bar-coding system for failure analysis which we learned from. They are very happy that we share their knowledge on how to analyse failures. We have even used their equipment. They have pieces of kit there and they are happy to show us how to use it. That's fine, and on procedural things there are examples of information exchange. It is when you get into the technology itself, where the knowledge is transferable - there is no doubt about that - but people won't want to tell you about it. Because that is where it is very much the competitive advantage. The technology with which most of the companies over here are working with can be found in industry papers. But when you are at the leading edge people are very secretive. I think if you asked around you could find out what National's process is - it is something which could be worked out, but it is not openly talked about.

People in this industry would rather help you than not help you. There is a very human reason for this. It is amazing how many of us know one another: because we used to work together at National or Digital, and are now representing some other company. In this industry you do not make enemies lightly, that's why you would rather help somebody than not help - you never know when you may need help from them. That's how we tend to work. But there are certain things which are just out of bounds - process specific information. For instance, we were looking at buying a piece of equipment, and Motorola East Kilbride were quite happy that we went and looked at something similar they have to see how good it is, how bad it is. That is running there processes, but we would not talk about what we know is proprietary to them.

**What knowledge input is there into this plant from non-customer organisations?**

We have been involved in several different schemes. The universities provide two examples. One you know of the Scottish Microelectronics Forum
where the industry got together to influence the content of courses. In terms of new knowledge, the use of their research capability to do things which we cannot do, such as services using expensive equipment which we could not justify having. So having large education institutions on your doorstep is very helpful. We can send wafers along to Edinburgh or Herriot-Watt in some cases and ask them to analyse surfaces and they will tell you what contamination is on the surface. You get that analysis back the same day. That really is a good service (they of course charge). They have set up external companies to do this work. But it is worth it if you look at the multi-million pound price of the kit they use. They do that on a regular basis for us. There is one just opened up MYAK it is called, which is really trying to provide all of these services in one location - a centre for analytical work from universities into the microelectronics industry. This reflects the level of demand from the industry - they believe they can make a profit from buying in the equipment and charging for the services. This is all an important part of the infrastructure now available in Scotland.

Can you give an example of an indigenous company which Seagate has helped by passing knowledge to it?

No I can't really think of one. There are a number of indigenous companies which have sprung up to supply the industry, but they do tend to be distributors of products made elsewhere. I can't think of a manufacturing example. There are companies that spring up, for example MPS in Falkirk - they supply a lot of stuff such as lights, masks, all that type of stuff - but I can't say that we pass knowledge back to them. There business is to supply the likes of ourselves and that is really it.

We have had local companies in here making up benches. Light engineering work tends to go to local companies - that has worked really well for us.

We get these companies to provide us with a service. We are adding no value to them in terms of helping their procedures. There is perhaps just one example of us doing this, but I am not sure if it is an indigenous company, is SemiFal up in Glenrothes. They are in the same type of business as us, they will undoubtedly learn from the Motorolas and Seagates. They will learn from cross-fertilisation with bigger players in the industry. They do phone up and want to borrow something or ask about something.

Seagate itself is perhaps an example of this. We were a Scottish company and learned from inward investors, but were taken over by Seagate. We have now proven our success for Seagate Corporation as a wafer fab, and are delivering into their bottom line, they can see a strategic reason for us being here. It has to be said if it was just because we delivered some dollars
into Seagate, we might not be here. Seagate tends to vertically integrate where ever possible, and make every part of the product. They are very proud of having 108,000 employees world-wide. If all we did was to add some dollars into the bottom line, we might not be here. It is the fact that we can provide other value-adds such as quick turnaround and prototyping, early warning, our ability to come in a take over demand when there is a problem (say if a supplier is letting them down, and we have a similar capability). Let's put it this way, we have more motivation to see that Seagate does not run out of parts than DI or National, because we are captive. So it is that side which gives the additional value-add. We are a little bit more autonomous than most areas of Seagate, but Seagate get involved in so many parts of the manufacturing process, that it is probably as appropriate that we are part of Seagate as some of the other plants.

Seagate are even at the stage where they do the metal plating for the disc drives: they vertically integrate to control supply. Out-sourcing is a condemnation, it means that you think that someone can do it better than you can. Why should a supplier be able to increase capacity to supply Seagate and do it better than Seagate - that's the philosophy. They have to take a profit margin out of it. So if Seagate does it itself that profit remains in the drives. That's why Seagate can get a higher profit margin out of the drives, they don't give away each bit of margin to suppliers, and allows them to be more competitive in their pricing. That's why they have 108,000 people world-wide, compared to a number of their competitors who are lucky if they employ 8,000 because they get somebody else to make each component.
JABIL - HUMAN RESOURCES

Audrey McGuckin, Human Resource Consultant at Jabil Circuit Ltd, was interviewed at the Livingston plant on Wednesday 12 March, 1997.

COMPANY HUMAN RESOURCE PROFILE

In your opinion why did Jabil located this plant in West Lothian?

I was not involved at this time [1993]. I believe the key issues were the availability of our type of employee, the grants available and access to customers.

Does Jabil have a Human Resource strategy. If so what is it?

We have various policies which make up a strategy. We have looked at recruitment, compensation and benefits, and employee relations - how we see ourselves and how we want to behave and how we create employee satisfaction. Indeed, one of the key goals of this plant is employee satisfaction. So anything that we do is tied back into these policies and goals.

It is important to us that we respect every individual, it is important that we treat them with respect, and dignity. These are underlying values for Jabil: we try and treat everyone the same, and with respect.

Do you have a model new employee profile? If so what are the main characteristics?

The cultural outlook at Jabil is strong and there are certain attributes and certain types of individuals who fit in quicker than other to our culture. Somebody who is up-front and honest, non-political, straightforward if you like. We like people who want to work hard, aggressive, pro-active are good characteristics.

From an human resource point of view what we normally try to do is identify competencies. So if we were hiring a quality engineer then we would sit with the Quality Manager and say let's look at an existing successful Quality Engineer in your department - what personal attributes do they have which make them successful, and would you want to see this in someone coming in. Or do you want someone who will compliment the existing team. Then
we would build questions around these attributes so that we could try and identify a suitable candidate.

Our average age is very low, and the gender distribution 40:60 women to men.

**How many employees do you have: permanent and temporary?**

Jabil run with a 70% permanent workforce and 30% temporary. This can pose difficulties for human resource but we need to manage this process to accommodate production scheduling. We are up-front and honest with temporary staff when they come in, we tell them - everybody here on the manufacturing side comes in from temporary; we repeat this at interview and induction, outlining the needs of production scheduling. We point out these reasons, and indicate that after the three months we could have no need for temporary staff, and therefore the contracts could be finished. Alternatively, we could have lots of business and we could have vacancies in permanent staff. Jabil believe it is important to be up-front and honest, I always try to operate in this way.

**What are your levels of turnover and absenteeism?**

Running with 30% temporary staff can pose human resource problems. We treat everyone the same: everyone wears the same coats in production, and are integrated into the team. One distinctive problem amongst temporary staff is labour turnover. Because they are temporary, some get offers of permanent jobs, and understandably go to them.

Amongst permanent staff turnover is below two percent per month giving an annualised figure of about fifteen percent.

**Does Jabil recognise trade unions?**

No, but we are not anti-union. Individuals may be in a trade union if they please.

**Do you consciously use an internal labour market model i.e. low points of entry, high levels of training and internal promotions rather than external labour market recruitment?**

Yes, this is how we work.

**How does Jabil ‘eradicate fear’ to induce TQM commitment?**
It is important in day-to-day dealings with people that, for example, if a mistake is made we don't say "Who made that mistake," but "How can we fix it, how did the process allow that to happen." We like to learn from mistakes, and move on rather than attribute blame.

**What categories of employee do you have?**

We have manufacturing operators, administration people, professionals, and management. By professionals we mean engineers: quality engineers, technical engineers.

**Do you have specialist R&D employees?**

No. We have engineers who liaise with our customers, but the R&D work for Jabil is done in the US.

**What is the ratio of direct employees to indirect?**

Our total indirect labour on this site is 176, and total direct labour is 252.

**Do you employees feel a mutual obligation to you? Is Jabil paternalistic as an employer?**

Yes we bother about every individual employee, we feel that if we show an understanding of their problems, they will return that commitment to us.

**Do you have a 'rate for the job' payments system?**

All employees start on a base rate. After a few months that increases, after twelve months from joining us it becomes performance related - performance is the individual rather than the team; currently this is between zero and five percent.

**Do you operate a single-status plant? What does this mean for Jabil?**

We are completely single-status in every aspect of our operation - it is an essential ingredient of the Jabil philosophy that everybody counts for the same.

**Labour flexibility is important in mass production, how do you motivate flexibility?**

This is just part of the way we operate. When product demand changes we re-adjust where people work and they re-integrate into new teams. We have
a Trainer for each customer, so that trainer will identify people coming on to that customer's line ensuring that they have the skills.

**For what positions would you go to the external labour market rather than internal labour market?**

We have a firm policy of advertising all vacancies internally. We interview everybody who applies for a position. Our goal is to fill 50% of vacancies internally.

This is backed up with our further education policy: we pay for all further education (books, course fees, exams). Courses do not need to be work related, all we say is that it needs to be an identified institution providing the course, to a recognised qualification. About 40% of the workforce, at any one time, are participating in one course or another.

We are very proud of this high level of participation, particular amongst our operators. ONCs, NVQs and SCOTVEC modules are popular especially in electronics. Six are doing the HNC in Mechatronics.

**How geographically diverse is the external labour market Jabil operate in?**

About 30% of our employees stay in West Lothian. Quite a lot come from the Hamilton/Motherwell area. Remember we recruit from temporary staff into permanent staff, and one of the agencies we use is based in that area.

Our engineers and professional staff come from a wider catchment area: Edinburgh, Fife, East Kilbride and Dundee.

**How does Jabil make the sons and daughters of ‘conflictual’ miners and BMC workers into committed employees sharing the company’s goals?**

Peer pressure is important. We hired a number of people who have worked in conflictual environments - for example we have some people from Cummins in Shotts. These people have been very successful here. I think it is the way we do business in here. We also do a fairly extensive induction programme so people know how we work and what we expect before they start here. Peer relationships are important - everyone knows we are committed to continuous improvement to keep ourselves in work and profitable - our people share that commitment.
Do you think there has been a paradigm shift from an old Industrial Relations model to a new Human Resource model. If so is Jabil part of that shift?

There are some people who don’t like working in our sort of environment: you are not always told what to do, you are not always given a simple shopping list of tasks. People at Jabil are expected to be pro-active, we want people to extend themselves, use their minds constructively - we value that. So yes we have a new human resource model in here.

Empowerment is a big thing for us. But it is not going to be a big thing if people don’t respond to the opportunities. I would say that people who don’t want empowering either decide not to come here, or don’t last very long.

Which area will give Jabil the greatest additionality over the next years: investment in technology or investment in people?

Soft-systems are a much greater driver of change and improvement for us than harder technology.

**JABIL AS AN ORGANISATION**

What label would you give to the organisational form of Jabil here?

Different. Our organisation is based around each customer having a dedicated team doing their work, knowing their needs, being aware of sensitivities such as delivery times and quality. Each Team is an independent business unit totally dedicated to the needs of their customer.

Internally, would you say that Jabil exercises power by using coercion, remuneration or emphasis on symbols? Or something else?

We operate through empowerment. People here have real responsibilities and by and large respond to that challenge. We are not rule-driven, but an empowering organisation.

Does Jabil organise control of work using technical processes or attitudes of employees?

Our aim is to exceed customer’s expectations. Other turnkey microelectronics manufacturers have the same equipment and same statistical process control systems as us. Our difference is that our people
are organised in groups working for particular customers, and with an attitude favouring high quality and continuous improvement.

**Is Jabil simply controlling the behaviour patterns of its employees, or are you altering their attitudes?**

We have very few employee relations problems here. Attendance is perhaps the main one. Our absenteeism goal is 2%, and we measure this by line - this is rarely exceeded. Each line gets the figures through their Team Leader on a monthly basis. We try to look at the underlying issues when there is a problem rather than the symptoms.

**You perhaps know that the American Etzioni categories organisational forms as being coercive, utilitarian or normative. Can any of these labels apply to Jabil?**

We are a normative organisation. We want people to share our values rather than be told what to do all the time.

**How does Jabil measure commitment from its employees?**

This is obviously difficult to measure in numerical terms. We expect a lot from out operators and all categories of employee.

In our business you have to be customer driven. Often customers will change orders, so we might have to change shifts, we expect our people to understand this is what happens when you are customer-driven. We talk about this a lot at interviews and induction, giving people scenarios asking them, “How would you feel.” We try to make people consciously decide whether this is the type or organisation they want to work for. This is all part of being up-front with people. We look for new employees to select us, just as we select them.

When we are recruiting Team Leaders internally, we use the same scenario method: have you had to deal with this? How did you handle it? Was that the right way to handle it? What lessons did you learn? We often use ‘behavioural-event interviewing:’ from case studies asking how would you feel? Tell me your thoughts?

**JABIL HUMAN RESOURCE SYSTEMS**

How would you describe the Human Resource structure at Jabil?
We are a matrix organisation, so human resource fits in with engineering and production, we are not separated off somewhere. Every project team involves human resource, and every individual in the plant has access directly to us.

**Describe the teams or cellular manufacturing you use?**

Teams are crucial to the way Jabil works. Each team has a 40 minute meeting each week for team building. Our Production Management see this as very important. The members of the team see these meetings as important, allowing everyone to have their say.

**At a personal level what do you think is Jabil’s greatest achievement in training?**

I am probably not the best person to answer this question. We have many people who have come through the ranks here: starting as a temporary operator and now doing other jobs in the company. For example, one person is now human resource administration; she came in as an operator, moving to Line Leader and is now in human resource. That’s a good example of the development plan for individuals which Jabil favours. Another person came here as a temporary operator. We found he had an engineering degree and was between jobs. We promoted him to graduate engineer, and now is on our permanent engineering staff. We have lots of examples like this.

**How does Jabil ensure that training strategies are synchronised with the technological trajectory of the factory?**

Internally we provide on-line training: soldering, workmanship standards - all those elements. Our on-line training are related to the requirements of each customer. Each team knows they are working for a particular customer. The Line Leader would also manage job rotation to allow the flexibility he or she needs and promote job enrichment. The Line Leader would decide which people can be released, and call in Training to get specific training.

Most of our ‘soft-skills’ training is done externally. We have a Training Facilitator here, Amanda Herriot, and Amanda co-ordinates with all Colleges and Universities keeping up to date with related developments. Broadly speaking, I would say that ‘soft-skills’ are mostly done off-site.

Some people comment that single loop learning impacts upon the individual, but double loop learning occurs when the organisation is prepared to re-structure itself to implement new knowledge. Is Jabil prepared for double-loop learning? How fixed is the structure?
We alter our structure internally all the time. The Manufacturing Engineer at the work-cell meetings often indicate the need to change structures. We have to meet the needs of our customers, not internal preferences. We try to get people away from an attitude of "this is the way we have always done it."

Every Jabil employee went through the 'Investment in Excellence' programme. This was very much about the need for continuous change and improvement in a high growth company like Jabil.

Which aspect of your operation will most improve output: improving the technology or improving the people?

Most of our change and improvement is 'soft-systems' driven; after all, all of our competitors have got the same machinery as us. How we treat our people is what differentiates us - we don't just sing a good song, we actually do it!

NON-CUSTOMER KNOWLEDGE TRANSFERS

Can you give an example of how Jabil has improved its capability by contact with non-customer, non-supplier organisations?

This is difficult to answer in broad terms, we deal with these agencies when they can help. Also other sections of Jabil may have working relations which I am unaware of.

Have you benefited from contacts with SE, LEEL, LIS in after-care services?

For human resources I have phoned up LEEL in the past to find out about training schemes such as modern apprenticeships.

Do you belong to any trade association which provides you with human resource knowledge or information?

Companies in the same industry are often most used by us to find out what's happening and what opportunities exist. We are part of the West Lothian Personnel Association.

We phone other companies with questions about benefits and conditions, and they do the same with us. We do a lot of this with our competitors. There is no question of confidentiality - we share quite a lot of information.
Is knowledge and information appropriate to human resource transferred here from other Jabil plants?

There are some visits arranged between Jabil plants, but from what I understand we are ahead of many of the others. Anyway, each plant runs its own systems and does what is right in its local circumstances.

CUSTOMER KNOWLEDGE TRANSFER

How involved is human resource with your customers?

Human Resources here can get quite heavily involved with customers because we sell our people to our customers. They want to know who the team is on their product, what our training and development policies are, how we induct people, how we organise the lines. There is a lot of interchange with customers.

Sometimes we pick up things from other companies - we try to take the best practice from wherever we find it. I also identify good practices on the courses I attend and feed information and good ideas into Jabil. [Audrey is completing an Institute of Personnel and Development post-graduate professional qualification at Glasgow Caledonian University]. I get a lot of information from these and other courses, and the subjects we cover are both topical and relevant.

INTERNAL KNOWLEDGE SYSTEMS

Is this a ‘learning organisation’ - constantly generating, transferring-in, accumulating and socialising knowledge?

Very definitely yes. Within human resource one of our key task is to help create a learning environment; the management style is important - how people are treated. In a learning organisation, it is OK to make mistakes. It is OK to try things, it is OK to take risks, or come up with a wild idea. Learning is encouraged within Jabil.

Is Jabil a learning organisation? Can you give an example of what this means to you?

If we look at our further education policy. We measure ourselves in training hours, we guarantee that everyone get at least 40 hours training a year. If we look at all of the external development courses we put on for our Line Leaders - they have the biggest impact upon the majority of people. We are
 Appendix One:  
Interviews with Inward Investors

investing a lot of money in these people, to make sure that they are encouraging their people. I think the continuous development programmes are important in becoming a learning organisation.

A learning organisation accumulates knowledge. How do you ensure that lessons learned in Human Resources are not forgotten and become part of Jabil’s knowledge base?

We are not bureaucratic in here, so there are very few things written down at all. Custom and practice is important to us, and the open mindedness to promote change. People are always saying: look I’ve found this out, or let’s try this.

A learning organisation ‘socialises’ knowledge - ensure that those who need to know do know. How does this occur within the Human Resources at this plant?

Line leaders meetings and discussions are important for sharing best practice. An example would be the Stephen Coby stuff, the seven habits of technically minded people. One of our Team Leaders had got these tapes, and had enjoyed them and found some benefit. So she copied them to the other Team Leaders. It is quite normal in Jabil for people to share what they learn rather than keep it to themselves.

We encourage work-cells to learn from one another. We invite people to assess why one work-cell is performing well, what is it that they are doing? Can we emulate it? How can teams for other customers learn?

How effective are two-way communications within this company?

Our information systems are very open. Every month in Team briefs we try to give people an honest picture of where the business is. We also have a quarterly presentation to the whole plant covering future investment and product changes. We cover forecasts and actual out-turns.

Some information can’t be given because it could change. Or if a customer was about to dramatically reduce their order, we might be careful how we discussed this - we would not want to de-motivate, and we would always try to turn around situations such as this.

Do you use project teams to implement product and process innovation?
All projects here are matrix managed, in fact this whole plant is matrix managed - everyone is part of the matrix. So yes project teams are used all of the time - that's how we work - flexibly.

**Do you have a fear that process innovation will out-pace market growth or product innovation and result in jobless growth or job cuts?**

Jabil believes that it can improve productivity faster than the rate of market growth. We are always searching for new products and customer. As an human resource function, we are always scanning other companies and the literature to pick up new ideas suitable for us.

We like to find the best practice elsewhere, and consider what can be learned for use here. Our engineers also work like this. We have a dedicated engineer whose job is to identify practices elsewhere which we can introduce. We are continually looking to be the best, and to be taking best practice in human resource and processes for elsewhere.

**CONNECTIONS ALONG SUPPLY & VALUE CHAINS**

Have you ever offered Human Resource assistance to local suppliers to Jabil?

It depends upon the supplier. If it was a supplier of temporary workers then if they asked for advice on some of their internal issues then yes we would respond very openly and share information.

If a supplier of consumables or materials came and asked, we would help them also, but this is less likely.

**Do your human resource systems correspond most closely to those of your customers or your suppliers?**

This is difficult - we have both suppliers and customers who are both larger and smaller than ourselves, so it varies a lot.

The human resource functional manager at Jabil is on the same level as production, materials and quality functional managers. I would say our experience puts us on a par with these other functional areas.

In any major initiative at this plant human resource is centrally located at planning stages and consulted at every stage in all important projects. A good example of this is our move to the new site at Oakbank, which will allow
us to amalgamate this factory and the Bathgate one, and introduce new production lines. We in human resource are centrally involved in this major project team.

**TRADING WITH INDIGENOUS COMPANIES**

**What competition is Jabil in with other companies for labour?**

This is difficult for us. We only want people to stay with us who are contented here - otherwise we will not get the best from them. So if people choose to go to another organisation then that has to be up to them. We run exit interviews for anyone who leaves. But we believe we have most of the right policies in place.

In the past while we have lost a couple of people to Smart in East Kilbride, because it was easier for them to travel there. This is why the exit interviews are important - we don't worry about losses like this. We don't lose people to Mimtec, we don't lose anybody to Burr-Brown. There have been two people left us to go to NEC in the past 12 months.

**How competitive are your salary levels with these companies?**

We won't try and compete with Motorola and NEC - we cannot compete with original equipment manufacturers. But, we want to be in the upper quartile of similar organisations to ourselves. We salary survey our competitors every so often, to try and set a point. However, we are competitive on the other conditions we offer - that's what we sell.

**Is Jabil conscious that as world class local indigenous companies want to learn from your Human Resource systems?**

I'm not conscious of this, but we are always willing to help, especially if people were getting up to speed to become suppliers or do business with us.

**LOCAL NETWORK**

**Knowledge networks may stimulate innovation, improving competitiveness. Are you part of one?**

Yes, and we try to build up relations with local human resource people. I think it is important that we can call them, and they can call us. For example on salary levels for particular jobs, or conditions.
Mainly these connections are with other inward investors, but sometimes with local companies. In fact our network in these matters is mostly competitors: Selectron, Avex, SEI - we do tend to have good relationships with them. But we also work closely with Motorola and Digital in Ayr.

The West Lothian Personnel Association is something else we are active in. They often call or we call them about human resource matters. We are happy to exchange information with all of these companies. Sometime you get a lot from these meetings, other times very little - but being part of the network is important to us.

PUBLIC POLICY SUGGESTIONS

What could the local authority or the government do to improve the institutional framework facing West Lothian-owned manufacturers?

The links between business and schools needs improving. We don't get a lot of people phoning us, saying we have a good bunch of seventeen year olds who are not interested in further education, they want to be in the work environment, we don't want you to miss out on them. I think connections between schools and industry need to be closer, with teachers as well as students.

Jabil has sponsored a course in Castlemilk - we are happy to become involved, but few schools and communities approach us.

How adequate are West Lothian training providers for your purposes?

We have been very happy at the range and accessibility of training provision in West Lothian. Firms like ourselves need young people with the right attitudes, we can teach the skills, and I believe that these attitudes will come more from schools who understand the nature of our business.
JABIL - PRODUCTION AND PROCUREMENT

Ronnie Darroch, Manufacturing and Procurement Manager at Jabil Circuit Ltd., was interviewed at the Livingston plant on Wednesday 12 March, 1997.

GENERAL COMPANY PROFILE

What is your job at Jabil?

I am the Manufacturing Manager at Jabil. This means that I am responsible for all manufacturing activity at both the Livingston and Bathgate sites, looking after all the production direct and indirect staff. We have around 600 direct employees and around 20 indirect covering a three shift operation.

What is the product range you are responsible?

All products through printed circuit board assembly from start to finish, so from the raw materials to the line until the product is shipped. We probably ship 150,000 PCBs a month on predominantly surface mount technology: a mixture of assembly through hole, assembly through solder, various processes are involved (some single sided, some double sided) and various technologies - the predominant focus now being on network products (mother-boards and other small peripheral cards).

What is your annual turnover?

Our turnover was about $2.25 million a month when I started here two years ago, it is now about $20 million a month.

What WIP do you carry?

We operate on continuous flow manufacturing lines, our secondary facility - smaller facility - is to box them with space for two surface mounts. Generally we try to ensure that there is no more than four to eight hours WIP on the line. There will be exceptions to that, there will be conscious decisions: for example we may have a parts shortage, we may have capacity issues: so there will be times when we build more stock.

What percentage and amount of your turnover is value-added? What are your products and your output profile?
If you take off material content, which is 80% the value added is about 20%. We buy in materials and provide the service of assembly. We are both a manufacturing company and a service company. We aim to understand and exceed our customer’s expectations. As companies move and look at their ‘core competencies’ towards ‘virtual manufacturing’ partners, we see ourselves in that area of operation. There are no equipment manufacturers who specialise in what we do best. We try to lock ourselves in with customers, offering the design service. A customer can come and say I want a PC, I want a 200 megabyte functionality, at this cost and with these applications: Jabil in the US will design that product from the bottom up. This helps us to build a longer term relationship with customers, we don’t just provide a manufacturing service.

Can you describe the management structure in production at Jabil?

When I started I re-structured this. I looked at the growth in the number of line shifts that we were facing, with the management structure they had, I would have ended up with something like 23 Supervisors all working to me. This would not have been a good idea, so I have set each line up as a business. There is a Line Manager, the title we use is Team Leader, who is on day shift but is responsible for co-ordinating a 24 hour line shift activity. And there is a Line Leader on each of the line shift teams. One of the plants we are only currently only using a Team Leader in, and using self-directed work teams. So we tend to keep one indirect to 20 to 25 people - that’s the optimum figure.

What systems are used to organised work at Jabil?

A group is a collection of individuals. Jabil works around the Team culture. Each line has an individual profit and loss account for customers, these are rolled into the plant profit and loss account. Each support team works as part of a work cell, as part of that profit and loss account. The Programme Manager or Director for each customer has direct responsibility for that customer.

Each Team Leader has direct relationships with customers rather than being mediated through central management in the plant.

What are the main technological processes you use?

Our processes are product specific to the individual customer. These customers are producing a range of final products: automotive products, industrial, PCs, networking products, medical equipment and telecommunications products. Our processes stretch from one-off
prototyping to volume manufacture; from the most complex surface mount assemblies and system integration devices. Part of our competitive advantage is to lessen the learning curve during ramp up, so we purposely secure a high level of skills in our teams. Customers often join in specific training exercises for new products. The actually technology in here: automatic insertions, manual insertions, soldering and testing are no more sophisticated than our competitors have - our competitive advantage is in our people.

**Do you use of target costing and value engineering (kaizen costing targets)?**

Over the last year we have developed our manufacturing strategy. This started looking at our top level plant goals. To summarise them they are: customer satisfaction, profitability and employee satisfaction. I then looked at further defining that within my group, say in profitability, we are recognised for our consistent achievement of plant financial targets, customer satisfaction (we are dedicated to understanding and exceeding our customer's expectations). And for employee satisfaction we create an environment in which everyone feels valued, that they can contribute and make a difference. That's how we defined these plant level goals within manufacturing; then we have looked at what strategies do we use? How do we check that we are on or off track, and what measures do we use to check the effectiveness?

We also use general production measures. For example: production plan achievement, revenue performance on a monthly basis, first pass yield, efficiency, scrap, overtime, absence level - that type of general information. These are now collected from every line shift report - generally a weekly report by line. We then roll these up to do a monthly report, it is graphed and shared with the teams at their 40 minute weekly meetings.

**Which element would you say drives productivity improvement at Jabil, technological change or changing people processes?**

If you study the performance effectiveness within an individual, looking at some of the research that has been done in the US and here; if you take performance effectiveness at 100%, then generally 70% is based on 'soft-skills' and 30% on 'hard-skills.' So how to think is important? I have the bulk of this organisation working for me - probably two thirds of it - and my group has to focus on getting the best from individuals. Getting them to make a difference. We don't neglect 'hard-skills' training, and we look at seeking out best practice, but we don't neglect the 'soft-skills' - the mix is more towards the softer end.
What do you do that converts the school leaver into a committed Jabil employee?

The whole key to this is if people feel they make a difference in an environment, and you can create that environment, and your behaviour is consistent with what you need and you talk, then.........people are basically good - if my philosophy - their life experiences can sometimes colour their views and change their behaviour, for me it is up to us to say here is the environment, here is the part you can play, here is how open it is, and you do make a difference. And it is up to us to try and educate people through training and demonstrating by the way we work and interact within teams to get the best out of people. There is a golden rule which says treat other in the way you would like to be treated - that is the positive approach which we try to follow.

What motivates your workforce?

Our aim is to make Jabil a place where people can come and express themselves - release their potential. We find that our investment in training, and supporting the career development of individuals is paid back in commitment and motivation.

We constantly offer recognition to achievements, such as winning some the West Lothian Council ‘Employee of the Year’ awards. But also for ‘small wins’ within the workplace.

At a team level we encourage a lot of informal rewarding: pizza nights out, a buffet lunch, tee-shirts or mugs. These things may only cost $15 a quarter, but are more about recognition than their cost. We want people here to know they are valued, and that their effort and commitment is noticed and appreciated.

We run a credit based individual appraisal system. We find that 80% of our employees meet the requirements of the job, including continuous improvement, 10% exceed the requirements of their position, and 10% only partially meet the requirements of their position. All employees meeting or exceeding the requirements of their position receive an annual salary increase. Additionally we offer a monthly performance bonus, paid in cash, to sustain the momentum of continuous improvement.

What is the relative weighting you attach to price, quality, time, continuous improvement?

Equal weight to each of them. Our customers know that their Team is measured for ‘manufacturing metrics’ on quality, cost and delivery for
continuous improvement. The results are reviewed months in all Teams, and are shared with the customer.

KNOWLEDGE GENERATION WITHIN PRODUCTION AT JABIL

What staff, budgets and time do you allocate to product research, development, and product design?

Virtually no research and development at all at this point. What we tend to do, if we have got a design that is going on in the States is we will company engineer it, and we will do pre-production runs, prototype builds and quality engineering builds on this site and feed all this back into the design process, saying here is what we have found. It would be better if the layout was changed in this area, we have a Plant Technology Manager on site who has just recently started to work directly to the San Jose group in California, so we have that expertise on site. We have a CAD station on site that we can use, and we tend to get involved in feedback in the early stages of design both with products that we design or with products that our customer's design, and we feedback and get comment. The earlier that we are involved in the design then obviously the greater cost that we can save.

Do you anticipate that with the move to the new plant that there will be increased R&D functions carried out locally?

We have no plans at this stage to increase local R&D, but I see us moving towards offering value-added services like R&D. We currently do a fair amount with all of our customers. But, would we say at this stage some come to us and say, I want Jabil, Scotland to design the product............we would use the company expertise in the States, and let them carry the overhead for that. But we piggy-back on their expertise, and we would feedback on the systems we use globally. We can modem them changes very quickly. So we are very close to San Jose.

Can you give an example of how and why a process innovation has occurred?

We drive changes in both product and process. We look at best practices in processes, various technological developments and what is appropriate for our business. Each product in turn we look at how we can get involved early with the customer in that design phase, how can we get involved in testability, how can we get involved from a manufacturing point of view, how can we get involved from a materials point of view. We aim to become really locked-in with our customers at an early stage.
Appendix One:
Interviews with Inward Investors

Does process innovation arise from a planned and conscious strategy or respond to events and opportunities?

Our Teams and work-cells know that continuous improvement is part of the conscious manufacturing strategy of Jabil.

Does design-for-manufacture system in product innovation? How are you consulted at product design stage?

Of course, that is what we are best at. We liaise with our product development group in San Jose as they develop new products, and get along side new customers or new products as quickly as possible to design in manufacturing efficiency.

What drives process innovation at Jabil? What stimulus comes from customers and suppliers?

Very little come from suppliers. Predominantly between ourselves and our customers we will drive change and improvement, we will go to customers and say we feel (for example) in product A we have noticed that part B is single-sourced, we have noticed that it is coming out of Japan, we are concerned that there is a risk in that area, would you look at re-qualifying our vendor; here is a preferred vendor, here is a price - we will go back and make recommendations. Sometimes our customers will take that on board, sometimes they are dependent upon the design of the card and the costs involved and may not wish to take our recommendations. An example recently, after us pre-releasing and making recommendations on one or two parts, the customer who had initially chosen not to act on our recommendations, the part is now moving from a two week, to a four week, to a sixteen week lead-time; within the last few weeks the customer is now re-looking at our recommendations. We try and work closely with our customers.

NON-CUSTOMER KNOWLEDGE TRANSFERS

Has the Jabil plant actually gained knowledge support from any public agencies in Scotland for example universities, SE, LEEL, LIS?

From Universities - we have close links with Napier who we use to do some testing, we use to do some assessments. We have got them today starting a course on capability studies on some of the advanced manufacturing techniques, looking at DFM. Working with us they have designed a course that they will run in-house. So we tend to use links in that area.
From a materials point of view, we are currently looking at bringing the CBI in. We have been speaking to them for about six months, at what services they can offer, and is it cost-effective for us to look at the information they provide, to keep us in tune with the macro-economic situation. They have an experienced team who have been in the industry, who know the vendor base and they know the materials management business and the supply chain management. We are currently looking at how our supplies and materials match what our customers require - how do we get maximum flexibility with minimum exposure, or minimum liability.

CUSTOMER KNOWLEDGE TRANSFER

Can you give an example of customers making suggestions which have improved your products and/or your processes?

Our customers see us as the manufacturing expert, so they are looking for us to have the knowledge base, they design state-of-the-art and they expect us to be able to piggy-back that. Sometimes our customers will give us some initial thoughts and we will give them some initial recommendations - we have done this quite recently with a customer. It may be that the customer comes and its situated here for a couple of weeks, and sometimes helps with the training. So it is very much a partnership basis. At the other end of the spectrum, we have customers who see us as the manufacturer with the expertise and so they rely more on us.

Do you have customers who see you as a principal agent within a tiered supply chain to them as OEMs?

This is very much the kind of model that we follow. We don't see ourselves as just offering capacity to people that do their own internal manufacturing, that is not our preferred model. We don't see ourselves as looking at consigned business expect as a short-term basis for a product start-up or material testing. We are very much in knowledge partnerships with our customers.

Give me an ideal type customer relationship?

Take Jabil world-wide. You are probably talking about a billion dollar corporation in global manufacturing: Scotland, Malaysia, new plant in Mexico, plant in Michigan, design in San Jose and a plant in Florida.

We are looking to do business for the larger OEMs, and we are looking for people who don't in general have their own internal manufacturing. For us to
set up a business relationship and become involved, we are looking for a settled turnover that makes it mutually worthwhile.

**What is the competitive advantage for the Jabil plant in Scotland when the obvious cluster is Malaysia?**

What our industry is finding is that commodity products are very much under price pressure and are moving from the UK to the far east or other lower cost regions whether they be Mexico, China or Malaysia. My concern is that we may see more of that. We generally are able to offer the advantage in that product life cycles are shorter, the technology can be more complex, and that we are in the same time zone and have certain differentials on freight duty (but the abolition of EU external tariffs in the year 2,000 will be a major challenge for us). We have got to position ourselves to provide the additional value-added services to convince people to continue manufacturing in the UK. The other thing is a strategy that corporately we can look at is we manufacture where we choose to manufacturer, but customers receive a global price for the product. So Jabil can look at different ways of meeting these challenges.

**LEARNING ORGANISATION FEATURES**

*Is Jabil a learning organisation? Can you give an example?*

I would like to think we are a learning organisation, we have spent a considerable amount of time measuring this goal, spent on training and developing towards a learning organisation. In our organisation we look at a minimum of 40 hours per employee training each year. We also look at offering internally support for any employee wanting to do a further education course to improve themselves; it could be something directly relevant to the job, or Spanish, or Home Economics. Our philosophy is that if our people are learning, they are happier in their job, they are extending themselves, then their performance within the plant improves.

**A learning organisation transfers knowledge in from outside. Can you give an example of production in Jabil doing this?**

People have to look at the complexity of the cards we are building. This is not a screwdriver plant; we are placing UMPs, we are making 17,000 solder joints, and double sided cards.

**A learning organisation is generates its own knowledge - how does the production function contribute towards this end within this plant?**
Our liaison with San Jose and with major customers means we are generating knowledge about how to improve production processes all the time.

A learning organisation accumulates knowledge. How do you ensure that lessons learned in production are not forgotten and become part of Jabil’s knowledge base?

Generally through the continuity of the workforce that we have got here, we don’t have a lot of our indirects leaving. So we have a continuity of employment which helps us to learn. We are not a perfect organisation, everyone makes mistakes, but the key is we have the culture of, “Let’s fix the process, and not fix the blame.” Let’s look at why the processes has gone wrong. People don’t get out of bed and think: what can I screw up today - it is generally the process that needs sorting - there has been a loophole or whatever. It is up to us to try and create the systems that learn from mistakes, to make a difference the next time. And when it comes to new products to build in what we have learned to avoid repeating mistakes.

A learning organisation ‘socialises’ knowledge - ensure that those who need to know do know. How does this occur within the production function at this plant?

Team Leader meetings are a key forum for exchanging new ideas of how to do things better, or the benefits of a training course, or one design versus another. Our view is that too many companies pay attention to the golden egg that the goose has laid and forget to feed the goose - we don’t.

How do you conduct two-way communications within Production at Jabil?

We spend a lot of time on our communications processes. Every shift has a start-of-shift meeting for ten minutes which allows them to get the previous day’s performance figures, here is today’s target: generally ‘hard’ information - what your first-pass rate was, what your output was, what your efficiency was. Any issues that affected their production line on that day.

From communication comes co-operation. For example we have introduced banking of hours. We recognise that our business is unpredictable. The whole strategy which I have for manufacturing is based upon two premises: one is that the future of our business is unpredictable, secondly that people are the foundation for our success. That is the only two premises upon which everything is based. Recognising that we have to generate the systems that can support that and create the environment that encompasses that. One of
the areas we are looking at is how do we provide more job security in this
day and age, this is a basic survival need. We have had the situation in the
past where we have had to let employees go because of schedule cuts. How
do we balance that we our value-set, and how we want to treat people. The
way that I generally rationalise is the lesser of two evils, doing nothing puts
everybody's future at risk, so sometimes you have got to take some action to
protect the long-term. What I try to do is recognise the survival need of job
security, but recognising also that my business is unpredictable, to create a
system that would work. In busy period people work additional hours, and in
quiet periods people would work less hours. This flexibility and co-operation
allows us to give job security in return. It has to be a win-win situation.

How do you manage such a complex production process with
such a high proportion of temporary labour?

We generally operate with 70% permanent employees and 30% temporary.
Based on our last experience, when we had to let go some permanent
employees, we have now adopted a strategy of using a contract agency. The
key part for us is that we don't treat people any different. So everyone who
comes in here is part of the teams, but they don't have the same security as
permanent employees. We have recently let go a number of contract
employees; but we managed through working with the agency was to get
every single person that we let go an offer of employment elsewhere. We
spent a week doing that, we carried that cost for an additional week (we
should have let them go sooner), it cost us £80,000. We see that as a
responsible approach, trying to treat people with as much dignity as possible
- it is people's lives we are dealing with, every individual has their own hopes
and dreams. If you do that often enough, and are consistent in your
behaviour then it gets across to people that we do care.

Also from the contract pool we recruit many of our permanent employees.
Since this time last year we have recruited 50 permanent employees, and
generally they have come from the contract pool.

Do you use project teams to implement product and process
innovation?

Some people talk about matrixed management, we do it. Every project on
this site is matrixed managed, whether large scale or small scale, to make
sure that all the expertise we have is brought to bear on the project.

SUPPLY CHAIN CONNECTIONS ALONG SUPPLY & VALUE CHAINS
Within this Jabil company who takes ‘make or buy-in’ decisions?

We assemble on to boards or cards parts, including chips that others have manufactured. So we are not in the business of making the parts we are turnkey manufacturers of boards from parts others have constructed. In turn our boards are then used to manufacture products often then sold to the final consumer.

**JABIL’s TRADING WITH LOCAL SMEs**

Of the suppliers you use who are located in West Lothian which would you are the most satisfactory and why?

We have a number of local suppliers. We have recently set up a vendor for one of our customers in Shotts - the parts were previously being made down south. We found a vendor here, and qualified him as a second source. We look to try and do this. We have a number of suppliers in the central belt.

If one of our local suppliers would benefit from our technical advice then we would give it, and examine their processes. We have actually lent to suppliers and borrowed equipment from Motorola and even lent equipment to our competitors (for example ABEX). You might think this strange, but I would much rather that we all succeed, and that there is enough business to go around, and therefore Scotland succeeds.

How much of a constraint on this Jabil plant is the supply chain you use?

We use engineering support to qualify potential PCB suppliers which we buy locally. If possible then we will look locally. Clearly in the main our customers are highly specific in what parts they want us to use.

What proportion of this plant’s output is sold within the EU?

Most of our output is shipped out of the UK to within Europe, but many of our customers then ship on. Often product goes to distribution centres and can then go anywhere in the world.

Does Jabil actively set out to help Scottish SMEs who may in future become suppliers to you?

I am not sure, none jumps straight to my mind. But I am sure that we have helped many, for example the recent start-up in Shotts which I have mentioned. We helped them a lot lending equipment, going through the
schedules, outlining what Jabil would pay for up-front from a tooling point of view. I think we have helped this company get going by identifying to them our needs, and then helping them start up with tooling costs.

LOCAL NETWORK

Knowledge networks may stimulate innovation, improving competitive-ness. Are you part of one?

At this point we don't have a network of UK suppliers, but our Procurement team is actively pursuing this. We do vendor feedback on a much more detailed level than we have previously been doing. We give all our suppliers measures on their performance: here are our expectations, and here is how they match our customer's expectations, and try and get that on a more structured basis.

Other networks that we use, one of the internal courses that we ran called "Investment in Excellence," which is based on cognitive psychology - it has been run for 25 years - is American based. We ran this also for the Govan and Castlemilk Development Agencies. We are committed to helping try to re-generate parts of the economy. We ran this at a cost to Jabil and continue to be committed to running one course a quarter for them. We have also got Scottish Power involved in that network who are taking some of the people for work experience and giving some of them jobs. Part of our responsibility is to the community in which we operate. Some of our people, including myself even use holidays to get involved in some of these activities. We are hoping to set up a UK network of facilitators to become involved in running these courses; either for a community group or local schools and teachers.

Is a knowledge network amongst West Lothian-owned manufacturers an achievable goal?

Our human resource people are involved in the West Lothian Business Alliance, and other local networks.

Do you participate in other networks such as the Scottish Electronics Forum?

We are in the Scottish Electronics Forum, but I am not sure what our participation level is like. Off the top of my head I am more interested in the soft-skills and community based networks.

How do you see Jabil's place in the cluster of the semiconductor industry in Scotland?
The infrastructure for a semiconductor cluster is there in central Scotland: educational levels, availability of skills (although this is an area needing continual looking at to keep skills up to date). The supply network with contract manufacturing is well established, and if you want to be a global player then Selectron, ABEX are here, Jabil are here; that market is going to become two tier in that there will be five or six global players and then there will be a secondary tier. Then there will develop third tier suppliers. I would say from a knowledge base and a skills base, with the infrastructure, and management competencies we have the makings of a cluster.

**How important in Jabil’s decision to locate here, and to make a second round of investment, was the presence of the OEMs?**

I am sure the presence of Motorola and NEC was a factor in the initial decision to locate here - the predominant factor in the recent expansion has been the success of the Scottish plant, and the desire and need to expand our capability within Europe. If you take some of the opportunities that are coming our way, we have got to the stage where both Bathgate and here are almost full. When you are bringing customers round, they want to see room for their line. So we were potentially missing out on business opportunities if we didn’t make a decision to expand and consolidate on one site.

**Do the workforce here understand that they are part of a globally competitive business?**

To a degree the workforce understand our trading position is global, because we feed back quarterly our global trading performances comparing Livingston to the rest of the corporation, and trends in customer relations, and the changes all of this means for this site. They have got an awareness at this point in time, that they are in a competitive global market, but probably not at the level that we have discussed - we still need more education of our people.

**PUBLIC POLICY SUGGESTIONS**

**What could the local authority or the government do to improve the institutional framework facing West Lothian-owned manufacturers?**

For me the key part of this, having in a previous life formed a company, the need is for as much support and assistance from one body. When I personally went through that process, the Lanarkshire Development Corporation were fairly supportive and helpful with lawyers and business
plans, and that kind of stuff - there was a one stop shop between them and the other agencies. For me the key part is that we are continually investing in our skills and our education. We use the local college. But it is the soft skills that we have to focus on, the hard skills are the easier part. It is making sure that we get rid of the 'learned hopelessness' which can be present in some parts of Scotland. People need more self-esteem. For me this is a matter of doing more in the schools, starting at an earlier age to get across the message that every single person is unique, there will never be another one, so how can I maximise the potential of that individual - that's my educational philosophy, and I see it going right through from Primaries to Higher education. We would support more interface between education and ourselves.
Appendix Two

EMPIRICAL DATA FROM INDIGENOUS MANUFACTURING COMPANIES

Appendix Two begins by indicating the raw data of companies from which the indigenously owned and managed manufacturing companies were drawn. Details of the (largely quantitative) questionnaire are given, followed by a record of the 84 companies responding. The raw data from these responses is presented in a spreadsheet format. Extrapolated from this raw data are some key statistical conclusions from the survey which are recorded in some detail in chapter four of the main thesis. The second part of this appendix is a report on a qualitative survey of eleven indigenously owned manufacturing companies. Beginning with a report on how the eleven were selected from the 84 original survey respondents, and copy of associated correspondence, the appendix then presents the transcripts of eleven interviews which followed a familiarisation period.

<table>
<thead>
<tr>
<th>Page</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>133</td>
<td>Postal survey population selection</td>
</tr>
<tr>
<td>135</td>
<td>Introductory letter for questionnaire survey</td>
</tr>
<tr>
<td>136</td>
<td>Questionnaire and design details</td>
</tr>
<tr>
<td>141</td>
<td>List of 203 company survey population</td>
</tr>
<tr>
<td>143</td>
<td>List of 84 companies responding to survey</td>
</tr>
<tr>
<td>144</td>
<td>Tabulated responses from quantitative survey.</td>
</tr>
<tr>
<td>151</td>
<td>Selection criteria for qualitative survey</td>
</tr>
<tr>
<td>153</td>
<td>Semi-structured interview questionnaire</td>
</tr>
<tr>
<td>157</td>
<td>BCF Technology Ltd. - transcript</td>
</tr>
<tr>
<td>175</td>
<td>Computer Investments Ltd. - transcript</td>
</tr>
<tr>
<td>191</td>
<td>Dacoll Ltd. - transcript</td>
</tr>
<tr>
<td>208</td>
<td>Deans Engineering Ltd. - interview transcript</td>
</tr>
<tr>
<td>227</td>
<td>Diagnostic Instruments Ltd. - interview transcript</td>
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<tr>
<td>244</td>
<td>Glossbrook Engineering Ltd. - interview transcript</td>
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<td>259</td>
<td>Hunting Park Engineering Ltd. - interview transcript</td>
</tr>
<tr>
<td>278</td>
<td>MGK (Scotland) Ltd. - interview transcript</td>
</tr>
<tr>
<td>293</td>
<td>Scotforms Computer Stationery Ltd. - interview transcript</td>
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<tr>
<td>313</td>
<td>Trivet Sheet Metal Ltd. - interview transcript</td>
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<td>327</td>
<td>Wilson Byard plc - interview transcript</td>
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POSTAL SURVEY POPULATION SELECTION

Population selection was guided by the design of empirical research, which in turn arose from the research topic: the successful transfer and subsequent diffusion of lean production manufacturing techniques into West Lothian.

West Lothian is a local government administrative area containing 156,000 people, (2.9% of the Scottish population), in an area of 425 square kilometres. It’s largest town is the new town of Livingston with a population of 48,000. Stretching from Whitburn and Bathgate in the east to Broxburn and Linlithgow in the west, West Lothian contains 3,495 firms classified as Table 1 shows. This classification is used on the West Lothian Business Centre data base and is not the standard SIC classification. Scottish Enterprise and West Lothian Council support the Business Centre as a one-stop-shop access point for business information. Company data is collected by survey, from Jordan’s Index, new company registrations and industrial rating registrations. The data base is 90% accurate overall, and 95% accurate for manufacturing companies.

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<th>WL Companies by classification</th>
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Table 4.1 Source: WL Business Centre

Classification into the manufacturing category is on the basis of “manufacturing things.” This attempts to overcome the conventional difficulty of distinguishing service from manufacturing firms. Staff in the Business Centre believe their classification be more accurate than those contained in SIC criteria, because it is based upon frequent contact and knowledge of the companies, and the proportion of their work manufacturing rather than servicing. For example, in the Business Centre manufacturing classification there are 24 sub-categories, these provide a greater local suitability than the SIC codes many of which are inapplicable. The population for this survey is
taken from the above classification using the method outlined in table two. Foreign owned companies are taken out of the base population of manufacturing firms located in West Lothian because their production systems may arise from transfer rather than diffusion. Also many of these firms will feature in later aspects of the research. Sole traders have been excluded since they are of too small a size to use lean production techniques.

| Construction of quantitative survey population from manufacturing companies in West Lothian |
|---------------------------------------------------|---------------------------------|
| 332 Total manufacturing Companies in WL          |                                 |
| - 80 Minus foreign owned manufacturers            |                                 |
| (of varying size)                                 |                                 |
| 36 US                                            |                                 |
| 15 Japan                                         |                                 |
| 20 EU                                            |                                 |
| 9 RoW                                            |                                 |
| - 42 Sole traders                                |                                 |
| - 7 Not trading                                  |                                 |
| 203 Survey population                            |                                 |

Table 4.2, Survey population from WL manufacturing companies

Seven of the companies were found to have ceased trading. Two hundred and three companies were selected as initial survey population.
Introductory letter to 203 indigenous manufacturing companies situated in West Lothian:

Tony Kinder  
West Lothian Economy Research  
The Business Shop  
Waverley Industrial Estate  
BATHGATE EH48 4HY

10 August 1996

Dear

The attached questionnaire has a two-fold purpose. Firstly, I hope that the information gathered will help influence public policy - improving the trading environment for locally owned and managed companies in West Lothian. Secondly, it forms a part of my PhD research, under the direction of Professor Jamie Fleck of the University of Edinburgh Management School.

Please spend the five minutes necessary to complete and return the questionnaire. All returns will be considered with utmost confidentiality. A pre-paid return envelope is enclosed.

Should you wish to receive a copy of the preliminary survey results I will be happy to forward one to you - simply 'X' the box at the end of the questionnaire.

Your co-operation in this matter will be deeply appreciated.

Yours sincerely

TONY KINDER
QUESTIONNAIRE DESIGN AND POSTAL QUESTIONNAIRE

Five minutes was calculated as the time to complete the questionnaire which is in three sections.

- Section One covers a company profile: age, ownership, market, and products. Opportunity was given to add comment as well as mark ‘X’ boxes. TQM registration and its importance as an ‘order-qualifier’ was inserted to indicate the customer-focus of the company. There are limits to the profile information but these are deliberate - in qualitative study much more detail of strategy, structure, systems and technology will be elicited.

- The second section examines the trading relationships and knowledge sources of the company. A list of the 34 foreign owned West Lothian manufacturers is offered to identify trading links, and opportunity given to indicate the extent and quality of these links. Customer numbers and relationships are also explored.

- Section three explores the drivers within the companies business strategies. Price, quality, time and continuous improvement are scored and weighted from the customer perspective. Opportunity is given to indicate changes to production technology, systems, learning processes, and improvement implementation. Finally, an invitation was given to comment on the difficulties of doing business with inward investing manufacturers.

The questionnaire was piloted with three company managers; their helpful revisions were incorporated into the circulated format. With hindsight the content of the questionnaire could have been improved in two areas. Firstly, my pilot group had no difficulty with the wording of question 20 on types of supply agreements, unfortunately some respondents did have. Secondly, question 23 caused a few respondents difficulty, and perhaps should have been presented graphically rather than as a table. In the main, the respondents seemed to have no difficulty completing the questionnaire. Indeed, seven also wrote explanatory letters, and six made contact by telephone to discuss their company. Half of the respondents asked to receive a summary of the results, which I consider a fair degree of enthusiasm for the project. After two weeks a tele-canvassing exercise sought to elicit more responses, and where necessary a second copy of the questionnaire was sent out. The West Lothian Business Centre return

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1 Clearly a disadvantage of using such a list is to limit information regarding FDIs outside of West Lothian which indigenous companies may trade with, the questionnaire attempted to cover this point by leaving space for such firms to be added.

2 Summary results have been circulated to these companies.
address, added credibility to the exercise. A 42% return is a credible return from which to deduce significance.
Questionnaire to indigenous manufacturing companies in West Lothian (size has been 30% reduced):

COMPANY PROFILE

What are your products and your output profile?
Who are your customers? Describe a typical customer.
Who are your competition? How intense is competition?
What is your strategy for this business?
Can you describe the management structure?
With what systems is work organised?
What are the main processes you use?
What range of technology is employed?
How many permanent and casual employees do you have?
Do you operate a participative or top-down employer model?
How is employment structured?
Describe the teams or cellular manufacturing you use?
Do you employees feel a mutual obligation to you?
How do you recruit and improve 'quality' employees?
What motivates your workforce?
Price, Quality, Time, Kaizen scoring explanation from questionnaire.
Can you describe how the culture of your firm corresponds with the social culture in West Lothian?
What is your annual turnover, annual profit, and profit margin?
What strategic opportunities for innovation and technological change do you face?
What constraints do you face in taking advantage of these strategic opportunities?

INTERNAL KNOWLEDGE GENERATION

What staff, budgets and time do you allocate to product research, product development, product design?
Can you give an e.g. of how and why a process innovation has occurred?
Does process innovation arise from a planned and conscious strategy or respond to events and opportunities?
Has information technology stimulated process innovation?
Do you operate a 'design-for-manufacture' system in product innovation?
How influential is your marketing expertise in product innovation?
Have your suppliers stimulated innovation of product or process?
Have your customers stimulated innovation of product or process?
What motivates product and process innovation for this company?

NON-CUSTOMER KNOWLEDGE TRANSFERS

Can you give an example of how this company gets knowledge which may stimulate innovation from: big companies contacts higher education contacts SE, LIS, LEEL, The Business Shop, marketing agencies, financial bodies, trade associations, Competitors, scanning the environment of your business, other outside bodies.
Questionnaire to indigenous manufacturing companies in West Lothian (Ctd.):

CUSTOMER KNOWLEDGE TRANSFER

Can you give an example of customers making suggestions which have improved your products and/or your processes?
How often does this happen, and how welcome are such suggestions?
How have customers transferred their knowledge into your company: staff transfer, financial help, joint RD&D, equipment loan, worker-worker liaison, other ways?
Why have customers transferred their knowledge into your company: crisis in your relationship with the customer, arising from the type of relations with customer e.g. vendor rating, a continuous improvement relationship with a customer?

LEARNING ORGANISATION FEATURES

Is this a ‘learning organisation’ - constantly generating, accumulating and socialising knowledge?
A ‘learning organisation’ actively seeks out new knowledge and ways of doing things; can you give an example of this culture in your company?
It is suggested that a ‘learning organisation’ has leadership rather than management. Leadership constantly challenges the knowledge base of the organisation. Does this distinction make sense to you?
Can you give examples of how the following act as constraints on your company being a learning organisation: your financial structure or financial healthiness, the time-scales in which competition forces you to operate, the risks involved in continuous change and improvement, your business environment, the knowledge base of your employees, the skills and capabilities within your company?
How do you ‘scan’ for new knowledge of products and process innovation?
How do you ‘scan’ for new knowledge of marketing opportunities?
Who acts as a ‘gate keeper’ assessing how valid outside knowledge could be?
Who effectively takes the decision/risk on technology changes in this company? How are these decisions taken?
How effective are two-way communications within this company?
Do you use project teams to implement product and process innovation?
Does this company actively socialise knowledge? By what means?

SUPPLY CHAIN CONNECTIONS ALONG SUPPLY & VALUE CHAINS

What is the scope of your supply chain in terms of geography, technology and value of procurement budget?
What percentage and amount of your turnover is value-added?
Do you regard your suppliers as partners? Give an example.
Explain the type of trading relationships from your questionnaire answers.
Are these inter-organisational or inter-personal relationships?
Are you part of the tiering of a supply chain to an OEM?
Is your sourcing policy: single sourcing, multi-sourcing, competitive sourcing or spot sourcing?
Which is your preference?
What are the main differences between your supply chain, and those of your major customers?
Do you actively transfer knowledge backwards along your supply chain by transferring technical information to suppliers.
Questionnaire to indigenous manufacturing companies in West Lothian (Ctd.):

Do you actively transfer knowledge backwards along your supply chain by involvement in business strategy changes of your suppliers.
What routes do you use to transfer knowledge to you suppliers e.g. staff loan, joint development, equipment loan, financial support.
What is your aim in improving the knowledge base of your suppliers e.g. to improve price, delivery time, product quality.
Would you say that your suppliers have a similar commitment to continuous improvement as yourself, or not? Give examples.
Do you actively transfer knowledge forwards along your value chain by transferring technical information and suggestions to customers.
Do you actively transfer knowledge forwards along your value chain by any involvement in business strategy changes of your customers.
What routes do your customers use to transfer knowledge to you e.g. staff loan, joint development, equipment loan, financial support.
What are your customers aims in improving the knowledge base of your company e.g. to improve price, delivery time, product quality.
Would you say that your customers have a similar commitment to continuous improvement as yourself, or not? Give examples.

FOREIGN DIRECT INVESTOR TRADING

What allows you to successfully trade with major inward investors, or alternatively prevents you from doing so?
How do you weight the potential advantages and disadvantages of becoming a preferred supplier to an inward investing OEM?
How aware are you of FDI sourcing outwith West Lothian which you believe your company could successfully meet?
Is this company prepared to improve its capabilities to meet FDI supply chain requirements?
What would you be prepared to do?
Is trading with FDIs for some reason only a limited part of this company’s growth strategy? If so why? If not - how broad a location of FDIs do you consider your potential market?
Local FDIs are considered to be ‘world-class’ manufacturers, how important is it that this company learns from their best practice?
Working in supply-chain partnership may mean allowing an OEM to influence investment, product development and training strategies. How would this company balance this against organisational independence?
Developing a long-term supply chain partnership may involve investing a lot of personal time to build up trust. It this your experience? Would you be prepared for such an investment?
If developing a long-term supply relationship necessitated a large financial investment, would you be prepared to seek external funding to finance it?
If an OEM asked you to jointly develop a new product, the cost to you being significant, how would you respond?
Why can West Lothian owned manufacturers export so successfully, but trade so little with inward investors?
Questionnaire to indigenous manufacturing companies in West Lothian (Ctd.):

LOCAL NETWORK

Knowledge networks may stimulate innovation, improving competitiveness. Are you part of one? Is a knowledge network amongst West Lothian-owned manufacturers an achievable goal? Who would be the participants in a knowledge network of most use to your company? From a knowledge network what sort of knowledge would this company find most useful? Which organisation(s) should have the responsibility to further develop a West Lothian manufacturing knowledge network? What input from outside manufacturing companies in West Lothian would you like to see in a knowledge network? How do you balance being in competition with other West Lothian manufacturers, and the possibility of sharing knowledge with them?

PUBLIC POLICY SUGGESTIONS

What could the local authority or the government do to improve the institutional framework facing West Lothian-owned manufacturers? How adequate are West Lothian training providers for your purposes? Is the information you put into, and receive from the labour market in West Lothian satisfactory?
**LIST OF 203 WEST LOTHIAN INDIGENOUS MANUFACTURING COMPANIES FORMING QUANTITATIVE SURVEY POPULATION SHOWING THOSE 84 REPLYING AS EMBOLDENED.**

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<th>Capital HPLC Ltd</th>
<th>103 Fastek Electronics Ltd</th>
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<td>2</td>
<td>Chairman's (Scotland) Ltd</td>
<td>104 Flexco Packaging Ltd</td>
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<td>Colweld Fabrication</td>
<td>105 Forth Instrument Services</td>
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<td>Compack Ltd</td>
<td>106 Glenhaze Ltd</td>
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<td>Computer Investments Ltd</td>
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<td>Crawford Packaging Ltd</td>
<td>108 Glossbrook Engineering Ltd</td>
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<td>CTI Cryogenics</td>
<td>109 Almond Engineering Products Ltd</td>
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<td>Cuth Connections</td>
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<td>Adam Currie &amp; Sons Ltd</td>
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<td>Dacoll Ltd</td>
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<td>D&amp;B Mobile Welding &amp; Eng</td>
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<td>Deans Finishing Ltd</td>
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<td>VASPAC (Packaging) Ltd</td>
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<td>Wilson Byard PLC</td>
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<td>House of Skinner (UK) Ltd</td>
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<td>Lamb Signs &amp; Engraving Co</td>
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<td>The Lauder Merchant Co Ltd</td>
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<td>TLW &amp; M Allwright Ltd</td>
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<td>Lothian Optical</td>
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<td>JC Welding and Fabrication</td>
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<td>Lintech Services</td>
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<td>Helica Instruments Ltd</td>
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### Appendix Two:
Empirical Data From Indigenous Companies

#### THE 84 COMPANIES RESPONDING TO THE QUANTITATIVE POSTAL SURVEY

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## TABULATED RESPONSES AND SIGNIFICANCES FROM QUANTITATIVE SURVEY OF INDIGENOUS COMPANIES.

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**Key:**
- **Second product %** represents the proportion of employees in the second most important product or service.
- **Other products** include a variety of goods and services.
- **New prod < 2 yrs** denotes products or services introduced within the last two years.
## Appendix Two:
### Empirical Data From Indigenous Companies

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*Note: The data provided is a summary of empirical data collected from indigenous companies, indicating the percentage of customers by years trading and the assistance received from customers.*
## Appendix Two:
### Empirical Data From Indigenous Companies

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Appendix Two: Empirical Data From Indigenous Companies

## Difficulties in Trading with FDIs (Cont.)

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Appendix Two: Empirical Data From Indigenous Companies

SELECTION OF QUALITATIVE SAMPLE FROM POSTAL QUESTIONNAIRE

From the respondents to the survey the following companies have been selected for this qualitative further study. Initial selection was on the following basis:

1. Capability: each company below create products or are capable of creating products used by FDI in the microelectronics industry.

2. Competency: each company has a proven ability all (except one) has survived for over five years, is TQM focused, and exports.

3. Capacity: all have over 20 employees (except one), and turnover more than £1 million pa.

4. Continuous improvement: most have stated a propensity to improve both technology and systems.

5. Customers: supply agreements: all have 'special relationships' with customers, and many have experience of vendor rating or supply agreements.

Twenty one of the companies completing the survey met these criteria, from this group eleven were selected for further study and a qualitative survey.

From the 84 quantitative survey respondents, 21 appeared to meet the above mentioned criteria for qualitative study. Five percent of the original sample i.e. eleven companies. From the twenty one companies complying with the above criteria, six were selected who trade with FDIs and five who do not (but who appear to have the capability, competency and capacity to do so). Three of the 21 were reluctant to pursue further research, and two were busy (one with re-organisation, VASPAC Packaging Ltd, and one being taken over, EPS Moulders Ltd). Of the remaining sixteen, six who currently trade with FDIs were selected and agreed to participate in qualitative interviews:

1. BCF Technology Ltd., Livingston.
4. MGK (Scotland) Ltd., West Calder.
5. Sco forms Computer Stationery Ltd., Livingston.
6. Trivet Sheet Metal Ltd., Kirknewton.
Appendix Two: Empirical Data From Indigenous Companies

The five companies from the sixteen not currently trading with West Lothian microelectronics FDI, but capable of doing so, and agreeing to participate in further research were:

1. Diagnostic Instruments Ltd., Livingston.
2. Glossbrook Engineering Ltd., Blackridge.
3. Dacoll Ltd., Bathgate.

SEMI-STRUCTURED SURVEY MATERIALS FOR QUALITATIVE INTERVIEWS WITH INDIGENOUS COMPANIES

The structure given below of questions used in semi-structured interviews with indigenous companies was the starting point of these interviews. In most cases 'leads' were followed and explored, rather than a rigid pattern of questions adhered to. Each interview was taped and transcribed, and each interviewee offered the opportunity to amend the transcript and to verify its accuracy. The transcripts are given later in this appendix.

COMPANY PROFILE

What are your products and your output profile?
Who are your customers? Describe a typical customer.
Who are your competition? How intense is competition?
What is your strategy for this business?
Can you describe the management structure?
With what systems is work organised?
What are the main processes you use?
What range of technology is employed?
How many permanent and casual employees do you have?
Do you operate a participative or top-down employer model?
How is employment structured?
Describe the teams or cellular manufacturing you use?
Do you employees feel a mutual obligation to you?
How do you recruit and improve 'quality' employees?
What motivates your workforce?
Price, Quality, Time, Kaizen scoring explanation from questionnaire.
Can you describe how the culture of your firm corresponds with the social culture in West Lothian?
What is your annual turnover, annual profit, and profit margin?
What strategic opportunities for innovation and technological change do you face?
What constraints do you face in taking advantage of these strategic opportunities?

INTERNAL KNOWLEDGE GENERATION

What staff, budgets and time do you allocate to product research, product development, product design?
Can you give an example of how and why a process innovation has occurred?
Does process innovation arise from a planned and conscious strategy or respond to events and opportunities?
Has information technology stimulated process innovation?
Do you operate a 'design-for-manufacture' system in product innovation?
How influential is your marketing expertise in product innovation?
Have your suppliers stimulated innovation of product or process?
Have your customers stimulated innovation of product or process?
What motivates product and process innovation for this company?

NON-CUSTOMER KNOWLEDGE TRANSFERS

Can you give an example of how this company gets knowledge which may stimulate innovation from: big companies contacts higher education contacts SE, LIS, LEEL, The Business Shop, marketing agencies, financial bodies, trade associations, Competitors, scanning the environment of your business, other outside bodies.

CUSTOMER KNOWLEDGE TRANSFER

Can you give an example of customers making suggestions which have improved your products and/or your processes?
How often does this happen, and how welcome are such suggestions?
How have customers transferred their knowledge into your company: staff transfer, financial help, joint RD&D, equipment loan, worker-worker liaison, other ways?
Why have customers transferred their knowledge into your company: crisis in your relationship with the customer, arising
from the type of relations with customer e.g. vendor rating, a continuous improvement relationship with a customer?

**LEARNING ORGANISATION FEATURES**

Is this a 'learning organisation' - constantly generating, accumulating and socialising knowledge?
A 'learning organisation' actively seeks out new knowledge and ways of doing things; can you give an example of this culture in your company?
It is suggested that a 'learning organisation' has leadership rather than management. Leadership constantly challenges the knowledge base of the organisation. Does this distinction make sense to you?
Can you give examples of how the following act as constraints on your company being a learning organisation: your financial structure or financial healthiness, the time-scales in which competition forces you to operate, the risks involved in continuous change and improvement, your business environment, the knowledge base of your employees, the skills and capabilities within your company?
How do you 'scan' for new knowledge of products and process innovation?
How do you 'scan' for new knowledge of marketing opportunities?
Who acts as a 'gate keeper' assessing how valid outside knowledge could be?
Who effectively takes the decision/risk on technology changes in this company? How are these decisions taken?
How effective are two-way communications within this company?
Do you use project teams to implement product and process innovation?
Does this company actively socialise knowledge? By what means?
What do you understand by lean production?
Do you consciously use lean production techniques?
Have you learned these techniques from local FDIs?
Where else have you learned lean production from?

**SUPPLY CHAIN CONNECTIONS ALONG SUPPLY & VALUE CHAINS**

What is the scope of your supply chain in terms of geography, technology and value of procurement budget?
Appendix Two:
Empirical Data From Indigenous Companies

What percentage and amount of your turnover is value-added? Do you regard your suppliers as partners? Give an example. Explain the type of trading relationships from your questionnaire answers.

Are these inter-organisational or inter-personal relationships? Are you part of the tiering of a supply chain to an OEM? Is your sourcing policy: single sourcing, multi-sourcing, competitive sourcing or spot sourcing? Which is your preference?

What are the main differences between your supply chain, and those of your major customers?

Do you actively transfer knowledge backwards along your supply chain by transferring technical information to suppliers. Do you actively transfer knowledge backwards along your supply chain by involvement in business strategy changes of your suppliers.

What routes do you use to transfer knowledge to you suppliers e.g. staff loan, joint development, equipment loan, financial support.

What is your aim in improving the knowledge base of your suppliers e.g. to improve price, delivery time, product quality. Would you say that your suppliers have a similar commitment to continuous improvement as yourself, or not? Give examples.

Do you actively transfer knowledge forwards along your value chain by transferring technical information and suggestions to customers.

Do you actively transfer knowledge forwards along your value chain by any involvement in business strategy changes of your customers.

What routes do your customers use to transfer knowledge to you e.g. staff loan, joint development, equipment loan, financial support.

What are your customers aims in improving the knowledge base of your company e.g. to improve price, delivery time, product quality. Would you say that your customers have a similar commitment to continuous improvement as yourself, or not? Give examples.

FOREIGN DIRECT INVESTOR TRADING

What allows you to successfully trade with major inward investors, or alternatively prevents you from doing so?

How do you weight the potential advantages and disadvantages of becoming a preferred supplier to an inward investing OEM?
How aware are you of FDI sourcing outwith West Lothian which you believe your company could successfully meet? Is this company prepared to improve its capabilities to meet FDI supply chain requirements? What would you be prepared to do?

Local FDIs are considered to be ‘world-class’ manufacturers, how important is it that this company learns from their best practice?

Working in supply-chain partnership may mean allowing an OEM to influence investment, product development and training strategies. How would this company balance this against organisational independence?

Developing a long-term supply chain partnership may involve investing a lot of personal time to build up trust. Is this your experience? Would you be prepared for such an investment.

If developing a long-term supply relationship necessitated a large financial investment, would you be prepared to seek external funding to finance it?

If an OEM asked you to jointly develop a new product, the cost to you being significant, how would you respond?

Why can West Lothian owned manufacturers export so successfully, but trade so little with inward investors?

**LOCAL NETWORK**

Knowledge networks may stimulate innovation, improving competitive-ness. Are you part of one?

Is a knowledge network amongst West Lothian-owned manufacturers an achievable goal?

Who would be the participants in a knowledge network of most use to your company?

From a knowledge network what sort of knowledge would this company find most useful?

Which organisation(s) should have the responsibility to further develop a West Lothian manufacturing knowledge network?

What input from outside manufacturing companies in West Lothian would you like to see in a knowledge network?

**PUBLIC POLICY SUGGESTIONS**

What could the local authority or the government do to improve the institutional framework facing West Lothian-owned manufacturers?

How adequate are West Lothian training providers for your purposes?
Is the information you put into, and receive from the labour market in West Lothian satisfactory?
Brian Fraser is the founder and Chairman of BCF Technology Ltd., he was interviewed at the company premises in Brewster Square, Livingston, on Thursday 7 November, 1996.

BCF is located in the Brucefield Industrial Estate at Livingston. The is a smart, modern environment presenting a business-like image. At first the image inside the factory is of clutter - they appear short of space. Investigation shows that in part this arises from a deliberate decision to hold 'public' space for social interchange.

COMPANY PROFILE

What are your products and your output profile?

I'm interested that your research is about trading with inward investors. Now when you talk about trading with inward investors the question is just what does what mean. Part of our business is sub-contract for electronic assembly. In this company you can rule out our indigenous product in terms of sale to inward investors, for the simple reason that our inward investors are not veterinary surgeons or people concerned with animal produce. Our indigenous product is sonic diagnosis of animals. We are not going to sell our indigenous product line to inward investors. We are going to export it. Ultrasound scanners are 80% of our output, sub-contract assembly 15% and hearing and speech aids 5%.

This company may be able to broaden its own horizons to broaden its product range. Unfortunately this means building up our expertise. It is one of the failings of the money market not to recognise that development engineers are product oriented. They know the tricks of that product. They learn those tricks. If you take them and try to transfer them to some other product range, say for example you took our people (who have a lot of experience in signal processing and digital manipulation, and video presentation) and say try to transfer it to computers - it would be a naive product because they are not steeped in the tricks of making a product which the customer wants.

We would look very serious at any opportunity to develop products for the inward investors. Our difficulty is the capital availability during development stage. What we have built so far has been without involvement from financial institutions: we have built on our own resources. And that despite our expertise in ultra-sonics. Large volume business requires a large amount of capital. Most people only have capital in their house - I believe it is both
irresponsible and immoral to ask partners to take this risk - it also distorts business decision making.

Our PCB line was to some extent a logical extension of what we were doing with sonic products. Everything that we designed our used in the product was made elsewhere at the beginning. This proved unsatisfactory - the terms of the agreement were fine, but we ended up paying above market prices. We started to manufacture our product ourselves. We made considerably more money.

Who are your customers? Describe a typical customer.

We have about 1,000 customers. On the sonar side we sell to veterinary groups, and do specialist work for anyone who asks us. In PCB assembly we provide prototyping and small batch work mainly for small manufacturers.

Who are your competition? How intense is competition?

Competition is growing on both sides of our business. For PCBs big companies are now looking at batch sizes which they previously would have though too small. On the sonar instrumentation side and Australian company is trying to muscle in on our patch.

What is your strategy for this business?

At one point in time I thought the most growth potential lay not in the veterinary product, because it is aimed at a relatively small market. Massive expansion would come more from PCB sub-contracting. But this would mean major investment. We produce prototype and small batch PCBs. If you take our current investment (six machines each at £100,000; automatic insertion machines) - this only handles small volume business e.g. 4,500 components an hour not the 25,000 an hour NEC would use. So for PCBs we are in the low volume market. It may be that PCBs become our main business rather than sonic products. We started in PCBs to manufacture for ourselves, and took in work to use up spare capacity.

From the electronic point of view we made it ourselves. On the mechanical side one was not going to look at that, because this stuff (the mechanical bits) were all made on automatic machinery. To invest in that is to say we are going to trade in to a machine shop as well, that in any sensible terms of development at this point in time. There is not any sense to look at that kind of thing.

One difficulty we face, I face, is - I'm 76. My only son is a senior lecturer at Liverpool University and not interested in this business. Sooner or later BCF
minus 'B' will have to be addressed. George has too daughters. The accountant may have an interest in the business - but who knows.

Can you describe the management structure?

We have three working Directors and seven development engineers. All of us have a say in making decisions. But nobody is excluded. We employ 30 people and each one has their ideas treated with respect.

With what systems is work organised?

The advantage of a small company is flexibility. Not everyone can do everything. Our 'shopfloor' are divided between sonar and PCBs, but if we have a rush on we all pitch in.

What are the main processes you use?

We have two products: PCBs and sonic instrumentation. But two processes one for prototyping and one for production. In prototyping we work in ones and twos reporting to the development team. For production, which is small batch, we operate with maximum flexibility: within those doing production runs, and by moving people about when one side is slack or another very busy.

What range of technology is employed?

As you have seen we use CAD, automatic insertion and auto-checking on the PCB side. Again we use CAD on the instrumentation side with skilled assembly and testing tools and surface mounted technology.

How many permanent and casual employees do you have?

We employ 30, all permanent, all paid at about district average rates, everyone is local.

Do you operate a participative or top-down employer model?

This is a small company, everyone listens to and talks to everyone else.

How is employment structured?

We have three working Directors, seven engineers and 20 staff.

Describe the teams or cellular manufacturing you use?
For development we work in ones and two. In production we have about 8 people each on the instrumentation and PCB sides. But this changes with the flow of work.

**Do you employees feel a mutual obligation to you?**

I think so, most of our people have been with us a long time. Some since we started 25 years ago.

**How do you recruit and improve ‘quality’ employees?**

We recruit locally or by someone knowing someone. Everyone here is trained, and we send people on specific courses and to conferences.

**What motivates your workforce?**

Partly its money. But partly it’s operating in a small organisation which breaks down peoples ability to hide behind barriers.

**Price, Quality, Time, Kaizen scoring explanation from questionnaire.**

Quality is the key to our business - there are no second chances. Because we are a small batch producer we are not as price sensitive as the big boys.

**Can you describe how the culture of your firm corresponds with the social culture in West Lothian?**

We now have this liberal society but if you look at the consequences of that liberal society I would say that the consequences have been disastrous. It isn’t surprising to me that the youngsters behave the way they do I mean fundamentally I would say that the biggest failing we have in this country for the past 30 years now certainly the last 20 it probably started about 30 years ago is in fact with the teaching profession. To call themselves a profession I think to my mind is all their objectives and all their claims are all on paper and whilst it is atrocious to generalise about a body as large as the teaching profession the fundamental problem is that the largest proportion of the teaching profession are plumbers.

It’s not peculiar to West Lothian, it’s peculiar to the nation as a whole. It’s a whole social structure that we have built up and a whole way to behave. If you talk about schools, my wife was a teacher, it is one of the reasons e.g. I started this business. Nobody had to come in and tell us to make a living now I think I made a living because I didn’t take any money at all out of the
company in its early days how could I do that. I could do that because my wife could support me, she was an assistant head teacher.

Yes, I want to build things I don’t want to tear them down let’s put it that way. There is a strong feeling for social responsibility I mean I have got to do something I want to create jobs not destroy them that doesn’t mean the ludicrous and that is what upsets me. For example, these old styles union leaders who were praised and given awards I felt that they should have been shot because they defended yes because they didn’t recognise what was happening in the world and this idea that you protect your job by saying right I’ll specialise it as much as possible, I’ll split it into as many bits as possible so that if I have a man that wants to drill a hole in a ship’s bulkhead firstly I’ll have to get a marker out, then I’ve got to get a puncher and then I’ve got to get the man with the drill and all of them have to have a mate because they are all tradesmen and then the bloke drills the hole. All that is necessary is that one man goes along to drill the hole and he could do it in 10 minutes instead you have got a process that takes about 3 hours and involves half a dozen people. They have to get the ship’s manager’s approval before they do it.

What is your annual turnover, annual profit, and profit margin?

We turnover around £2 million a year. Profits are ploughed back in, but are around 7%.

What strategic opportunities for innovation and technological change do you face?

Our sonic instruments side could development into medical from veterinarian uses. One the PCB side I think we are about right. If we tried to go for mass production this would cripple us financially, and our prototyping record is a good one. We are development engineers not mass producers.

What constraints do you face in taking advantage of these strategic opportunities?

Financial - we have to make our own capital for development work.

INTERNAL KNOWLEDGE GENERATION

What staff, budgets and time do you allocate to product research, product development, product design?
Well at the core of any Company with indigenous products has got to be research and developed. To my mind seems to be a fundamental statement. Now it does not necessarily matter in some respects whether that research and development is indigenous or whether it is part of the Company, or whether in fact it may be sub-contracted. The fundamental issue is that a significant part of the Company’s resources income is placed into research and development. Research - well I would put a query on that one, because the two terms are thoroughly confused. There are a large number of Company that claim they have Research and Development Departments, when in fact all that they have got is Development Departments. They are not researching anything! Some are even design. I can not honestly say we have development. If you just take numbers at the present moment, then what you would say is about 15% of the Company’s labour resources are dedicated to product engineering.

This Company is totally self sufficient at this point in time. In reasonable measures always has been. I think this is one of the things that I said to you about, that is raising money was something at the start that I could not do. This was despite having had, what I would have said in any reasonable terms was quite a reasonable track record. I am bringing with me the people who had been associated with me at that i.e. marketing, engineering.

If you took the saddle of three founders of this Company, the ‘B’ the ‘C’ and the ‘F’ - the Bowie the Coleman and the Fraser - in fact were a distribution of skills, my own was major systems skills and a broad background in business and business management. Mainly on the technical side that has to be omitted. George Bowie is major in marketing all his life, and Alan Coleman is a top side engineer. So we were low distributed and quite strong on what was needed, except possibly finance. We all came from what had been Nuclear Enterprise, which at one time was considered one of the World leaders in sonic technology.

Can you give an example of how and why a process innovation has occurred?

Well again, we are talking about small companies still, so you don’t have anything like the same wall tight compartments. You have got a much more flexible type of organisation, so whilst we have got engineers working on the development of product, that same engineer, we may have a problem on say programming the automatic insertion machine and we will then go to the bloke who has got the intellectual resource to be able to handle that problem. Now we can either do that by going back to the manufacturer which in the case of the people-place machine we have got or we can also go to our own resource which equally we have done and ask but my definition is not now a develop engineer. Well we have that kind of flexibility, mind you interesting
though, even in nuclear enterprises, I try to implement the same flexibility, for example, I try to use all the test technicians to get them out into the field and services instruments so that they themselves were in touch with our markets - they get the blast from the customer. So they realise it's their slip-shod work; what happens out there what the programme service engineer may have to put up with if it's a consequence that the failure to perform at the level they are really ought to.

**Does process innovation arise from a planned and conscious strategy or respond to events and opportunities?**

We respond to suggestions from customers and changes in their business.

**Has information technology stimulated process innovation?**

Not really, except in CAD. This is a powerful tool and also allows us to streamline our costings.

**Do you operate a ‘design-for-manufacture’ system in product innovation?**

Always. This is nothing new. Development must always interface with production.

**How influential is your marketing expertise in product innovation?**

One of our working Directors is a marketing specialist. Our people get a buzz out of creating and making a new product so when George comes up with a suggestion that he believes will sell that's good news.

**Have your suppliers stimulated innovation of product or process?**

Not really.

**Have your customers stimulated innovation of product or process?**

More than our suppliers. We constantly get suggestions from customers which we try to incorporate into our instrumentation products.

**What motivates product and process innovation for this company?**
Partly the customers, partly George, and partly that's why we're here - we are development engineers.

NON-CUSTOMER KNOWLEDGE TRANSFERS

Can you give an example of how this company gets knowledge which may stimulate innovation from: big companies contacts, higher education contacts, SE, LIS, LEEL, The Business Shop, marketing agencies, financial bodies, trade associations, Competitors, scanning the environment of your business, other outside bodies.

We have had discussions with them but it has never finished up with anything. Again you problems - the problems of finance. The Universities by definition are looking for investments and the way Universities work. I mean you do not get - I would say that any development work that was done for us by a University would cost five or six times as much as if we took the intellect and resource into the Company and paid for it there.

CUSTOMER KNOWLEDGE TRANSFER

Can you give an example of customers making suggestions which have improved your products and/or your processes?

We do not trade with any big Companies. I can not think of any big Companies. Well that is not entirely true! We trade with on the contract side of it e.g. we trade with the Gas Board. But it is only for the proto-type and there is no transfer of knowledge there, in fact funnily enough the reverse might be the case. The knowledge that goes into from us as manufacturers, as people who put electronic boards together, we discuss that aspect of it. In other words the aspect of manufacturing it with the Gas Board engineers before they actually make something. So that they do not provide something that (you may have heard it yourself - the expression) a draftsman is inclined to say "if I can draw it - you can make it!" or the engineers who have got to make, as the machinist once said "These buggers think if they can draw it - I can make it". You get ridiculous situations. I can site one beautiful example actually of a ridiculous situation where if you look at our probe (I can show you) the fold that arose. That the probe itself is actually enclosed in a case. It is a very neat fitting case. The interesting thing was that the bloke who designed it originally - when I say designed it - it was obviously what I specified what the damn thing would do, and I laid out the mechanics and all that, but then a draftsman actually drew it all up. The draftsman drew the cover up, in fact he drew it in such a way that we got the bits made up, rather
stupidly I never really checked it. We got the bits made and then found it absolutely impossible to put these covers on. It was absolutely impossible.

Well. Customer knowledge transfer is relatively little. But the relationship with the customers pushes you to acquire knowledge in the sense that they obviously talk about things they would like - so you are trying to respond to the customers if you have any sense. And you will therefore follow up intellectually and possibly more practically.

How often does this happen, and how welcome are such suggestions?

This happens all the time. The examples can be simple, because they tend to be simple. Say you take the first thing about the instrument that we have been selling. We have just re-designed an new sonic-diagnosis instrument. If you look at the pressures involved. Now the technology moves on and the devices available moves on, it's an instrument which uses just as a simple, for instance, memory. Now the memory situation has changed enormously over those 15 years, so what you say is that we have now got, we can get one chip which will give us as much memory as we have put onto the whole board in the old instrument. So you can see what I am getting at here, the technology has changed and that in fact is a pressure because, the devices you have got your design anyway will cease to become available. So you have got to try and recover that, so that's one pressure - or at one area that you are going to look at. The next is to look at the requirements, are there things customers have been asking for. Now one of the things that we asked for, for example in our instrument is that it be lighter in weight because of the way it is used - it be smaller. Technology to some extent is answering this for you - you can go from a board to a chip. This gives you another area for what you can do in design. That the last, well it's not the last but another area is of course the innovation: are there things that the customer asks for. Now you may have responded to these along the way as a sort of add on, but when you are doing a re-design, it is equally obvious is that you can start to look at how you put that as a standard part of the instrument.

How have customers transferred their knowledge into your company: staff transfer, financial help, joint RD&D, equipment loan, worker-worker liaison, other ways?

As I say, we are more likely to transfer knowledge to them.

Why have customers transferred their knowledge into your company: crisis in your relationship with the customer, arising from the type of relations with customer e.g. vendor rating, a continuous improvement relationship with a customer?
Customers make suggestions, they don't transfer knowledge to us.

**LEARNING ORGANISATION FEATURES**

Is this a 'learning organisation' - constantly generating, accumulating and socialising knowledge?

Absolutely. This is why we came together - we are development engineers at heart.

A 'learning organisation' actively seeks out new knowledge and ways of doing things; can you give an example of this culture in your company?

We are learning all the time: personal contacts, trade magazines, conferences and courses. Our blokes regularly go to various courses run by various people. A good example there, I suppose is the brew-ha-ha we have had recently over electromagnetic interference. Our blokes went on courses there, had lots of discussions with examining authorities - an awful lot of transfer of know-how. Our two engineers picked up lots of knowledge of electromagnetic interference. Obviously they have the tools of their trade which tell them what it ought to be about, but now we are talking about the subtle bit - the tricks of the trade. How do you achieve the sort of thing that in theory you want to achieve. There are lots of ways in which this is done, and an awful lot of it is because there are materials available for doing the kind of thing that will work. But it not necessarily always obvious how you will use it.

It is suggested that a 'learning organisation' has leadership rather than management. Leadership constantly challenges the knowledge base of the organisation. Does this distinction make sense to you?

You have to lead from the front. What the hell is leadership about. People who lead from the back, to my mind, are not leading. This is a matter of how you define management, what is management. I mean a lot of countries don't even have a word for it. Management in that sense seems to be a peculiarly American and British phenomenon. This is the advantage the Japanese have over us. Management organises things and people - resources. Leadership marshals a vision of where you're going. That's the role of the leader. We need people to think, not just do as they are told. For many managers this is completely outwith their comprehension I think. This is unfortunate and makes organisations what they are. Many manager finish up trying to avoid blame when things go wrong; trying to make sure his shirt
tails are clean! They busy themselves with memoranda - playing a management game. This doesn't matter in here. If you make a cock-up in here, then all we are worried about is how we sort it, we are not immediately worried about who to blame. We may later look at how or why it happened to make sure it doesn't happen again but fundamentally our first objective is let's sort it. In a large organisation the first reaction on the part of the managers is how do I make sure they don't pin this on me. This is part of why does management in larger companies become what it is - a bureaucracy.

Can you give examples of how the following act as constraints on your company being a learning organisation: your financial structure or financial healthiness, the time-scales in which competition forces you to operate, the risks involved in continuous change and improvement, your business environment, the knowledge base of your employees, the skills and capabilities within your company?

Finance is our constraint. We have to sell to stay alive, and develop new products and ideas while we do that. We don't have the luxury of going full time on product development.

How do you 'scan' for new knowledge of products and process innovation?

Well, for example, our sonic scanner was extremely innovative - it remains a unique product. But when does an innovation cease to be an innovation - arguably when it is widely adopted. In our case that is not going to happen (or is unlikely to happen) although one gets interestingly enough to get a push against our type of product from an Australian company - which is involved in ultra-sonics across the board. But is interesting how they to some extent started up successfully in the veterinary market and have stretched themselves into the medical market. They are becoming quite a sizeable company. If one looks at the type of product they have got. One of the things you can look at to assess a company is manufacturing methods and these are interesting: you can make a guess at the volumes. Our stuff is machined - it's good quality machining, it's good quality product. But what you can say is now wait a minute if they were doing very high volume they could go into very high quality mouldings instead of machining. Process choice matches volume and margins! This is not the same as saying that the quality is low - that's a totally different argument.

How do you 'scan' for new knowledge of marketing opportunities?
We listen to our customers. If you don’t ….. your customer has got to be happy. It is interesting if you look at peoples business interests there are three areas that you can talk about in terms of the business. There is the shareholders, the employees and the customers. Now one of the things that a private company allows you to do, as opposed to a public company with shares that trade is to avoid short term financial gain. Number one - the customer - that is all that the business is about; if my customer is not happy then this company is going to go down the tubes. The second area you have got to look at is the employees; because you are a small company, you have no reserves, you have got to keep your employees happy at all levels. And the final estimate is of the shareholders. And since it is a private company the shareholders can say I will look at the value of the business rather than how much it pays me monthly or in dividends.

Who acts as a ‘gate keeper’ assessing how valid outside knowledge could be?

We all do in a sense because any new idea is discussed by all of the technical staff before we implement anything.

Who effectively takes the decision/risk on technology changes in this company? How are these decisions taken?

In the early days I did. Now this is again part of the group discussions.

How effective are two-way communications within this company?

Constantly - I can’t have a cup of tea without people talking about the business and our products and ideas for improvement.

Do you use project teams to implement product and process innovation?

Well, here everyone is involved. Some people work things up separately, but they always refer back to the group. This keeps everyone on the straight and narrow - stops them getting lost.

Does this company actively socialise knowledge? By what means?

I think it is reasonably important. Well in our case you do it as I say because there is this flexibility which we need. By definition - if we are using say a test technician we ask him to go out and service an instrument, there is that closeness between us because you know you have discussed he is out there as well so he recognises what the customer is/what the job is, how the
instruments are used, all of these things. Flexibility itself generalises knowledge.

If you are doing something different then they are not slow in telling you. I mean we have got this laddie, they do the production flows; so there is a constant feedback which you don’t get in larger organisations.

SUPPLY CHAIN CONNECTIONS ALONG SUPPLY & VALUE CHAINS

What is the scope of your supply chain in terms of geography, technology and value of procurement budget?

Procurement for us is just under £1 million a year. A lot of our stuff comes from specialist suppliers, mainly in England.

What percentage and amount of your turnover is value-added?

Prototyping is nearly all value-added. PCB batches make a small profit. Instrument production has a mark up of around 30%

Do you regard your suppliers as partners? Give an example.

In the main, though we have had our problems. Our main suppliers have been with us for years, they respond to urgent requests so we stick with them. Recently a supplier near London drove up overnight to deliver parts.

Explain the type of trading relationships from your questionnaire answers.

We try to keep long term suppliers. Take for instance the components for the sonic probes. They are all done on CNC machines at relatively low volume - maybe 50 in a box, sort of thing. Now their machines have been programmed and set up; they have got the programmes and set-up, and have been supplying quality to us for 15 years. If we lifted this out and put it with somebody else, it would be to take one hell of a chance. Because the new company would have to re-programme with all the bugs involved, until they got it sorted out. The odds are if they are a well organised company we will not gain any advantage. They all use the same methods now - at our level of volume - automatic machinery doesn’t depend to the same extent on the skills of the operator.

Are these inter-organisational or inter-personal relationships?
You have to know your suppliers at a personal level, so you can ring them up and ask for a favour. You can't do that unless you can pick up the phone and speak to the person you know can deliver.

Are you part of the tiering of a supply chain to an OEM?

We don't know the final customer for our PCB work. Our final customer is the man we are doing the work for. If you take Scottish Gas as an example were some of our instrumentation we make for them finishes up - we've no idea. That's big company branding stuff. They sell to pipeline companies all over the world.

Is your sourcing policy: single sourcing, multi-sourcing, competitive sourcing or spot sourcing? Which is your preference?

We are not big enough for fancy stuff. We find a good supplier we can work with - trust - and stick with them.

What are the main differences between your supply chain, and those of your major customers?

We operate in niche markets, they often are global.

Do you actively transfer knowledge backwards along your supply chain by transferring technical information to suppliers.

In general terms, the transfer of know-how on the sub-contract side, is from us to them rather than from them to us.

Do you actively transfer knowledge backwards along your supply chain by involvement in business strategy changes of your suppliers.

No. Having said that around 500 of our customers have been with us for over five years - so they like what we do.

What routes do you use to transfer knowledge to you suppliers e.g. staff loan, joint development, equipment loan, financial support.

We discuss things and show them what we need. Sometimes we visit them, but its mainly over the phone. I like to deal with technical people who understand our business.
What is your aim in improving the knowledge base of your suppliers e.g. to improve price, delivery time, product quality.

Quality and performance.

Would you say that your suppliers have a similar commitment to continuous improvement as yourself, or not? Give examples.

It varies. People in the industry, technical people like ourselves, like a challenge. Others are only fixed on price.

Do you actively transfer knowledge forwards along your value chain by transferring technical information and suggestions to customers.

In the main we are probably only making a small part of their product. In many cases the customer asks us to sign a confidentiality agreement on PCB or instrument prototyping work. By their nature prototypes are new products and they want to keep them quiet until launch. Confidentiality is important in this business. In mass production this doesn't matter so much - anyone can reverse engineer these products.

Our veterinary customers wanted lighter instruments. Re-design of materials and the use of chips rather than boards provided this. The technology is there - it needs to be used.

Do you actively transfer knowledge forwards along your value chain by any involvement in business strategy changes of your customers.

No.

What routes do your customers use to transfer knowledge to you e.g. staff loan, joint development, equipment loan, financial support.

Customers come saying that they are developing their products and ask us to re-train staff or alter our equipment. We try to respond within our financial resources.

What are your customers aims in improving the knowledge base of your company e.g. to improve price, delivery time, product quality.

Quality and performance.
Would you say that your customers have a similar commitment to continuous improvement as yourself, or not? Give examples.

Very much so. Our instruments are used for testing: in veterinary work or industry. You can't afford to go wrong. Customers are always doing more or different tests - we supply the equipment for them.

FOREIGN DIRECT INVESTOR TRADING

What allows you to successfully trade with major inward investors, or alternatively prevents you from doing so?

We don't in the main directly trade with foreign inward investors. Though our PCB prototyping is often - we suspect - done for them.

How do you weight the potential advantages and disadvantages of becoming a preferred supplier to an inward investing OEM?

We have no problem with that. British Gas has been a customer of ours for over 20 years.

How aware are you of FDI sourcing outwith West Lothian which you believe your company could successfully meet?

I'm not aware of this. On the PCB side we only produce small batches - not really in their league. Our instruments will by and large address different industrial needs. Mass production relies on not over-engineering, they have to pay as much attention to marketing as production. For our specialist products this is less the case.

Is this company prepared to improve its capabilities to meet FDI supply chain requirements? What would you be prepared to do?

We would look at anything within our capabilities and financial resources.

Local FDIs are considered to be 'world-class' manufacturers, how important is it that this company learns from their best practice?

We have a lot of good practice in British industry. We brought a lot of this out of British Nuclear and Smiths. I am not aware of anything in particular which foreign investors have to teach us.

Working in supply-chain partnership may mean allowing an OEM to influence investment, product development and training
strategies. How would this company balance this against organisational independence?

As I say we would look at anything.

Developing a long-term supply chain partnership may involve investing a lot of personal time to build up trust. It this your experience? Would you be prepared for such an investment.

We always try to develop a personal relationship with both suppliers and customers.

If developing a long-term supply relationship necessitated a large financial investment, would you be prepared to seek external funding to finance it?

No. We have grown by investing profits. Outsiders would impose short-term profit targets and cut development. I have no time for this.

If an OEM asked you to jointly develop a new product, the cost to you being significant, how would you respond?

Yes, if there was some up-front development money.

Why can West Lothian owned manufacturers export so successfully, but trade so little with inward investors?

The big foreign investors are tied into sources back home. Why should they change if they have good relations?

LOCAL NETWORK

Knowledge networks may stimulate innovation, improving competitive-ness. Are you part of one?

Yes, we keep up to date with developments in sonic engineering. But this is mainly informal. There are formal bits like courses, conferences and personal contacts. It's very difficult. Take Diagnostic Sonar down the road. We could be in competition with them, so we rarely participate in local events.

Is a knowledge network amongst West Lothian-owned manufacturers an achievable goal?
It would be very difficult for the reason I’ve just given. You can’t co-operate with your competitors.

**Who would be the participants in a knowledge network of most use to your company?**

I suppose people who were not in competition with us.

**From a knowledge network what sort of knowledge would this company find most useful?**

In our field this could not be local. Most of the people we have dealings with are down south.

**Which organisation(s) should have the responsibility to further develop a West Lothian manufacturing knowledge network?**

We don’t participate in the Business Alliance or the Chamber of Commerce. If something came up we might give it a shot to see who else was there.

**What input from outside manufacturing companies in West Lothian would you like to see in a knowledge network?**

As I say, we relate to companies who are largely down south.

**PUBLIC POLICY SUGGESTIONS**

**What could the local authority or the government do to improve the institutional framework facing West Lothian-owned manufacturers?**

Well that would be argumentative in the sense that I can’t speak for the company now because I have no measure of control in the company and therefore anything that I said would be a purely personal opinion it wouldn’t be a statement of what this company objectives are. Going back to the other question. I am not sure that there is a public policy because it's private policies. Business in this country is still largely dominated by the money men and in very few instances do these money men have a real interest in the businesses that much. You can see this. If anyone can’t believe it all I have got to say ask yourself what has happened to all these activities that were public and that have been privatised and god we have heard enough about it. The salaries that these men have voted themselves and all the rest of it and the prime example of how much interest they really have in that business is to say wait a minute all these changes that they have made, all
these so called improvements they have made why did they have to wait until they could line their own pockets before they did it because most of them were in the bloody jobs before they were privatised and all they have done is to line their own pockets at the expense I would say in large measure of the business. Somebody would say that o that is not necessarily true these businesses are much better and I would say you would tell me that the gas industry is much better than it was. It is clearly obvious that it is not. Would you say that a number of these water companies are better off than they were - really not. So and we are back again to personal greed money men so when you say public policy public policy is at the end of the day the private policies of individuals so to my mind private policies of individuals is a kind of society we are now constructing - pure greed.

How adequate are West Lothian training providers for your purposes?

People are leaving school without a proper education or readiness for work. This needs sorting out. Our training is internal or at courses and conferences down south.

Is the information you put into, and receive from the labour market in West Lothian satisfactory?

Yes.
Simpson Buglass, Chairman and Chief Executive of Computer Investments, was interviewed on Friday 6 November 1966, at the company premises in Naysmith Court, Livingston.

Houston Industrial Estate is a modern (seven years old) collection of small industrial units targeted at small scale manufacturing and ‘hi-tech’ businesses. CI is therefore well furnished and presentable - signalling a lean but progressive atmosphere.

**COMPANY PROFILE**

What are your products and your output profile?

In 1983 we commenced a company for strictly third party hardware maintenance I recruited one, two three, and four building up to six ex-Burroughs engineers because the population out in the field at the time using Burroughs were very dissatisfied with the poor level of service in the field. So it wasn’t too hard to get Burroughs users signed up, and the company grew to a certain extent by these customers saying that in addition to the Burroughs equipment we also have of other equipment - can you look after it? The answer was yes. So this became our growth pattern. We had excellent household names such as Scottish Equitable, Angus District Council (which we still have) and Trebor Sweets - which were using Burroughs equipment in those days. Burroughs were very very unhappy and were determined to wipe out the third party maintenance. But it didn’t happen anyway and we just took on other maintenance contacts. Then about three and a half years ago we realised that hardware maintenance was not a growth industry given the growing reliability of equipment, manufacturers giving on-site three year warranty contracts. We decided that there had to be in addition something else. We were not going in for selling small packages of software, shrink-wrapped off-the-shelf. So I decided it had to be some form of document management which was a growth industry. We looked around and took on the agency for an Edinburgh-based outfit (whose name escapes me) to sell there product. But the more I looked at it, it was so shot full of holes and wasn’t really finished. And then I sent two of the team down to an exhibition and they came back saying they had seen this DOS based software called Ultra which was excellent, and remains excellent. We started pushing that and we had over thirty installations around Aberdeen and Inverness including household names such as Health Boards, Hydro-Electric and Police. The windows version of this product was always going to come out, but the company concerned didn’t invest in it and were bought over. After all
those years the windows version has now appeared just in the last four weeks. The philosophy of Ultra was excellent. The Augusta version is windows based and is millennium compliant. Recent debate on millennium compliance shows that 80% of British business doesn’t even know there is a problem. We also ran with a UNIX programme, using windows, called Excalibur. Excalibur is a third generation product out there on its own. We hold the agency for Scotland and the north of England and have installation in the Bank of Scotland, Hydro-Electric - these recently featured in the Financial Times. Excalibur is now in a NT version, which means that instead of UNIX servers costing £17,000, IBM, HP and other Sun machines can be used. A double Pentium server for maybe £1,500 using Excalibur was recently exhibited by ourselves in Birmingham. Our product range now is customised scanning hardware and software packages and service support - document management.

**Who are your customers? Describe a typical customer.**

This is difficult because we cover a wide range of commerce, industry and public sector. Our typical customer is not decided by which industry they are in but by how much paper they handle. Most organisations have paper handling problems.

**Who are your competition? How intense is competition?**

Competition is growing. Canon have a good product but without ‘plug-and-play’ availability. MDi, who are partnership with the Swedish group 2M wanted us to handle their product. Their product is a lash-up; if we had their capital we would be of much greater size than we are. They use IBM OS2 operating system, which is not as widely used as windows. Their price is so low for what they are offering, and margins so tight, that you would have to sell barrow-loads to make money. I can put the same effort into a deal with far greater potential. We offer a complete service, including maintenance: this remains a unique selling point.

**What is your strategy for this business?**

I foresee growth in each segment of our business. Pre-sales and survey, with ‘legacy’ or new hardware systems. Hardware range from disc drives, PCs, scanners, software and ‘juke-boxes.’ We install, up-figure, and maintain these document management systems. My only regret, as an executive member of the Scottish Software Federation is that the software is American. The SSF, as you know, are supported by the Scottish Office and the Council
to support indigenous software authors. We will never have another Bill Gates; the nearest we ever had was chap from Dundee who wrote games software. Unfortunately all the promising programmes are bought out or the authors go to America. My belief is to encourage Scottish authors, but the added value from merchants such as ourselves handling products coming from America remains valid. I know I am talking a lot to give you my views. But the added value is critical. Let's consider imaging as a product. The added-value is dramatic. Take for example, the classic document imaging contract. Until the customer has the information in his system little value is added. Nobody has addressed the back-log scanning operation in Scotland. This is a growth area for this company. Our constraint is simply capital for an ISDN line, a few PCs and working capital - about £25,000. The indexing takes keyboard skills - usually women because they have got better control. We receive untold enquiries for back-log scanning. We did the Dunfermline Building Society who are a file-net user; but we did it, sure! We prefer to set up an Excalibur based system, but back-log scanning can be done by us for any system. Format bridges are available for indexation between systems. This is a growth area - occupying Scottish fingers, Scottish people, Scottish expertise.

You will be interested that the Labour Party went across to the States, about two years ago and asked Bill Clinton for campaign ideas. He recommended the use of Excalibur to index what the opposition had been saying on every subject for the last ten years. This is pulled out, lies identified and 'pre-emptive rebuttals' made to opposition announcements. Labour now use this in the UK - putting all the Conservatives speeches etc into files. Unfortunately they used an English back-log scanning bureau. Robin Cook used this to demolish the 'Arms to Iraq' report in the House of Commons. The Tories were stunned. The English agent for Excalibur then phoned the Conservative Party - they had people around the next day. So both the Conservative Party and the Labour Party are now using Excalibur for information retrieval.

Can you describe the management structure?

We have three field engineers, one working from an office in Newcastle. Others are based in Dundee and East Kilbride. Ten staff in total. Each engineer does pre-sales, training, and installation. Our competition simply

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3 The SSF is located in Livingston at Kirkton Campus. It has 206 member companies aiming to represent their interests, foster co-operation, improve market share for Scottish software, lobby government, educate the public, set professional standards and encourage the use of software to improve competitiveness. See Scottish Software Federation, 1996, Directory of Member Companies, Michaelson Square, Livingston.
sell software. Each of our engineers negotiates a start to finish solving of document management problems.

**With what systems is work organised?**

We are a 'virtual' organisation - constant contact without physical contact.

**What are the main processes you use?**

Each engineer draws in staff, of time from our workshop as needed, for each job they do.

**What range of technology is employed?**

We configure all the hardware systems with all available scanners mainly using Excalibur software interfacing generally with Microsoft or customised programmes.

**Do you operate a participative or top-down employer model?**

Everyone here is a self-starter. Most days only Ann (the office Administrator) is here - everyone else is working in customers premises. That is unless they are in the workshop with hardware.

**How is employment structured?**

Through myself engineers draw on the team.

**Do you employees feel a mutual obligation to you?**

And to themselves and the customers - we solve problems, we are not simply in the business of marketing software and hardware packages. Our customers want a 'one bottom to kick' approach.

**How do you recruit and improve 'quality' employees?**

I personally recruit people who know the business, often I have come across them in the Scottish Software Federation. Everyone learns on the job. They are motivated by solving problems for customers who generally have no idea of what is available.

**Can you describe how the culture of your firm corresponds with the social culture in West Lothian?**
I am not sure what the social culture of West Lothian is. We are happy to be located here but only our Office Administrator lives in West Lothian. We really have little connection with the place except for the Scottish Software Federation and the Software Centre.

**What is your annual turnover, annual profit, and profit margin?**

On a £2 million turnover we make a 8% profit.

**What strategic opportunities for innovation and technological change do you face?**

Information management is a growth industry - our limits are set really by the limited vision of businesses to do away with paper.

**What constraints do you face in taking advantage of these strategic opportunities?**

Capital! We are and always have been under-capitalised. We could double our turnover if we had an extra (say) £100,000 capital.

**INTERNAL KNOWLEDGE GENERATION**

**What staff, budgets and time do you allocate to product research product development and product design?**

We don’t have the resources to have our own in-house R&D, therefore we have to rely upon the companies for whom we act - like Excalibur - they have a tremendous R&D. And our customers re-defining their needs. The market in America is so big compared to Scotland - we have to learn from there. We attend courses and discuss with authors rather than do research. Our contribution helps research and development but our main efforts are in development and design. We test Excalibur’s stuff and feed back suggestions before they release it.

**Can you give an e.g. of how and why a process innovation has occurred?**

Every project is different. So every time we get a job our first thought is who has done something similar. We pick each others' brains.

**Does process innovation arise from a planned and conscious strategy or respond to events and opportunities?**
Appendix Two: Empirical Data From Indigenous Companies

For Excalibur and other software authors this is the case. For us we learn from our customers.

Has information technology stimulated process innovation?

IT is our life-blood.

Do you operate a ‘design-for-manufacture’ system in product innovation?

We manufacture nothing except the final links in the chain from hardware and software to document management systems.

How influential is your marketing expertise in product innovation?

Look at our brochures. Every completed system is an advertisement to similar potential users.

Have your suppliers and customers stimulated innovation of product or process?

Our product is constantly altering as suppliers and customers alter their internal hardware and software systems.

What motivates product and process innovation for this company?

Our product changes as the industry changes what’s on offer and what is used. To some extent our processes are simplified as companies use the same stuff.

NON-CUSTOMER KNOWLEDGE TRANSFERS

Can you give an example of how this company gets knowledge which may stimulate innovation from: big companies contacts higher education contacts SE, LIS, LEEL, The Business Shop, marketing agencies, financial bodies, trade associations, Competitors, scanning the environment of your business, other outside bodies.

I would say very little. Certainly none from LEEL. Trade Associations are interesting. In particular you know of my involvement with the Scottish Software Federation. But although there is some amount of networking amongst people there - it doesn’t affect our product at all. I would say we are
Appendix Two:
Empirical Data From Indigenous Companies

kept up to date by reading the trade press, journals, and SIMDECH (based in a University down south), together with the courses and conferences that we go to. We are constantly scanning for new ideas and opportunities. There is an element of ‘creative selling’ - thinking where the potential is. Even when we don’t get an order, it helps us understand our product potential better. Our own knowledge of the computing industry and applications is crucial. Most people have little real knowledge of computing.

CUSTOMER KNOWLEDGE TRANSFER

Can you give an example of customers making suggestions which have improved your products and/or your processes?

Oh yes. They discuss their problems, and they hope we can come back - as we have done - and say “Well have you thought of doing this or that?” Often they reply no; because they don’t have the computing power knowledge to address their own needs. So really, to a great extent, this is where our strength is.

How often does this happen, and how welcome are such suggestions?

I am working with a colleague, in a company in Aberdeen in the oil business. And the oil company had said, we would like you to specify with us some software to help with team working. They have individual teams for each job. A team might be five men (usually they are men). And that team could be composed of a welder, a rigger, a fitter, a jointer etc. So they have these teams available for 24 hours a day, seven days a week. If one man has to drop out (for whatever reason; sickness or holidays) they have got to fill that skill gap to complete the matrix of the team. We developed a software package to hold information on skills, allowing team members to be immediately re-defined. At the weekend I arranged to further develop the same software for the casualty department of a Grampian hospital. We are now looking at other situations where teams with specific skill abilities could use the same software.

How have customers transferred their knowledge into your company: staff transfer, financial help, joint RD&D, equipment loan, worker-worker liaison, or other ways?

Equipment loan certainly. Staff transfers no. But we put in an evaluation to a company to prove its worth. The Bank of Scotland approached us and said we have a manual system at present in our marketing department which takes every article in every magazine world-wide which we see that is
relevant to banking. They kept this in rows of box-files. An experienced person kept a register and provided cuttings for management who asked. In our test we hit upon a car leasing scheme for newly-weds in Canada - a new product for them. The magic of our Excalibur system is that full text retrieval, not based upon key words. Information is kept in binary pattern; there is no OCR cleaning up. They then asked us not to reveal to the other banks how they were keeping tabs on the world-wide business. This was driven by them saying, “Do you have a solution to our problem.” We re-defined the problem to their enormous advantage. Our work is customer driven.

Another example is the Dunfermline Building Society. Throughout the branch network each Branch has a record of those customers who should not have tax deducted from earnings on their account. This used to involve the physical sending of Inland Revenue forms between Head Office and Branches. With our system the form can be instantly transferred anywhere in the network, with the paper staying at the home branch. The customer comes to us posing a problem. Our customised solution involves capturing their knowledge for them in a more usable form. They may know what the problem is, but they don’t know what the solution is. They don’t have the technical experience to know what is possible. We don’t know what the problem is until they come and tell us - we can’t go around saying we have a solution, what’s your problem.

Why have customers transferred their knowledge into your company? For examples: crisis in your relationship with the customer, arising from the type of relations with customer e.g. vendor rating, a continuous improvement relationship with a customer?

A very big builders merchant called us in saying, “We have a hell of a problem with paper - especially customer records.” They asked us to spend time talking through potential solutions. We took a sample of their information base and showed it to their Board, in an Excalibur system. They had slack jaws! Not because we were doing anything magic, but because they had never comprehended what we could do. It was an education project as well as business.

How much easier is it to know what the final user of products wants, than to know what an intermediate customer wants?

That is both the software and hardware producers problem. We deal with the final customer. Not Procurement Officers - the final customer on the job.

LEARNING ORGANISATION FEATURES
Is this a 'learning organisation' - constantly generating, accumulating and socialising knowledge?

This is very important to our business. It is the only way to move forward. We do this informally rather than formally.

A 'learning organisation' actively seeks out new knowledge and ways of doing things; can you give an example of this culture in your company?

Often by direct phone discussions around 'new' problems between engineers which can turn out to be 'old' problems. In my experience even in big companies this is the best approach. For example, we recently had William Lows, the super-market chain. We had equipment in there, before they were taken over. We were asked to formal management monthly briefings on re-engineering. We helped them with networking and exchanging information about their business, not just computing.

It is suggested that a 'learning organisation' has leadership rather than management. Leadership constantly challenges the knowledge base of the organisation. Does this distinction make sense to you?

I would say that I provide leadership, but you have to take people with you. They have to understand where the company is going, they have to understand the technology.

We could only go forward quickly by amalgamation with a similar organisation creating a larger entity. For example a company with compatible products which we don't handle. An example may be a company hot on work-flow and project management, but without our expertise in information management.

Can you give examples of how the following act as constraints on your company being a 'learning organisation': your financial structure or financial healthiness, the time-scales in which competition forces you to operate, the risks involved in continuous change and improvement, your business environment, the knowledge base of your employees, the skills and capabilities within your company.

Financial structure is a constraint. We like most start-up companies are under-capitalised. A sounder capital base would enable us to employ the
software engineers we need to build up a broader range of solutions to customer problems.

How do you 'scan' for new knowledge of products and process innovation?

We do this ourselves, by attending conferences, and in part through the Scottish Software Federation.

How do you 'scan' for new knowledge of marketing opportunities?

Every time we successfully solve a customers information management problem, we target similar organisations touting for work. For example, our work with Hydro-Electric led them to ask us to produce an electronic safety manual for employees. Now everyone of their employees has instant access to the latest safety standards and procedures. We are now holding discussions with their legal and commercial departments. We are opening up another 'file-room' for them this very morning.

Who acts as a 'gate keeper' assessing how valid outside knowledge could be?

Effectively I do. We have to be very careful not to over-extend ourselves.

Who effectively takes the decision/risk on technology changes in this company? How are these decisions taken?

I discuss with the engineers and my son who is a shareholder. In the main I take all decisions.

How effective are two-way communications within this company?

Very effective, everyday, we all talk to each other.

Do you use project teams to implement product and process innovation?

Yes. Each new job is a new project. We matrix the team needed to complete the job.

Does this company actively socialise knowledge? By what means?

We talk - it is our lifeblood to exchange information and ideas.
SUPPLY CHAIN CONNECTIONS ALONG SUPPLY & VALUE CHAINS

What is the scope of your supply chain in terms of geography, technology and value of procurement budget?

We supply £1 million of gear a year, and turnover £3 million. The scope of our operation is limited by the scope of our customers.

What percentage and amount of your turnover is value-added?

200%

Do you regard your suppliers as partners? Give an example.

Absolutely. We constantly point out hardware interface problems, and regularly make suggestions to software suppliers.

Explain the type of trading relationships from your questionnaire answers.

Many of our customers are like department stores. We enter one area of their operation to solve a problem and hope to be invited into other areas to solve similar problems of information management.

Are these inter-organisational or inter-personal relationships?

Personal relationships are the foundation of all good business.

Are you part of the tiering of a supply chain to an OEM?

No.

Is your own sourcing policy: single sourcing, multi-sourcing, competitive sourcing or spot sourcing? Which is your preference?

We source hardware in accordance with customer needs. Most of our software is sourced through Excalibur.

What are the main differences between your supply chain, and those of your major customers?
Often, in computing, the difference is we know what we are doing. So often people don’t know what they need.

Do you actively transfer knowledge **backwards** along your supply chain by transferring technical information to suppliers.

All the time we are pointing out to Excalibur ways in which their base system can improve to enable 'jointing' into customer systems.

Do you actively transfer knowledge **backwards** along your supply chain by involvement in business strategy changes of your suppliers.

No.

What routes do you use to transfer knowledge to you suppliers e.g. staff loan, joint development, equipment loan, financial support.

We attend their briefings but no more than that.

**What is your aim in improving the knowledge base of your suppliers e.g. to improve price, delivery time, product quality.**

We are too small a player, but generally have little problem.

Would you say that your suppliers have a similar commitment to continuous improvement as yourself, or not? Give examples.

Excalibur listen to us and other software developers.

Do you actively transfer knowledge **forwards** along your value chain by transferring technical information and suggestions to customers.

Yes all the time - this is our business.

Do you actively transfer knowledge **forwards** along your value chain by any involvement in business strategy changes of your customers.

No, although the example I gave from William Low shows that we can get involved in this.
What routes do your customers use to transfer knowledge to you e.g. staff loan, joint development, equipment loan, financial support.

We test prototypes of Excalibur's work.

What are your customers aims in improving the knowledge base of your company e.g. to improve price, delivery time, product quality.

Quality is not a question for us - systems must work

Would you say that your customers have a similar commitment to continuous improvement as yourself, or not? Give examples.

FOREIGN DIRECT INVESTOR TRADING

What allows you to successfully trade with major inward investors, or alternatively prevents you from doing so?

We don't do business with the inward investors. They seem to source computing systems and information management systems from their home base.

How do you weight the potential advantages and disadvantages of becoming a preferred supplier to an inward investing OEM?

For us there could be no disadvantages provided we can avoid them taking advantage of their strength to achieve discounts which make the business unprofitable for us.

How aware are you of FDI sourcing outwith West Lothian which you believe your company could successfully meet?

This company could provide information management systems for these companies which are probably superior to those they use. I would like to see more closely what exactly they do use.

Is this company prepared to improve its capabilities to meet FDI supply chain requirements? What would you be prepared to do?

Yes. We would take seriously any proposition to co-operate on an interesting development.
Is trading with FDIs for some reason only a limited part of this company's growth strategy? If so why? If not - how broad a location of FDIs do you consider your potential market?

As I say, they source from their home base for systems such as we provide.

Local FDIs are considered to be 'world-class' manufacturers, how important is it that this company learns from their best practice?

It is very important for Scottish industry in general. But we have had no opportunity to learn from them. The only standards we deliberately adhere to are those published by the Scottish Software Federation: competency, ethics and mission statement. The location of these companies on our doorstep has had no impact whatsoever upon us apart from one which strangely happened this week. Bull Information Systems have asked us to do some hardware work which we are currently doing - re-working keyboards. This is the first work we have had from an inward investor. They quibbled about payment periods trying to make us wait 90 days, but we insisted upon weekly invoicing and they said, "OK, we accept your terms." All big companies should have a code of conduct for paying small companies.

Working in supply-chain partnership may mean allowing an OEM to influence investment, product development and training strategies. How would this company balance this against organisational independence?

Like most small business, the reason I start on my own is to be my own boss. I would be happy to consider any proposal but independence is very important.

Developing a long-term supply chain partnership may involve investing a lot of personal time to build up trust. It this your experience? Would you be prepared for such an investment.

Yes, trust is the basis of all good business, win-win! I spend a lot of time networking and trying to establish business contacts.

If developing a long-term supply relationship necessitated a large financial investment, would you be prepared to seek external funding to finance it?

Yes, and we are doing.

If an OEM asked you to jointly develop a new product, the cost to you being significant, how would you respond?
I would evaluate the risk involved in the new product, if it fitted the competencies of this company I would look seriously at it, provide there was a chance of good business.

Why can West Lothian owned manufacturers export so successfully, but trade so little with inward investors?

I really don't know. Getting into these inward investors is very difficult.

LOCAL NETWORK

Knowledge networks may stimulate innovation, improving competitive-ness. Are you part of one?

That is a good question and was part of the reason why we moved from Edinburgh to here. But having moved here I would say that problem not on balance but one had hoped that it would be. I likened it at one stage to living in London where you don't know who you are living next to. I hoped that Livingston would be more like a village where you would know everybody. There is no opportunity to mix in such a way to exchange and network other than through the meetings that we have with the Scottish Software Federation who make a deliberate effort to create that opportunity and it works. But they don't necessarily hold them in Livingston but Aberdeen, Edinburgh and Glasgow; despite the fact that the Federation is located here. That fact that you are in Livingston per se and that you are cheek by jowl with many other firms in the industry of information management doesn't mean that networking happens. Everyday you are so much involved in your own business that socialising or networking doesn't happen unless through the Software Federation. The Federation is for both the trade (the providers - the authors) and also the users. You will be familiar with the Federation Directory which contains our network.

There are specialists who we discuss with. There are hardware specialists in scanners, storage devices (optical drives, juke-boxes) and hard-drives. They know that if you are in the business of document management. But we liase with these people without being tied to them. We need to keep in touch with the network, without losing our independence.

Is a knowledge network amongst West Lothian-owned manufacturers an achievable goal?

Yes, but it needs to be organised.
Who would be the participants in a knowledge network of most use to your company?

Other similar companies, and potential customers.

From a knowledge network what sort of knowledge would this company find most useful?

New products and new problems requiring our services and products.

Which organisation(s) should have the responsibility to further develop a West Lothian manufacturing knowledge network?

Trade organisations like our Software Federation and groups like the Council.

PUBLIC POLICY SUGGESTIONS

What could the local authority or the government do to improve the institutional framework facing West Lothian-owned manufacturers?

Bring people together - for whatever reason. LEEL fails to be do this, maybe a West Lothian Local Enterprise Company will pay more attention.

The power that be too often look upon the computer industry as hardware manufacturing: chips, boards and metal. They regard the software industry as a tag-on that doesn’t really carry the same importance. We want them to regard the software industry as a very powerful section of the computer industry, in its own right! Not as .... well you don’t employ thousands of people - like Sun, Unisys and Digital. Together the merchants - the software innovators - represent a fair number of people and the difficult is having the powers that be, when it comes to business support (such as investment grants) recognising that software is a powerful industry in its own right. In fact, next Tuesday we are having a lunch to discuss these very facts - would you like to come? [Yes]

How adequate are West Lothian training providers for your purposes?

Training locally is completely inadequate to our needs. No support for our heavy investment in training is available - yet the big inward investors get money thrown at them even though they don’t need it.
Also at a national level. Our auditor has recently suggested that investment in training and intellectual property is no more than a lottery.

Is the information you put into, and receive from the labour market in West Lothian satisfactory?

We would recruit in West Lothian but have little idea who is available. In the main we don’t advertise, but recruit people who we know.
Appendix Two: Empirical Data From Indigenous Companies

DACOLL LTD.

Brian Colling, Chairman and Managing Director, Gardner’s Lane, Bathgate, West Lothian, 12th November 1996, West Lothian.

Bathgate is the corporate headquarters for the Dacoll Group. The company was established in 1969 and is one of the UK’s leading independent manufacturers and distributors in hardware and software. Situated in their own premises in the centre of Bathgate the offices, distribution depot and workshops adequately reflect a “no-frills” professional business.

COMPANY PROFILE

What are your products and your output profile?

Dacoll offer independent integrated IT and network solutions. Of course, we whole-sale hardware and software. However our value-added element is providing customers with IT solutions. We offer a range of quality services for this: networking, development, consultancy, maintenance service and support along with hardware and software sales.

We provide data collections systems and local networks. Also OSI gateway connections, and mainframe communication services and PCs. We sell an extensive range of single and multi-user printers. We are distributors or re-sellers of SCO, Novell, Borland, Microsoft, Aldis, DSL, Dataflex and MSE packages. We upgrade for Intel PC users and support maintenance, cabling, training, consultancy and field services. One of our subsidiary companies offers computer and electrical installation. Finally, we develop our own software materials.

Who are your customers? Describe a typical customer.

We have no typical customers, only typical IT problems which we try to solve. Our customers include major police forces, Alfred Marks Bureau, Bull, Levi-Strauss, Wyman-Gordon and Motorola. We cover a wide range of defence and aerospace companies, conservancy services as well as engineering, plastic and glass manufacturers.

Who are your competition? How intense is competition?

Competition for sales of hardware and software is, as you know, intense. So is competition to design, manufacture, distribute, install, diagnose and repair, and configure software and hardware products, customised to solve customer problems. This is the business we are in.
What is your strategy for this business?

To grow from £11m turnover to £23m over the next few years by expanding our range of services, products and continued development of new products.

Can you describe the management structure?

I lead from the front and am involved in all key decisions. Each section (Marketing, Software) has a Head of Department. We meet regularly to exchange information and take decisions.

With what systems is work organised?

We are information-led. Recent examples of this are in spares ordering, fault logging and stock controls.

What range of technology is employed?

Software development, hardware configuration and networking equipment.

How many permanent and casual employees do you have?

We employ 130, the Group around 200.

Do you operate a participative or top-down employer model?

We encourage all employees to make suggestions and to feed back ideas from customers.

How is employment structured?

We use functionally based departments for each of our main activity areas.

Describe the teams or cellular manufacturing you use?

Our regular Heads of Department meetings are conveyed to teams. Teams are organised on a matrix basis for particular jobs or projects.

Do your employees feel a mutual obligation to you?

Absolutely! We recruit the best people and train them to their potential.

How do you recruit and improve ‘quality’ employees?
We recruit from all over the UK.

**What motivates your workforce?**

We are a growing company with a future and invest significantly in internal and external training.

**Price, Quality, Time, Kaizen scoring explanation from questionnaire.**

We score 10 for each factor. In a competitive industry every feature of the business has to be right.

**Can you describe how the culture of your firm corresponds with the social culture in West Lothian?**

No.

**What is your annual turnover, annual profit, and profit margin?**

Dacoll Group has a turnover of £11 million. With a pre-tax profit of £3 million. About half of our turnover is value-added.

**What strategic opportunities for innovation and technological change do you face?**

We continue to develop our own software product range and feed into the R & D of other developers. Our main market opportunities are abroad: India, Ireland, Italy, China.

**What constraints do you face in taking advantage of these strategic opportunities?**

Money. This Company owes nothing. We grow organically. The pace of our growth is dictated by our ability to generate profits for re-investment.

**INTERNAL KNOWLEDGE GENERATION**

**What staff, budgets and time do you allocate to product research, development and product design?**

We spend around £400,000 a year on R & D. This draws from all parts of the organisation including marketing, not simply software development.
Can you give an e.g. of how and why a process innovation has occurred?

This business is about constant innovation. At pre-sales meetings our customers pose problems often requiring innovative solutions. The pace of change is such that sometimes developing the software isn’t worth it so we customise other peoples. Also in providing systems changes in EU regulations drive change.

Does process innovation arise from a planned and conscious strategy or respond to events and opportunities?

Both. We respond to customer needs and opportunities provided by markets or suppliers. But we also develop our products. We have just developed a product to protect the base configuration of Microsoft Work - even the Americans don’t have that.

Has information technology stimulated process innovation?

We follow market trends and our customers.

Do you operate a ‘design-for-manufacture’ system in product innovation?

We do less manufacturing of hardware. All of the systems we produce are to order for specific customers.

How influential is your marketing expertise in product innovation?

Marketing is wholly integrated into all of our activities. This is especially important for exports. We have to know exactly what each market is demanding.

Have your suppliers stimulated innovation of product or process?

Of course. Our engineers are high level programmers. They aim to link any set of PCs or mainframes with the customer’s software requirements.

Have your customers stimulated innovation of product or process?

Many of our customers come to us with problems not orders. This constantly stimulates us to analyse what we are doing and how we do it.
What motivates product and process innovation for this company?

This industry and products are moving so rapidly that we have to constantly innovate to remain a player.

NON-CUSTOMER KNOWLEDGE TRANSFERS

Can you give an example of how this company gets knowledge which may stimulate innovation from: big companies contacts higher education contacts SE, LIS, LEEL, The Business Shop, marketing agencies, financial bodies, trade associations, Competitors, scanning the environment of your business, other outside bodies.

Not really. We are members of the Chamber of Commerce, but ...... Scottish Enterprise help with our export drive. Not technically information marketing information through British Embassies. We are particularly interested in the third world, Italy and the US.

CUSTOMER KNOWLEDGE TRANSFER

Can you give an example of customers making suggestions which have improved your products and/or your processes?

We have twelve salesmen and 40 engineers out in companies. Improvement suggestions are rewarded.

How often does this happen, and how welcome are such suggestions?

Each customer has different problems and potential. Team meetings ensure that ideas gained from one customer can be transferred to others.

How have customers transferred their knowledge into your company: staff transfer, financial help, joint R D & D, equipment loan, worker-worker liaison, other ways?

Customers often provide advice but not other forms of assistance. Our value-added is not in hardware and software sales but consultancy, design, installation and servicing. Our programmers have the capability to solve our customers problems. There is a great differentials in awareness amongst our customers about what solutions are available.
We are vendor approved to levels of ‘Technical excellence’ and ‘Specialist service’ by major manufacturers and suppliers of hardware and software.

Why have customers transferred their knowledge into your company: crisis in your relationship with the customer, arising from the type of relations with customer e.g. vendor rating, a continuous improvement relationship with a customer?

Customers have to openly discuss their problems and aspirations with us to allow us to solve their problems. In the main this arises not from crisis but their changing business needs.

How much easier is it to know what the final user of products wants, than to know what an intermediate customer wants?

We deal with the final users of the systems we provide.

**LEARNING ORGANISATION FEATURES**

Is this a ‘learning organisation’ - constantly generating, accumulating and socialising knowledge?

Yes, development and design is a the core of our business. We spend £400,000 a year on R & D.

A ‘learning organisation’ actively seeks out new knowledge and ways of doing things; can you give an example of this culture in your company?

This is part of our culture - that's why we've been successful. We are constantly feeding in ideas from customers, suppliers, software developers and the industry in general.

It is suggested that a ‘learning organisation’ has leadership rather than management. Leadership constantly challenges the knowledge base of the organisation. Does this distinction make sense to you?

Yes. I have to be a leader.

Can you give examples of how the following act as constraints on your company being a ‘learning organisation:’ your financial structure or financial healthiness, the time-scales in which competition forces you to operate, the risks involved in
continuous change and improvement, your business environment, the knowledge base of your employees, the skills and capabilities within your company.

We own everything you see. I would be afraid to bring in interfering outsiders simply to gain more capital. We grow organically by re-investing profits.

In part this is about risk management. I would not wish to spend time keeping outsiders happy if we made a mistake and lost money. If we lose, we learn the lessons and re-build.

Cash is a serious constraint in exporting. We need an office in Italy and South Africa. Someone who knows the local market, networks, can offer pre-sales consultancy. This is expensive - but the only way to break into these markets.

How do you 'scan' for knowledge of products, process innovations and marketing opportunities?

Our people are constantly listening to customers. We pay attention to all of the trade press. We import software from the US maintaining an office there, and taking part in exhibitions. I suppose we scan for knowledge by actively seeking it. Tendering processes also give us a good idea of the way things are moving.

Who acts as a 'gate keeper' assessing how valid outside knowledge could be?

All major decisions are taken by myself and the Departmental managers.

Who effectively takes the decision/risk on technology changes in this company? How are these decisions taken?

Again, myself and the departmental managers. I'm from Bradford and run this business prudently. We like to talk things over and over - like when we moved into 32 bit technology. Anything we can do to reduce risk, we do.

How effective are two-way communications within this company?

Very effective.

Do you use project teams to implement product and process innovation?

Yes.
Does this company actively socialise knowledge? By what means?

Team meetings, in-house training, on-the-job learning, participation in project teams and systems design - they all help keep people up to speed.

SUPPLY CHAIN CONNECTIONS ALONG SUPPLY AND VALUE CHAINS

What is the scope of your supply chain in terms of geography, technology and value of procurement budget?

We have 175 suppliers, 25 of whom are in West Lothian and spend around £6m pa on procurement.

What percentage and amount of your turnover is value-added?

Around half of our £11m Group turnover.

Do you regard your suppliers as partners? Give an example.

Yes. We are a prototyping agent for Microsoft who supply some software. During prototyping our engineers identify bugs and suggested improvements from which Microsoft benefit.

Explain the type of trading relationships from your questionnaire answers.

70% of our purchases are regular, only 10% are based upon supply agreements. We make purchases mainly to meet customer requirements.

Are these inter-organisational or inter-personal relationships?

Some amount of good personal relationships are necessary.

Are you part of the tiering of a supply chain to an OEM?

No.

Is your own sourcing policy: single sourcing, multi-sourcing, competitive sourcing or spot sourcing? Which is your preference?
We seek out the best deal we can get, there are many suppliers for our needs.

What are the main differences between your supply chain, and those of your major customers?

Our value-added arises from services to our customers, not as a wholesaler of other peoples' products.

Do you actively transfer knowledge **backwards** along your supply chain by involvement in business strategy changes of your suppliers.

No.

What is your aim in improving the knowledge base of your suppliers e.g. to improve price, delivery time, product quality.

All of these.

Would you say that your suppliers have a similar commitment to continuous improvement as yourself, or not? Give examples.

Yes. They are in the same competitive environment as ourselves. You only have to look at the pace of product improvement in the computer and networking industry.

Do you actively transfer knowledge **forwards** along your value chain by transferring technical information and suggestions to customers.

All the time, this is our business.

Do you actively transfer knowledge **forwards** along your value chain by any involvement in business strategy changes of your customers.

Not directly but you can't design IT systems without looking at the collection and use of information.

What routes do your customers use to transfer knowledge to you e.g. staff loan, joint development, equipment loan, financial support.

We talk and plan together rather than do these things.
What are your customers aims in improving the knowledge base of your company e.g. improve price, delivery time and product quality.

Yes they expect all of this.

Would you say that your customers have a similar commitment to continuous improvement as yourself, or not? Give examples.

Sometimes, it depends upon their level of technical awareness.

**FOREIGN DIRECT INVESTOR TRADING**

What allows you to successfully trade with major inward investors, or alternatively prevents you from doing so?

We trade with Bull, Motorola but also with Siemens. They trade with us because of the service we offer.

How do you weight the potential advantages and disadvantages of becoming a preferred supplier to an inward investing OEM?

We have no problems.

How aware are you of FDI sourcing outwith West Lothian which you believe your company could successfully meet?

Perhaps, but each business must act in it's own interest. We source only about 1.5% within West Lothian.

Is this company prepared to improve it's capabilities to meet FDI supply chain requirements? What would you be prepared to do?

Yes, and we do constantly.

Is trading with FDIs for some reason only a limited part of this company's growth strategy? If so why? If not - how broad a location of FDIs do you consider your potential market?

We trade about 90% in England and see our growth in exports (Italy, Ireland, South Africa, China, the US and India). We see no limits to our market area.

Local FDIs are considered to be 'world-class' manufacturers, how important is it that this company learns from their best practice?
Appendix Two: Empirical Data From Indigenous Companies

We learn from all of our customers.

Working in supply-chain partnership may mean allowing an OEM to influence investment, product development and training strategies. How would this company balance this against organisational independence?

Our independence is very important.

Developing a long-term supply chain partnership may involve investing a lot of personal time to build up trust. Is this our experience? Would you be prepared for such an investment.

We have many such arrangements.

If developing a long-term supply relationship necessitated a large financial investment, would you be prepared to seek external funding to finance it?

We grow organically by re-investing profits and would not sacrifice independence for outside financial injection.

If an OEM asked you to jointly develop a new product, the cost to you being significant, how would you respond?

We regularly do this, but take care to cover the real costs of doing so.

Why can West Lothian owned manufacturers export so successfully, but trade so little with inward investors?

Companies grow by improving themselves.

LOCAL NETWORK

Knowledge networks may stimulate innovation, improving competitiveness. Are you part of one?

Yes - with our customers, suppliers and other companies in the Group (Crewe, Birmingham and London), not local. Transport is cheap for out business - artificial boundaries are not important.

Is a knowledge network amongst West Lothian-owned manufacturers an achievable goal?
Perhaps, but you have to be careful to keep information necessary to beat the competition inside the company.

Who would be the participants in a knowledge network of most use to your company?

Our own customers and suppliers.

From a knowledge network what sort of knowledge would this company find most useful?

What we get from customers and suppliers.

Which organisation(s) should have the responsibility to further develop a West Lothian manufacturing knowledge network?

I support this would be for the good. Perhaps the Council?

PUBLIC POLICY SUGGESTIONS

What could the local authority or the government do to improve the institutional framework facing West Lothian-owned manufacturers?

Shortage of capital is a problem for indigenous companies. Foreign investors seem to get more support - perhaps that's why they locate here?

How adequate are West Lothian training providers for your purposes?

OK, but we recruit from all over the UK. We have to get the best staff and not just promote internally.

Is the information you put into, and receive from the labour market in West Lothian satisfactory?

We are in a wider market for labour.
DEANS ENGINEERING LTD

Jim Galbraith, Managing Director of Deans Engineering, Royston Road, Deans Industrial Estate, Livingston on 16 January 1997.

Deans Engineering was established in 1976. Now in its own premises in the modern Deans industrial estate, the company produces high quality machined parts. Prestigious, clean and well presented premises create a modern image for the company.

COMPANY PROFILE

What are your products and your output profile?

We do not have our own product, we are purely sub-contract precision engineering. We manufacture purely to customer's requirements. We are not involved in design - a customer will come along with a drawing and say "I need a price for this part. Estimated annual usage is 'x' amount." It quote it from there.

Who are your customers? Describe a typical customer.

Our principal customers are NCR, AT&T, Unisys, Hewlett-Packard, Lucas EUI, Andrew Ltd, Bourn Electronics and Keystone Valves. Typically they are large original equipment or parts manufacturers.

Who are your competition? How intense is competition?

Competition is very intense, this is a very competitive market. Engineering does not get the respect it is due in the UK. It is very competitive. Most companies talk about building up a long-term relationship - to a certain extent they do that - but they will move a part for a tenner! Everybody can do part cheaper - ourselves included. But there comes a point when you can't do it any cheaper. Every customer that we have talks about cost reductions from one year to another. You don't get a cost increase in this game. The only way you can cost increase is when you are quoting for new components - then, hopefully, you can quote them at today's prices. But we are doing some parts, on-going for the last twelve years, and I am doing them cheaper now than I was twelve years ago.

I had a meeting with a company down south on Monday. It is a company that we have now been dealing with for five years. I have invested almost one million pounds of machinery to do three different parts for them. The main
reason for the meeting was to tell them how much of a cost *reduction* I can give them for 1997. At the end of the day, I didn’t tell them - they told me. This is a *very* competitive market.

**What is your strategy for this business?**

We have got to improve the service we give to customers - this is very difficult. Quality, delivery and price are equally important. It used to be quality, delivery and price, with the same price as last time. These three are all equal now. What we find with major customers, they don’t want to hold stock in any way, so everything now is just-in-time, our lead times have been cut significantly.

I would like Deans Engineering to be a £20m turnover business. This would be difficult simply from machining parts. There is no company in the UK with a £20m turnover from machining parts. We will have to add on additional work like sub-assembly. A lot of the big guys are going away from buying direct machined parts, and buying from sub-assemblers. We have a clear perspective for building up to £10m turnover, beyond that we need to reposition ourselves. We have just completed a major extension of the plant, doubling our production area.

**Can you describe the management structure?**

Myself and three other Directors run the company. We operate with four managers for Finance, a Works Manager, Maintenance Manager and Systems Manager, two Foremen and a Training Officer.

**With what systems is work organised?**

We work as a whole team and as small teams. For some customers we establish cells of machines, we have the same people in the team all the time - we try to avoid mixing them around. There is quite a demand on the quality on every job. We run SPC systems so we need people who the customers trust, and know operate these systems properly.

These systems are completely different from when I served my apprenticeship. Then you were given a drawing, you machined a part, an inspector would come around and check it. We were on bonus so time was important. Systems have changed. The machinery is more accurate. There is probably less chance of making major mistakes. Having said that, I find that if you are running a batch of 10,000 - if one is wrong, then they are all wrong. Likewise if one is right, you have a good chance of them all being right. Statistical Process Control is one of the major changes - but it doesn’t guarantee quality, it tell us you are running within tolerances. I don’t think I
had seen a CNC until I bought one for this factory. I worked on conventional machines. The only conventional machinery we have now is basically for making up bits and pieces for internal use.

**What are the main processes you use?**

We machine parts and often apply a finish. A typical batch may be 10,000. Most parts are machined from steel bar through automatically fed machining centres. The skill is in the set-up and tooling.

**What range of technology is employed?**

There are two sides to our business: machining and finishing. Machining processes are built around 50 (largely Japanese) CNC turning centres with associated milling and drilling machines. Many of these machines are automatic feed throughout their operation. Bar up to 42 mm is automatically fed through the process but we can operate with bar of 150 mm. All of our processes are ISO 9002 and BS5750 registered and use Statistical Process Control.

Some customers require a special finish to parts so we operate rack zinc plating, barrel zinc plating, electrolyses nickel plating, black oxidisation, zinc phosphating, anodising and chromate conversion coating of aluminium finishing.

**How many permanent and casual employees do you have?**

We don't use casual labour. Our eighty five staff are 20 management, quality control, and administration. Forty five are skilled workers and twenty semi-skilled.

**Do you operate a participative or top-down employer model?**

I would say participative. We encourage new ideas and team working. When people take responsibility for their own work, you have to listen to them when they have ideas.

**Describe the teams or cellular manufacturing you use?**

Our machining centres are grouped in cells for automatic loading and feeding. By and large staff work in regular teams for particular customers.

**Do you employees feel a mutual obligation to you?**
Yes, the old conflict situation is past. I feel an obligation to them, and they do to me.

**How do you recruit and improve ‘quality’ employees?**

It is becoming almost impossible to recruit good engineers. The time that we have been in business we have seen a difference every year. Engineering has changed in Scotland. If you take 30 years ago, Scotland was famous for heavy engineering, now it is light engineering.

I started a couple of lads from Cummins [a recent factory closure in Lanarkshire]. No disrespect to them, they were time served engineers, but we are having to re-train them. A set-up to one of these guys was basically changing the size of a tube in a horizontal machining centre, maybe to reduce from a 4 inch con-rod to a 3 inch con-rod. That was a set-up to them. Whereas if I hand a drawing to a guy saying make me that [showing milled car component], I need him able to do it. We are picking up people, but it is taking us a lot of time and costing us a lot of money.

Young people want to design or market - they don't want to make things. Most kids at school have got computers at home, and I think they have got into their head, that working on a computer is playing games. My one kids included. They want to play with computers rather than make things.

Also people don’t train apprentices. We try to take on a couple of apprentices every year. It is even difficult getting apprentices. We may interview six or seven each year, and it is amazing that people sometimes don’t even turn up. Or they will come along and say, “I've got another job.”

Another thing that amazes me, is when you speak to some of these boys or girls and you ask them if they know what a centre lathe is, or a milling machine or a micrometer - they don’t know. I can’t believe that all these youngsters are not even getting the chance of using a micrometer at school.

This is a difficult time for any young person considering what they want to be when they leave school. Most don’t know.

**What motivates your workforce?**

People like to earn decent wages with security. Also they like to work in a company that looks ahead and invests in the latest equipment.

**Can you describe how the culture of your firm corresponds with the social culture in West Lothian?**
I was born and brought up in West Lothian, so are 95% of our staff. Yes we are a West Lothian company - we aren’t afraid to make things.

**What is your annual turnover, annual profit, and profit margin?**

**What strategic opportunities for innovation and technological change do you face?**

We can double our turnover machining and finishing parts. If we want to quadruple our turnover we have to move into sub-assembly. This would be a big jump for us because that’s not our expertise.

**What constraints do you face in taking advantage of these strategic opportunities?**

I suppose money and competition. Money to invest in the equipment and trained labour, and the competition - it’s really cut-throat.

**INTERNAL KNOWLEDGE GENERATION**

**What staff, budgets and time do you allocate to product research, development, and product design?**

We do not do research and development.

**Can you give an example of how and why a process innovation has occurred?**

For new machine technological, myself and the Production Director take decisions. I visit a lot of machine tool exhibitions. They rotate around Europe. Also the type of machines that we have bought over the years, if a new model comes out the agents are the first to come along and offer a demonstration and purchase deal. We buy a lot of modern machines. Machines change each year, but there is not as drastic a change from model to model as what there was going from a centre lathe with handles to a CNC lathe with buttons. We keep well up to date with the machinery we use in our processes.

It is the same with tooling. We have the tooling guys here on a regular basis saying here is a new tool, do you want to try it. Tooling has changed quite a bit.
Does process innovation arise from a planned and conscious strategy or respond to events and opportunities?

I would say we pride ourselves on staying up with technology, but concentrate on areas where we can sell more parts.

Has information technology stimulated process innovation?

Not really, but our administrative systems are all computerised.

Do you operate a ‘design-for-manufacture’ system in product innovation?

Always, we advise customers on materials and designs if they come up with something which we think could be improved upon.

How influential is your marketing expertise in product innovation?

It has an influence. That's why we introduced our finishing lines - to widen our appeal in the market.

Have your suppliers stimulated innovation of product or process?

Yes in machines and tooling. But products are brought to us as part of a customer design for their product, we only change them at the margins.

Have your customers stimulated innovation of product or process?

Customers keep us on our toes watching our margins. As I say, customer pressure brought about our move into finishing.

What motivates product and process innovation for this company?

I would say growth. We have heavy overheads. Only in the last few years have we been seriously profitable. When we have doubled our turnover to £10 m then we will be highly profitable, with nearly the same overhead base.

NON-CUSTOMER KNOWLEDGE TRANSFERS

Can you give an example of how this company gets knowledge which may stimulate innovation from: big companies contacts
higher education contacts SE, LIS, LEEL, The Business Shop, marketing agencies, financial bodies, trade associations, Competitors, scanning the environment of your business, other outside bodies.

I would say definitely yes. The Scottish Enterprise (thought I stopped going to the meetings, because we were involved with our extension - I don’t get involved with these sorts of things as much as I probably should) involved us in their supplier development scheme. They used to use us like a showroom, if there was any inward investors they always came round our place. And they asked me to go on this supplier development scheme way back at the beginning, basically as a guinea pig, and I didn’t want to do it because at that point we were actually looking at moving in here [1989], we were trying to get BS 5750 - we had a lot on the go. When we moved into this factory, it was ‘sods law’ we went into a recession. There is nothing worse. You spend a lot of money, you commit yourself, and all of a sudden you have no work. I thought what’s happening, am I doing something wrong. So I spoke to SE and went on their supplier development scheme. At the end of the day I don’t think they told us anything that we really didn’t know. What was involved - they got consultants in here to do our strengths and weakness. These consultants only knew our strengths and weakness because of what we told them. The one good thing they did do, they wrote it down in a report. So it was there for us to look at - it didn’t go away. Whereas we knew our strengths and weaknesses but it was all in our head, we didn’t have a plan written down or anything like that. So it probably took longer to implement changes.

The knowledge we got from this exercise has helped us. It’s hard to point to one thing in particular. They used to come and discuss. I used to spend all our money on new lathes, let’s get new production equipment. They used to hammer me: you must build up your office team, your management team, computers. I must admit I am frightened from computers to a certain extent: I have always been and always will be I suppose. But we are in a world now where you can’t live without them.

The service side of the business is just as important as the manufacturing. I think we did well from Scottish Enterprise. We also received quite a lot of government grants, over the years. I think this is necessary for any young company. I don’t think it is right that only the Korean companies get the big grants. We got some grant help to extend this factory, but since then we have had a quiet year. Things are picking up again now. Unfortunately, we didn’t have the required jobs growth I thought we would have. I probably over-estimated the amount of people we would require. Because things went quiet we didn’t require them. Because of the state of the market you can’t find them. And also machines are changing to become less labour intensive. So
I have a wee problem. I have spoken to the grants people, and they seem happy to delay it.

We have had a good track record. We have been a very busy company. You obviously have your ups and downs.

CUSTOMER KNOWLEDGE TRANSFER

Can you give an example of customers making suggestions which have improved your products and/or your processes?

We only have six main customers. Most of them want delivery direct to their production lines.

We learn a lot of our customers. And I would like to think that some customers learn a lot from ourselves. When we are looking at a new project. Yes loyalty is important, once you have built up a relationship with a customer they do want you to continue being a supplier. Because at the end of the day you might be the best of a bad lot. Although they still tighten up on prices every year. But if a customer is coming along and saying ‘We are looking at this project, but it won’t happen for two years,’ we are now talking to people on this basis. Right now I am going through an exercise with a company in Switzerland, to do a part that won’t start in production for at least eighteen month.

How often does this happen, and how welcome are such suggestions?

With every customer, to a certain extent this happens. But on turned parts you are quite limited. Every customer will say to us, we want you involved at the prototype stage, is this a problem. I don’t think that’s as critical on machined components as it is on the likes of sheet metal. A customer might design a part on sheet metal, and it might be impossible to produce or very expensive to produce. Our customers come along and say, there’s a drawing, can you quote a price, and have a look at it. I will go back and say, there is a tight tolerance on it is that really required, or has someone been overactive in designing it. They do tend to change designs. I would say that we are involved with all of our customers like this. Every customer is willing to listen to you. If you go back with a proposition, and say, I can save you money by such-and-such. The only problem is big customers usually cannot make a decision overnight. Because they have put in a lot of research and development, they have run trials on a part, as is, so for them to make a change can take a long time. You are not talking about weeks, it can be a year down the line. So sometimes changing a part may not be cost effective,
although they would be getting a cost reduction, this has to be off-set against the cost of running trials again.

**How have customers transferred their knowledge into your company: staff transfer, financial help, joint RD&D, equipment loan, worker-worker liaison, other ways?**

Certainly worker to worker liaison. We try to keep our staff in customer product groups, so the customer knows and can deal with the group on their product. We have not had financial help or equipment loans from customers.

**Why have customers transferred their knowledge into your company: crisis in your relationship with the customer, arising from the type of relations with customer e.g. vendor rating, a continuous improvement relationship with a customer?**

All of our customers use vendor rating schemes, that's why Statistical Process Control is so important to us internally. Sure, when there is a crisis we all learn things.

**How much easier is it to know what the final user of products wants, than to know what an intermediate customer wants?**

I see no difference, for us the final user is our customer, that's who we have to satisfy.

**LEARNING ORGANISATION FEATURES**

**Is this a ‘learning organisation’ - constantly generating, accumulating and socialising knowledge?**

I would like to think we are learning every day. For example, I had a young lad leave here about six years ago, and he was a good operator - quite an ambitious lad. He said to me, is there any chance I will get a Foreman or Managers job. I said there was no guarantee, especially in a small company. He said that the challenge had gone out of his work, and claimed that he 'knew it all.' He genuinely thought that he did know it all. Now I have been in engineering for 37 years, and I am still learning.

We don't tend to use many outside sources for training. If we have a new machine coming in we will send people on a course if necessary. We also have a full time training instructor - mainly for teaching people on machines, and teaching apprentices. Any new ideas and new skills are rapidly passed around.
Appendix Two:  
Empirical Data From Indigenous Companies

A ‘learning organisation’ actively seeks out new knowledge and ways of doing things; can you give an example of this culture in your company?

I constantly visit our customers and scan about for new parts we could produce. We get involved with each of them in prototyping and feed back our best thoughts on their product development. As I say on the process side we try to keep up with the times. We introduced finishing lines, to compliment our products and give the customers what they were asking for. Every year we buy new machines to keep up with technological changes.

It is suggested that a ‘learning organisation’ has leadership rather than management. Leadership constantly challenges the knowledge base of the organisation. Does this distinction make sense to you?

I was born and brought up two miles from here, and I am proud to look at what I have built up at Deans Engineering. You’re right, building a company is not just about managing internal matters, it’s about seeing how markets are going and staying ahead.

Who acts as a ‘gate keeper’ assessing how valid outside knowledge could be? Who effectively takes the decision/risk on technology changes in this company? How are these decisions taken?

I take the decisions - for better or worse. We have no external money in Deans Engineering, no external Directors. It’s all up to me.

How effective are two-way communications within this company?

I would say very good. I spend a lot of my time talking to and listening to staff. Everyone here knows that we are wide open to new ideas. Within the machine cells I would say that a lot of improvements are made without reference to management.

Do you use project teams to implement product and process innovation?

All the time. Each product goes to a team and they decide how best to produce it. The same with new machines - people here want to keep up with the times.
Does this company actively socialise knowledge? By what means?

If we buy in a new machine that includes drastic changes, the supplier will run courses; be it at our place, their place, or the manufacturers. We send people on these courses. If it is a new machine, with only slight changes, our Training Officer ensures that everyone is brought up to speed.

We encourage people in the plant to spend time talking about different jobs and machines and opportunities.

Training is an on-going thing. Even time-served people who have worked with us for fifteen years still require training. Our Training Instructor aims to enable every skilled employee to be able to fully operate every machine. This, of course gives us flexibility to move people around - either at their request or ours. People pick up new things in different time scales - we have to allow for these variations. Age comes into this as well.

New parts sometimes mean that operators have to work together to put the work through - we have a job like this in the factory at the moment; people pool their skills to get things done.

We run two grades of semi-skilled. Those working within the cell, who become trained on a limited range of machinery, then we have semi-skilled people that de-burr or move work about.

SUPPLY CHAIN CONNECTIONS ALONG SUPPLY & VALUE CHAINS

What is the scope of your supply chain in terms of geography, technology and value of procurement budget?

We learn from our supply chain, but perhaps not as much as from our customers. Because we are ISO 9000 approved, we seek registered suppliers. Again, it is not just as highly critical to ourselves as it is to our customers. Our customers are buying in a finished, precision made component. Whereas our suppliers bring us raw materials. The raw material has to be correct, but there is more lee-way in our supply chain than the products we sell.

What percentage and amount of your turnover is value-added?
Do you regard your suppliers as partners? Give an example.

Not as much as customers. We work closely with Citizen [Japanese machine tool manufacturer] who supply most of our machines. We try to get our bar steel suppliers to improve things - but we are such a small player.

Explain the type of trading relationships from your questionnaire answers.

For raw materials we use a small group of suppliers, depending on price and delivery time and quantity options.

Are these inter-organisational or inter-personal relationships?

We know the people, but the relationships with our suppliers are more business than with our customers. There we really know the people, and they know the individual staff in here.

Are you part of the tiering of a supply chain to an OEM?

We supply a lot of components to engineering companies who are doing sub-assemblies for OEMs. Lucas is a good example. They do the assembly of parts from a range of parts, plastic mouldings and sheet metal companies like ourselves. We also produce some sub-assemblies ourselves.

Is your own sourcing policy: single sourcing, multi-sourcing, competitive sourcing or spot sourcing? Which is your preference?

Spot sourcing for raw materials, and single sourcing for machinery.

Do you actively transfer knowledge backwards along your supply chain by transferring technical information to suppliers.

We try but materials suppliers regard us as small fish, it is very difficult to get them to change their ways. But it’s slowly happening.

Do you actively transfer knowledge backwards along your supply chain by involvement in business strategy changes of your suppliers.

No.
Appendix Two:
Empirical Data From Indigenous Companies

What routes do you use to transfer knowledge to you suppliers e.g. staff loan, joint development, equipment loan, financial support.

None of this. We talk to them, and try to persuade them to meet price, delivery time and quality standards that give us a chance with our customers.

What is your aim in improving the knowledge base of your suppliers e.g. to improve price, delivery time, product quality.

All of these are equal. The days are gone when you could compete in the market on any one of these alone.

Would you say that your suppliers have a similar commitment to continuous improvement as yourself, or not? Give examples.

No. For example another company who we failed to hit it off with is Okai in Cumbernauld. We did a lot of work for them, through Scottish Enterprise. We did a lot of samples. Early samples were rejected, later ones they said, “You’re just about there.” Eventually we got their approval. One part was 7 mm square bar. The Japanese shook their head when they saw our samples. Off my own back, at my own expense I want to Japan along with one of our machinery suppliers. We looked at various machines. We then went to a sub-contractors in Citizen’s factory, supplying these shafts to Okai and other companies. The 7 mm bar they got delivered looked like precision engineered work. They would not let me take pictures. They said they had to work with their supplier for 18 months to get the bar coming in that condition. They gave me some off-cuts. I brought these back, and then spoke to our materials supplier. He said, “Get on your bike.” He said they met British Standard and were not going beyond it. We are too small an operator to make them change. He has changed since. We ended up doing one component for Okai. Unfortunately this component was electro-plated and at that time, we hadn’t opened our finishing shop. Every time we made a delivery it was late, because of our plating sub-contractor. In the end we parted company with Okai. Now we have the experience and capability to do parts for Okai - then we didn’t. Our suppliers haven’t learned as fast as we have, that to stay in business you have to give the customer what he wants.

Do you actively transfer knowledge forwards along your value chain by transferring technical information and suggestions to customers.

Quality has a cost. For example, we have a very good working relationship with NCR. If you make a mistake, which we all do, then it's important because we are approved to supply direct to their line. Any mistake has to be
responded to immediately. They are looking for parts immediately. NCR will try to use parts which have a problem - most customers are like that. Lucas is slightly different, because the components we supply are for fuel injection systems - they have to be spot on.

Do you actively transfer knowledge forwards along your value chain by any involvement in business strategy changes of your customers.

Yes in prototyping and advising on product development.

What routes do your customers use to transfer knowledge to you e.g. staff loan, joint development, equipment loan, financial support.

You could say joint development, but it is really us pitching in on what to them is a small part of their product development. But still this is important. We don't have these Japanese sort of inter-relationships with our customers.

What are your customers aims in improving the knowledge base of your company e.g. to improve price, delivery time, product quality.

I sometimes think we have the most demanding customers in the world.

Would you say that your customers have a similar commitment to continuous improvement as yourself, or not? Give examples.

Their commitment to continuous improvement is clear: Lucas, NCR and Unisys aren't standing still, and we have to move with them.

FOREIGN DIRECT INVESTOR TRADING

What allows you to successfully trade with major inward investors, or alternatively prevents you from doing so?

We used to do quite a lot of work with Seiko in West Lothian, up to about ten months ago, then their products just disappeared. Where we used to supply an average of 4,000 components a week we are supplying 3,000 every three months now. They say there is a possibility that this work will come back. I really don't know.

Price is a key factor with inward investors. I did a big exercise with Mitsubishi along with Scottish Enterprise. They approached us and asked if we would
set up to machine the drums. The drums are the most critical part of the video they produce. At that point I had actually been in Mitsubishi's factories in Japan twice. I had seen the drums, and knew what was expected from us. They approached us, and I must admit this was a good ego booster. Right away figures started to come into my head. I reckoned it would have cost about £10 and £12 million to set up to produce these parts. We had various different meetings with them, Scottish Enterprise, myself and Nakamura [Livingston, Mitsubishi MD]. At the end of the day I had to say, thanks, but no thanks. We looked at various aspects of the thing. Who was buying the machinery, joint venture, leasing - that kind of thing. Then, through the grape-vine I was approached by a company down south to join a joint venture for the same work. Mitsubishi had never heard of this company. It seemed that this company had heard of Mitsubishi's needs. I asked them what would happen if Deans declined their offer. They stated they would do it themselves. Since then I have met this guy from down south. He has started the first phase and invested £5m without getting an order. AT that time, the really tricky bit, was price. Mitsubishi were happy with our set up and standards.

Mitsubishi said that because we had put so much effort into the drums they would offer us other work. They gave me this package to have a look at. I worked out a realistic price. Remember we were buying the latest equipment. One of the parts from Mitsubishi in particular I quoted 50p each. They asked for a cost break-down. During discussion I broke the price down into materials, labour etc. Mitsubishi showed the same part broken down in cost from Japan at 17p. I couldn't believe it. The profit the Japanese supplier took was 0.005% - half of a percent. I said to him, we are using the best machinery and couldn't match 17p, what machinery is the Japanese supplier using a very old machine. I pointed out that with these margins there was no scope for re-investment in new tools and machinery. Mitsubishi replied that the Japanese supplier would not need to buy new machinery, another old machine would do the job perfectly well. This Japanese supplier was probably a father and son, with a machine in the basement of their house. A few years after that, a new buyer started at Mitsubishi and he phoned me up and said I would like to look over some drawings for me - he wanted to locally source the parts. These were the same parts: we just laughed about it.

I was down at Mitsubishi two years ago on a Scottish Enterprise visit, trying to spot parts that could be locally manufactured. They had a map of the world showing their sourcing. They claimed to locally source 90% of components. Local sourcing was anything outside of Japan! Although they were talking about local sourcing, they mean something very different by it.

I have been in Japan five times studying their techniques. These visits are well worthwhile. Two visits were with Scottish Enterprise. With them we
were seeing the really upmarket sub-contractors, that might only have had one customer. There was one who worked for Canon 100%. Some of their machines are the same which we use - but they cost half the price in Japan. I was also in the more typical sub-contractors in Japan, small family run businesses. They have good set-ups, but not as upmarket - swarf and oil lying everywhere. But they were producing good product. There are few people in the UK who can compete against these people.

How do you weigh the potential advantages and disadvantages of becoming a preferred supplier to an inward investing OEM?

This is not a choice for us. To be competitive we need large runs, and they only come from big companies. I know what you are getting at - becoming a dependent supplier. There are dangers in this. But there are greater dangers in not getting work in.

How aware are you of FDI sourcing outwith West Lothian which you believe your company could successfully meet?

I am sure this happens all the time.

Is this company prepared to improve its capabilities to meet FDI supply chain requirements? What would you be prepared to do?

We have undertaken a £2.5 million investment programme on the finishing side to meet customer requests. We hope it will significantly increase the value of the work we do for our customers.

Is trading with FDIs for some reason only a limited part of this company’s growth strategy? If so why? If not - how broad a location of FDIs do you consider your potential market?

No. Nearly 100% of what we do is with big companies including Lucas.

Local FDIs are considered to be ‘world-class’ manufacturers, how important is it that this company learns from their best practice?

The big companies we deal with are not in West Lothian. WE have learned a lot from Lucas. Take parts for a fuel injection systems. Everyone wants parts that are burr-free. But for Lucas a one micron burr can cause problems. Lucas have hammered us. Five years ago I thought, "My God, we'll never please these people." Even operators took a lot of training on their quality systems. Six months ago, I got a fax in from Lucas saying that they were returning a weekly supply of 5,500 parts for their actuator box. We have to educate our operators. So I went to see our operator. I told him about the
fax, explaining that Lucas had failed one part and were talking about returning the lot. Our operator said, “What one out of all of these thousands.” I had to explain that this was potentially 100% for the one Lucas customer getting the defective actuator. It could be Volvo or Caterpillar, who may decide to recall months worth of output. It’s just the same as a surgeon - he can’t just go to the store and get another part - it has to be right first time.

We have been pushed a lot by Lucas, but NCR is perhaps the company from which we have learned most. We have dealt with NCR for 18 years. They have educated us in a big way. If you think at that time, we were a three person company. Inspection was gauging one in 10,000.

We helped educated NCR in how to run machines. We have automatic feed bar loading machines. On one occasion they came down on a visit. Their Production Manager, Foreman and Operators came down here. They were gob-smacked. They arrived at lunch-time, and everybody was in the canteen having lunch. One of their operators confessed they switched off the machines during the breaks at NCR. Now, we switch machines off, if the component can’t be ram-fed, or is likely to smash up or collect swarf. They learned from us. All major companies have their in-house policies on the cost of parts production. I think they are all false. NCR is not in the market to make margins from machining components, they make money from assembling cash dispensers. A lot of their internal machining costs get lost. People like ourselves, who are specialists, can always produce parts cheaper than the major assembly companies. They realise this more and more.

Working in supply-chain partnership may mean allowing an OEM to influence investment, product development and training strategies. How would this company balance this against organisational independence?

You can’t operate in a vacuum. We have to buy machines that keep up with the times, train our staff on them, use the Statistical Process Controls customers want. If you lose touch with your customers, you’re out of business.

Developing a long-term supply chain partnership may involve investing a lot of personal time to build up trust. It this your experience? Would you be prepared for such an investment.

I spend a lot of time talking with out customers. They need to know that any problem they have I will deal with, not leave it on the back-burner or to someone else. Gaining trust means that when things go wrong, they know we will do what-ever to put it right.
If developing a long-term supply relationship necessitated a large financial investment, would you be prepared to seek external funding to finance it?

At Deans we have been happy to re-invest in machines and process equipment. We have had grant support and support from our bank. But I would be reluctant to bring in outside financiers who don't know our business, but would want a say.

Why can West Lothian owned manufacturers export so successfully, but trade so little with inward investors?

You would have to ask the inward investors and the local manufacturers. The prices some of these foreign companies are looking for are very competitive.

LOCAL NETWORK

Knowledge networks may stimulate innovation, improving competitive-ness. Are you part of one?

Deans Engineering is now a major precision parts supplier, we have one of the best set-ups in the UK. There is always knowledge which you can spin-off from other people. I have allowed Scottish Enterprise to bring 36 companies in here, answering questions on how we got where we are, our systems. For Scotland this is quite good. But I had two reasons for not continuing this after a couple of years. Firstly, SE changed to a consultancy operating down south from one in Scotland. I thought, why should I help SE with local sourcing initiatives, when they are using a consultancy from down south.

Is a knowledge network amongst West Lothian-owned manufacturers an achievable goal?

It is easier to work with people who are not in competition. Eraba competes somewhat, but in my view they are not in the same league as us. PES along the road are in competition, and they are giving us some pain by stealing employees from us. I know the consultant they are using to head-hunt. The thing is there are people unemployed who could do what PES want. They operate three shifts, and the shift allowance is £500 a year above what we pay for two shifts.
Who would be the participants in a knowledge network of most use to your company?

We allow some small companies to benchmark against us. But you have got to be cautious. Everyone is trying to cut each other’s throat. You learn from talking to each other, particularly at an informal level. One company through the west we are very friendly with, in some ways we are in direct competition. But we exchange a lot of information. A local company, still in Livingston approached me some years ago wanting information about what machines to buy. It later came out he wanted to tender for our work at Unisys. In fact I did help him, and pointed out what machinery he should buy. But he bought a useless machine.

Which organisation(s) should have the responsibility to further develop a West Lothian manufacturing knowledge network?

If the Council or Scottish Enterprise set up something serious I would participate. We have learned a lot in the past from these things.

PUBLIC POLICY SUGGESTIONS

What could the local authority or the government do to improve the institutional framework facing West Lothian-owned manufacturers?

We have had a lot of help. It is unfair that inward investors get more help than locally owned companies. Also, if local sourcing is a political policy, it should involve local businesses - the bureaucrats don’t know what they’re doing. Now the Japanese are bringing over their own supplying companies and they are getting government support. It would be better to support UK companies such as ourselves to do this work.

How adequate are West Lothian training providers for your purposes?

We do our own training, or use machinery suppliers.

Is the information you put into, and receive from the labour market in West Lothian satisfactory?

Information is not the problem. The problem is that too few young people want to come into engineering as a career. Perceptions of engineering in the schools have to alter.
Matt Snodgross is the Chief Executive of Diagnostic Instruments Ltd., and was interviewed at the company premises in Livingston on Wednesday, 3rd November, 1996.

Diagnostic Instruments is located in the prestigious Michaelson Square of Kirkton Campus in Livingston amidst a range of growth hi-tech companies and next to Bull. The workplace is bright and open, a clean and stimulating environment for creative work.

**COMPANY PROFILE**

*What are your products and your output profile?*

Our product range is portable noise and vibration measuring instruments which are used in separate market niches. There are three market niches: one is signal analysis - general purpose, second is condition monitoring, and third is production test markets i.e. production producing goods and we are testing the noise and vibration as an indication of product quality at the end of the line.

*Who are your customers? Describe a typical customer.*

Seventy percent of our product is exported. A typical customer will be a foreign manufacturer in their home base, or a North Sea Oil rig.

*Who are your competition? How intense is competition?*

In each of our markets we have different competition. In signal analysis most of the competition comes from Japan. In condition monitoring market most of the competition come from the USA. And in production test we have yet to see any strong competition.

*What is your strategy for this business?*

Our strategy is to use our noise and vibration expertise to penetration niche markets on a world-wide basis to grow the company so that we become a substantial size in five years. We are a design and manufacturing organisation.

*Can you describe the management structure?*

Our management structure has four executive Directors and two non-executive Directors. The non-executive Directors include an accountant: who
has set up all of our financial systems, and he comes in one day a week, really just to monitor and make sure that everything is going OK. This runs like clock-work. We don’t have a full time accountant. The second non-executive Director is our Chairman, who represents the institutional shareholders (3i and Scottish Enterprise), he basically makes sure we are doing the right things strategically to growing the company. Our four executive Directors include myself. We have an Operations Director, a Marketing Director and an Engineering Director, myself makes the four.

**With what systems is work organised?**

Our systems are very much IT based. We are a very computer literate company. All our computers are networked together. We have computerised accounts system, we have computerised production system including test. Without the computer we would not be in existence. So essentially our systems are all inter-linked via computers. That is our main system of operation.

**What are the main processes you use?**

We design, de-bug and test signal analysis, condition monitoring and production testing equipment. In the main our work is design and testing, our manufacturing is out-sourced.

**What range of technology is employed?**

Our technology includes hardware design which is micro-processor based instrumentation, so you get data acquisition, signal processing all that type of thing. But 80% of the design of our portable instruments is usually in the embedded software - that is the big thing which takes up a lot of time. We combine hardware and software - you can’t have one without the other. There are very few companies in the world who make portable instruments like us for these markets. There are a lot of people who make software for these markets but hardware is much more difficult. The combination of the two is very much more difficult.

**How many permanent and casual employees do you have?**

We employ 33 people all full time.

**Do you operate a participative or top-down employer model?**

This is an extremely interactive workforce, there is no top-down here.

**How is employment structured?**
Effectively design, marketing, testing and administration form teams, but all interact much of the time.

Describe the teams or cellular manufacturing you use?

The sharp end of this company is basically sales, marketing and engineering. We have product managers for each of the product lines who actually sit with the engineers to make up core teams for particular market areas. So the engineers get to know a lot about the markets and the product managers who are doing the marketing get to know a lot about engineering problems. And sitting together helps in that process. There is a lot of fluidity in our structures.

Do you employees feel a mutual obligation to you?

To me, the company and to each other. That’s the only way to move forward.

How do you recruit and improve ‘quality’ employees?

It varies with the level of employee. We allow a lot freedom to decide on employees. At the lower levels, for example, the departmental manager and the people within the department will actually choose people at the lower levels. Where we are looking for a senior person, then we involve the senior people. There the technique we use is a structured interview, with two people. One will observe and the other will ask pre-set questions. The observer will write down answers. We find that works extremely well for us. For more qualified employees, although there is a tremendous base of talent in Scotland, we usually advertise in Scotland first, some of our employees come from the south. More often than not they are Scottish ex-patriots who want to come back to Scotland.

What motivates your workforce?

Quality of life, job security, being in a company that is going somewhere, the challenge of the work.

Price, Quality, Time, Kaizen scoring explanation from questionnaire.

Quality and continuous improvement are by far more sensitive for us than price or delivery time - these are not unimportant, but less so.

Can you describe how the culture of your firm corresponds with the social culture in West Lothian?
This is difficult, because it is difficult to know what a West Lothian company is. We are based in West Lothian. I would say we are a global company - because our customers are right round the world - we export 70% our output. We are West Lothian in that we are located here, and most of our employees live here.

**What is your annual turnover and profit margin?**

We turnover nearly £5 million a year. Profits last year dipped because of a law suit in the USA, but normally are OK.

**What strategic opportunities for innovation and technological change do you face?**

Our technological opportunities are in products rather than processes. There is an awakening in the markets we are involved in to the power of using electronic signal analysis into the mechanical world. The market is virtually untapped and we can see tremendous opportunity for growing the company in these technological gaps in which we operate. Our product enhances the process capability of our customers. An example is condition monitoring on a North Sea Oil rig, they will predict when a machine is going to fail, so they can plan its outage, change the bearing or whatever, and it means less disruption to the process.

We sub-contract all of our product assembly to a Fife company, and we bring the product in here for testing, de-bugging. What we do in here are the difficult ends of the production process. The relatively straightforward part which is the procurement of the material and the assembly of the products is easily done outside. We never intend to bring that in-house, because this way we have so much flexibility doing it outside.

**What constraints do you face in taking advantage of these strategic opportunities?**

Partly finance. But finance to open up new areas of customers. We could do with an office in the US to sell our products and identify new ranges of products. Partly also, we can only move in production testing at the rate at which our products become acceptable to use in industry.

**INTERNAL KNOWLEDGE GENERATION**

What staff, budgets and time do you allocate to product research, development, and product design?
Quite a large chunk. We have about...........when you look at the sales-
marketing people, the people involved in engineering and the engineers
themselves: we have probably got about ten people out of 27 involved in new
products and new product development.

Can you give an example of how and why a process innovation
has occurred?

CAD and our new IT system which links all our PCs has been a major step
forward for us. It makes sharing ideas and testing out ideas far easier. This
has been our most significant process innovation in the last few years. Of
course we are constantly upgrading other aspects of the process. De-
bugging complicated eight layer PCBs is time-consuming - we have to make
sure that what we learn from one job is passed on to the next.

Does process innovation arise from a planned and conscious
strategy or respond to events and opportunities?

The investment to upgrade our IT was a conscious strategy. In everything we
do we have to combine technical knowledge with commerciality, so I
suppose that is responding to opportunities.

Do you operate a ‘design-for-manufacture’ system in product
innovation?

Design for manufacture is critical to us. Not only because we use sub-
contractors, design for manufacture is important - that why we have
sophisticated drawing packages.

How influential is your marketing expertise in product
innovation?

It is critical. We don't really do research. We design products for markets we
have identified.

Have your suppliers stimulated innovation of product or process?
Have your customers stimulated innovation of product or
process?

Ideas for product development are much more likely to come from the
customer side of our value chain than the supplier side. The customers are
key.

What motivates product and process innovation for this
company?
We want to grow and become a global company.

NON-CUSTOMER KNOWLEDGE TRANSFERS

Can you give an example of how this company gets knowledge which may stimulate innovation from: big companies contacts higher education contacts SE, LIS, LEEL, The Business Shop, marketing agencies, financial bodies, trade associations, Competitors, scanning the environment of your business, other outside bodies.

We have carried out projects with Caledonian University, we are discussing with Edinburgh University. For example, one of the projects we have finished with Glasgow Caledonian University is to look at production test systems at the Black and Decker, Spennymoor factory where they are putting through 13,000,000 products a year on various production lines. They want to test various parts. To first of all look at the cutting of gears, and tool wear. We have spent three years on these. The second thing was to look at the quality of drills coming out of the end of the line - and how you could measure that and replace a subjective test (someone listening to the drill) with an objective test. Thirdly, was the condition monitoring of the machine tools and the factory equipment which required three shift operation, so reliability was important.

I think the problem with working with academics is that they tend to go into an academic exercise without thinking of the commercial outcome. That is a problem. It is up to us to think of the commercial outcome and really drive it from that perspective.

We had another potential project with the University of Manchester which actually we stopped just in time. It was to do with tibia testing. The tibia is your leg and when you break it, we have a technique were you can check the strength of the leg. They wanted to carry out tests to prove the technique over a large number of patients and that was a three year project, which would cost us quite a lot of money - £40,000 plus a lot of time. We were not convinced that the market was there, so we commissioned a local market research company. They came back and said, “There is no market here, you won’t sell anything.” So we stopped the project. There is a problem with working with academics and universities that they don’t understand the commercial realities of why we want to do it.

CUSTOMER KNOWLEDGE TRANSFER
Can you give an example of customers making suggestions which have improved your products and/or your processes?

There are many examples of customers stimulating our product development. A classic example from a few years ago........We started the company in 1987, our first product was the general purpose analyser. We had conceived at the origination of the company that we would want to go into other market areas; one of these was condition monitoring. All our units, all our products are designed to be adaptable for these different market areas by changing software and perhaps a little hardware - they are modular. However, when we looked at condition monitoring markets we did not know where our competitive advantage would be. We looked at the competition, they were all going for high-spec products. This is something anybody else can do. We really didn’t know where to go. We thought this may not be worth while doing, because we are just going to come in with a medium product, into a market, which although it is expanding, but we will not be able to compete. We don’t have USPs. So what we did was look about, and spoke to a hell of a lot of customers who were already using the American equipment. Low and behold we found actually a consistent message: the American equipment was quite complicated to use, it had far to much “specs-man-ship,” and customers would like something simpler to use and some features making it easier for them to use. These were the features we focused into with our first product into that market which we launched in 1989. That product today is recognised as one of the easiest to use in the market, and we have sold quite a lot of them as a result. We have continued that into the second generation which we are selling lots of now.

HP is something of a model for us. They are in much bigger market areas, and they tend to go and sit with the customer. Perhaps one customer who has got say £1 million worth of requirements and they will design a product for him, and hope it will sell to other customers. We don’t have so many of these big customers, so it is difficult to emulate that. What we do encourage is engineers to go out and talk to customers. It is not just marketing-sales guys that go and talk to customers, we have got production people who go out and talk to customers. Everybody in the company in fact really needs to talk to customers at some point in the year. We encourage that. For example, we have our Analyser Road-show, every month we have a location in the UK where we have a seminar, on a day and we basically teach what our analysers will do, to people who don’t really understand the techniques and what-not. This has been very successful. The local ones - we have them in Glasgow regularly - we get a big chunk of employees here going through to meet the customers and to experience the seminar as well. So they go away for the day and go to that. That I think helps our employees understand what the customer is doing. It is not just...........the engineers we will get out
and see the customers much more. But everyone must meet customers and see what customers think.

**How often does this happen, and how welcome are such suggestions?**

It happens continually, and all suggestions are welcome, though not all are implemented.

**How have customers transferred their knowledge into your company: staff transfer, financial help, joint RD&D, equipment loan, worker-worker liaison, other ways?**

Mainly by our people talking to customers. Our people may take equipment or models out to try for a customer, but in the main we analyse the customers problems and recommend solutions or design solutions.

**Why have customers transferred their knowledge into your company: crisis in your relationship with the customer, arising from the type of relations with customer e.g. vendor rating, a continuous improvement relationship with a customer?**

No, none of these.

**How much easier is it to know what the final user of products wants, than to know what an intermediate customer wants?**

Always. We deal with agents, for example in the US. But you only get feedback when you are dealing with the final user.

**LEARNING ORGANISATION FEATURES**

Is this a ‘learning organisation’ - constantly generating, accumulating and socialising knowledge?

I think we are a learning organisation. But I think because of the change in market requirements you can’t over-do the learning process.

A ‘learning organisation’ actively seeks out new knowledge and ways of doing things; can you give an example of this culture in your company?

I think we really need to do a lot more of learning. Because change is consistent, and you have got to continually change the way you operate. The
only way you can change without causing confusion and so on, is to learn new ways of doing things. So the learning thing has got to be inherent in the whole company.

It is suggested that a ‘learning organisation’ has leadership rather than management. Leadership constantly challenges the knowledge base of the organisation. Does this distinction make sense to you?

Sometimes I wonder. We have had a few problems over the last year which have impacted upon our leadership and vision. We had a legal challenge against us in the States in the last financial year which wiped out all our profits. Its all gone now. But I think we lost a bit of our vision during this episode and we’re now trying to re-establish it.

Can you give examples of how the following act as constraints on your company being a learning organisation: your financial structure or financial healthiness, the time-scales in which competition forces you to operate, the risks involved in continuous change and improvement, your business environment, the knowledge base of your employees, the skills and capabilities within your company

I would say our necessity to run at a profit limits the risks we can take. It would be foolish to bet everything on one throw of the dice.

How do you ‘scan’ for new knowledge of products?

Really, its simple - we listen to our customers.

How do you ‘scan’ for new knowledge of marketing opportunities?

What we are trying to do at the moment is focus into two of the markets we are in. Historically we have tried to use the same organisation to cover all three markets, we are trying to remove the confusions this can create and put individuals in charge of each product market. There are two specific markets we want to focus in to - this may eventually result in a divisionalisation, and separate companies, but that’s a long way down the line.

Who acts as a ‘gate keeper’ assessing how valid outside knowledge could be?

This tends to be a consensus although the engineering manager will lead that. Our PRBs [product review boards] meet once every month, and we talk
about how products are going and the dynamics of the technology - that’s where ideas will be discussed and a consensus will be taken on the way forward.

**How effective are two-way communications within this company?**

I would say very effective. They have to be. Everyone pitches in their ideas and every idea is given due consideration.

**Do you use project teams to implement product and process innovation?**

All the time, everything we do here is a project and involves people as necessary, certainly someone from design, engineering and marketing.

**Does this company actively socialise knowledge? By what means?**

You have got to get people buying into the process of making that decision; people have got to feel part of that decision process: buy in to it, carry it, and really go with it. If you don’t do that it falls by the way-side.

**SUPPLY CHAIN CONNECTIONS ALONG SUPPLY & VALUE CHAINS**

**What is the scope of your supply chain in terms of geography, technology and value of procurement budget?**

There are no significant examples of our products or even processes being improved by information transmitted to us through our supply chain. There are lots of little things that we gain.......like we are into intelligent battery packs, and we work very closely with the suppliers of batteries that go into these packs, so from an technological point of view you are very dependent upon your suppliers giving you information. It has taken about a year to go up the learning curve in getting information from our supplier on these intelligent battery packs. What seemed simple at the beginning was not as simple as we thought.

**What percentage and amount of your turnover is value-added?**

Just over half of our nearly £5 million turnover.

**Do you regard your suppliers as partners? Give an example.**
We try to operate with a single sourcing policy. The best example is the sub-assembler we use in Fife - we look upon this as a partnership. What happens is that they will buy the materials. We know the price they are buying the materials at. We know what the cost structure is. We exchange accounts each year so that each of us knows what the other is doing. There is no financial information which is unseen. We know exactly what it is costing them to make our requirements, and what profit they are making. We can make suggestions about reducing costs and so on. I must say, we have kept some control over the materials procurement here, purchasing the long-lead time and the high value items. These materials we then free-issue, but the sub-contractor will buy the rest. They have to buy a year ahead to get the pricing right. We are not going to give a commitment to the sub-contractor for a year ahead, except in a general sense. So we have go to have that good working relationship to make it a success. Before Ian joined us, who is our Operations Director, we had a confrontational relationship with our sub-contractor - this is going back five years, and was another company in Fife. We got into a hell of a lot of problems on quality, not getting things done, and so on. With the present sub-contractor it is a wonderful relationship. Perhaps because its a personal relationship. Ian knows the people and used to work with them in sub-contracting.

**Explain the type of trading relationships from your questionnaire answers.**

Apart from our sub-assembler in Fife, we buy in as we need it. We have a range of people we go to, often it depends on what they've got and at what price.

**Explain the type of inter-relationships from your questionnaire answers.**

We have one close partner, and a range of other suppliers who we deal with on an 'as needed' basis.

**Are these inter-organisational or inter-personal relationships?**

Our partnership sub-contractor is a close personal as well as business relationship. The others...........we know people, but the relationship is business.

**Are you part of the tiering of a supply chain to an OEM?**

No.
Is your own sourcing policy: single sourcing, multi-sourcing, competitive sourcing or spot sourcing? Which is your preference?

Single for our sub-assembly, multiple for other procurement.

What are the main differences between your supply chain, and those of your major customers?

Many of our customers are major producers with vast turnovers. Our suppliers, on the other hand are small companies - often smaller than ourselves.

Do you actively transfer knowledge backwards along your supply chain by transferring technical information to suppliers.

It's a two way process. When we design a product we'll ask them "Is this layout OK, or is it easy to produce another way." So we rely on them to help and advise us on the easiest way to produce something. We need that input.

Do you actively transfer knowledge backwards along your supply chain by involvement in business strategy changes of your suppliers.

We help if asked, but not generally.

What routes do you use to transfer knowledge to you suppliers for example staff loan, joint development, equipment loan, financial support.

We discuss our designs, and listen to their comments on manufacturing difficulties. Often we change our designs if their suggestions make sense for the product.

What is your aim in improving the knowledge base of your suppliers for example to improve price, delivery time, product quality.

All of these, especially price.

Would you say that your suppliers have a similar commitment to continuous improvement as yourself, or not? Give examples.

Yes. We often suggest alternative components or sources of components to them. We have lent them equipment, but interchange of staff is more difficult -
conceivably it could happen. We might consider helping them financially if they required assistance and we were in a position to help; but we all have our own financial problems at any one time. We make sure that we pay our supplier on time, this is critical for them, because a big chunk of their business depends on us. We are very careful to pay one the nose, every month - and they now rely on that. That's part of the trust between us.

Do you actively transfer knowledge forwards along your value chain by transferring technical information and suggestions to customers.

Yes, we run customer seminars. We produce lots of materials on the applications of our products. And we help customers build in the non-portable monitoring equipment.

Do you actively transfer knowledge forwards along your value chain by any involvement in business strategy changes of your customers.

No.

What routes do your customers use to transfer knowledge to you for example staff loan, joint development, equipment loan, financial support.

No. We don't have big customers were these things may be appropriate.

What are your customers aims in improving the knowledge base of your company e.g. to improve price, delivery time, product quality.

Their margins - their aim is to reduce waste and process cost.

Would you say that your customers have a similar commitment to continuous improvement as yourself, or not? Give examples.

Difficult. Some do, other don't. This often depends on the quality of people you come across - whether they understand the technological possibilities or not.

FOREIGN DIRECT INVESTOR TRADING

What allows you to successfully trade with major inward investors, or alternatively prevents you from doing so?
Trading with foreign inward investors in Scotland is only a tiny part of our business. The North Sea took some safety products, the Howden and Weirs of this world take some for analysis of noise and vibration problems. Rosyth use our products and some paper mills. But all this is a very very small part of our total output.

**How do you weight the potential advantages and disadvantages of becoming a preferred supplier to an inward investing OEM?**

No firm could use so much of our product that we would become a captive.

**How aware are you of FDI sourcing outwith West Lothian which you believe your company could successfully meet?**

Of course, particularly in condition monitoring. But, these big companies bring these products with them from their home base.

**Is this company prepared to improve its capabilities to meet FDI supply chain requirements? What would you be prepared to do?**

We would look at the commercial realities of any such proposal. This is a niche market which could be quite good for us. The condition monitoring of semi-conductor plants is a specialised function, and if we could develop specialised techniques for doing that, then you could sell that world-wide. We are very much in the business of niche marketing, we don't compete against the big guys in the world. We try to identify these niche specialised markets in which we can push our way forward and nobody can touch us - nobody specialises the way we do. We have tried approaching several companies, but the problem with condition monitoring is...........well, in fact we have a project with NEC for condition monitoring. We are open to these approaches, but we are fairly practical about it. For small companies - the like of Jabil of this world - the application is not economically justifiable. So you can waste a lot of time on these sort of things. So you have got to deal with the commercial realities. Unfortunately, none of these opportunities were thought of when the big inward investors were induced to Scotland - they were allowed to bring their own supply chains with them.

**Local FDIs are considered to be ‘world-class’ manufacturers, how important is it that this company learns from their best practice?**

Yes, and we have. But don't forget that we also have a lot to learn from other West Lothian companies and our customers throughout the world.
Working in supply-chain partnership may mean allowing an OEM to influence investment, product development and training strategies. How would this company balance this against organisational independence?

All of these questions would be viewed in a commercial light.

Developing a long-term supply chain partnership may involve investing a lot of personal time to build up trust. Is this your experience? Would you be prepared for such an investment?

Yes and we have done this with our sub-contractor in Fife.

If developing a long-term supply relationship necessitated a large financial investment, would you be prepared to seek external funding to finance it?

If we got the chance to supply (say) condition monitoring to a big player, of course we would respond to that opportunity.

If an OEM asked you to jointly develop a new product, the cost to you being significant, how would you respond?

Yes, if it stacked up commercially.

Why can West Lothian owned manufacturers export so successfully, but trade so little with inward investors?

Because the inward investors bring their supply chain with them for value-added components and equipment.

**LOCAL NETWORK**

Knowledge networks may stimulate innovation, improving competitive-ness. Are you part of one?

Diagnostic Instruments is part of different levels of networks. There is the sub-contractor level where we have a very close relationship. There are other sub-contractors in Scotland, so in actual fact we have a good network here that we can use to manufacture our products. We also have a good infrastructure as far as the provision of engineers - electronic engineers - is concerned. This comes from the range of technological universities which is very useful. As far as the inward investors are concerned, the problem is they are screwdriver plants. They are not actually creating the designs for
products. There are a few exceptions such as Hewlett-Packard at South Queensferry, NCR at Dundee - they produce real value-added business because they have got the actual design and manufacture here. A lot of the companies, like NEC, do not have that kind of thing.

Is a knowledge network amongst West Lothian-owned manufacturers an achievable goal?

In West Lothian the Business Alliance is very good, I enjoy its meetings. When it was run by Matrix, [a networking facilitator used by West Lothian Council to support the Business Alliance] I found the interaction there very good - I like that type of thing. Historically, the Business Alliance and West Lothian Economic Development seminars have gone through some ups and downs, but I think it's probably difficult to attract many people to go to these sorts of things. The Matrix things is really helpful to people like me - you can get up to date, and have a useful discussion.

Who would be the participants in a knowledge network of most use to your company?

We can learn a lot from other companies, not just from inward investors, but other West Lothian companies - we need to get more West Lothian companies participating in these things.

From a knowledge network what sort of knowledge would this company find most useful?

New products, new processes and the latest management thinking.

Which organisation(s) should have the responsibility to further develop a West Lothian manufacturing knowledge network?

Probably the local Council and the Business Alliance.

What input from outside manufacturing companies in West Lothian would you like to see in a knowledge network?

More participation of the successful indigenous companies.

How do you balance being in competition with other West Lothian manufacturers, and the possibility of sharing knowledge with them?

There is nobody else in West Lothian with our capabilities.
PUBLIC POLICY SUGGESTIONS

What could the local authority or the government do to improve the institutional framework facing West Lothian-owned manufacturers?

In our experience, SE was key in setting up DI (the old SDA as it was). They gave us encouragement and a small amount of finance. Getting their backing was important in taking barriers down for other people to put money into us. They were followed by British Coal Enterprise, Bathgate Investment Fund - all small amounts of money but £15,000 here and £25,000 there. We got grants as well. This gave us a great launch pad. Now, I don't think that backing is there anymore. They make all the noises. The Scottish Office are trying to make SE much more commercial. LEEL are trying to do their own thing. No doubt any new West Lothian LEC will do its own thing. But, it needs some central expertise to do the investment part in small companies such as ourselves. It needs such a wide variety of knowledge at the core to make investments effectively, whereas local investment companies will not have this experience. Also different expertise is needed to help the start-up company, and those going through various stages of growth. Doubling the size of 100 companies of our size is worth two Motorolas, and locates design and manufacture in Scotland where it will stay. It is crazy economics to put £107,000 per job into a foreign investor and leave local companies unsupported. You can see this happening in the motor car industry down south - such support for inward investment can end up destroying, not creating jobs. You can't compete with inward investors who have been subsidised up to the hilt - that is inherently unfair. There must be more balance in all this. The American way of funding small companies like us, is to some extent dependent upon the particularly capitalist nature of their society: so many millionaires and venture capital companies there are prepared to put money into small companies. I recently looked up one of our distributors on the Internet and found that they had recently raised $9 million. There are hundreds of companies doing this in the States which you don't really see here. Venture capital here is too much into big management buy-outs. That's what's happened to SE. Look at the successes they used to have, but not anymore.

How adequate are West Lothian training providers for your purposes?

OK. But bear in mind that for more experienced and qualified staff we have to widen our net to the whole of Britain.
Is the information you put into, and receive from the labour market in West Lothian satisfactory?

We find it satisfactory. We don't really put information into the labour market unless we need staff, then we work through the local labour exchanges or informal contacts.
GLOSSBROOK ENGINEERING LTD

Interview with John Kenny, MD of Glossbrook Engineering Ltd, held at the company premises at Blackridge, West Lothian, on Wednesday, 20 November 1996.

Glossbrook is located on the very west of West Lothian, in the otherwise dormitory village of Blackridge an ex-mining community. The company’s smart exterior stands out as a modern profile in an otherwise ‘old’ community. A no-nonsense interior holds the modern equipment of a hard working company containing an expanding knowledge base.

COMPANY PROFILE

What are your products and your output profile?

My business is injection moulding - trade moulding. This includes vacuum plating and mould manufacturing. The products we produce for trade range widely from plastic casings, venetian blinds, tags for cows, and coffins furniture.

Who are your customers? Describe a typical customer.

We have around 100 customers. Our largest customer is Clip Blinds in Johnston - they manufacture venetian blinds. We run two moulding machines 24 hours a day for that company producing items for their blinds.

Who are your competition? How intense is competition?

It is local. Fortunately what has happened is that most of our major customers have a policy to purchase within a 50 mile radius (to be hands-on). So when we quoted for this venetian blind work, for example, we knew it would go to a local moulding company and we were fortunate enough to win the contract. Since then they have been our major customer. Prior to that we did a tremendous amount of work for the toy trade but that’s just because of past contacts that I had. Locals still think that we are a toy making factory. But its just coincidence really. I moved up to Scotland 25 years ago and worked for Model Toys. They unfortunately went bust. It was then that I started this business up, and it was through contacts there that we inherited sales. What has happened in recent years, say four years, is that the Chinese production of cheap toys (not necessarily poor quality) has killed the domestic market. We have just recently, this week, had a contract for some components for which we were bidding against the Chinese; it was only the fact that the people felt they would not have enough control getting the stuff
Appendix Two: Empirical Data From Indigenous Companies

across here that we won the contract - there was no problem with the quality of the Chinese product, it was just controlling the items coming into the country.

What is your strategy for this business?

There has never been a strategy as such other than the fact that we get a feeling for what is happening and expand the business when we feel customers are ready. We have a solid base of customers. It is who you know not simply what you know. At least 50% of our business is these core customers. It tends to be on the more technical aspect of moulding. We specialise in small runs, more technically difficult - we do very well at this. We find this is very profitable business.

Some are instrument makers looking for cabinet casing. People who manufacture mobile phones. Small parts are good money for us. We have recently been asked to help out in a contract to make ear tags for cattle; this looks very promising. It is now a matter of whether we secure all of the business. It was a company that was going into receivership, and we were asked to inherit the tools and keep the thing running - but the final decision on the whole of the business has yet to be made. So we don’t quite know whether we will retain this business. One industry’s problems can be the opportunity in other industries.

Can you describe the management structure?

I am the MD, I started the company. My wife is the Company Secretary. The tool-room manager is my eldest son. My accountant is my youngest son. On the main production we have a production manager, and under him there is an under-manager. Then we have two under-managers responsible for the nightshift. We don’t have a strong management team at all really, we work as one. This is a family firm with a trim management structure.

We have recently, through LEEL, been using a management consultant. Probably looking to the future, in ten years time when I retire, whether we need a non-executive Director. Remember my two children are young. We have got someone coming in for a period of 15 days. But I can’t say we are learning a lot, but he is probably making us more aware of ourselves, we are putting effort into seeing what is happening. At the moment we just run the factory and if it has made a profit at the end of the year, we have done well, and if we haven’t then we’ve got to do something about it. We have to be careful only to bring in skills we need, but to continue the family base of the company. We’re just looking at all this.
We question ourselves whether we want to expand any more. At the moment we have run out of land now, we can't expand any further; we have expanded the original factory four times, we have run out of room here. Now we have to get the maximum capacity out of what we have. We are aware of that. But we don't visualise 24 hours a day, seven days a week - we are looking for a livelihood not gold medals. Life is too short to work yourself into the grave. Obviously, we have been through that when we started the company, it was hard, not that we don't work hard now - we are more organised now.

**With what systems is work organised?**

The toolroom and the trade-moulding are separate. Tool-moulds are used in the moulding using materials specified by customers.

**What are the main processes you use?**

Toolroom processes are CAD-CAM based around an engineering workshop, with the usual machine tools. In the moulding we have individually operated heat moulding machines.

**What range of technology is employed?**

Our toolroom is very sophisticated. It is right up to date with CAD-CAM systems. That is one thing we have always attempted to do is keep ahead of the technology the technology in the industry. We have spent a lot of money in the toolroom. We have 14 moulding machines, of various ages, the newest being top of the range.

**How many permanent and casual employees do you have?**

44, all permanent.

**Do you operate a participative or top-down employer model?**

We are participative.

**How is employment structured?**

Really in three areas: administration, toolroom and moulding. Each is small enough to work under one Foreman or manager.

**Describe the teams or cellular manufacturing you use?**
Our people have worked together for a long time - usually over ten years. They know each other well and work as a team.

**Do you employees feel a mutual obligation to you?**

I hope so, and think so.

**How do you recruit and improve ‘quality’ employees?**

We go in for in-house training but I must admit that labour is a major concern our ours at the moment. We have just taken on two apprentices because we have remained dormant. We have only ever had one apprentice, and the toolmakers - well three of them used to work with me when I was at Model Toys and I brought them with me when I started this business. We are aware of the fact that our skilled labour is getting older, and there is no younger people about. We intend to see the apprentices get a good training. We just don’t bring people in to the toolroom. We have remained stagnant there for the last ten years. We are one of the few toolrooms around here where the toolmaker is responsible for the mould tool from start to finish. A lot of the other toolrooms only have specialised grades.

**What motivates your workforce?**

In the moulding we run a bonus scheme. In the toolroom we are one of the few toolrooms where the mould maker is responsible for the mould-tool from start to finish. Most other toolrooms fragment work between millers and turners etc. Because there is only seven men, our way of working gives them a sense of pride at the end of the day when the first ‘shot’ (i.e. mould) comes off the tool. I served my time as a toolmaker, and this business started up to make tools. CAD-CAM can take a lot of the skills from the toolmaker, passing them to the programmers. For a few this increases skills. CAD-CAM enables us to achieve a lot more in the technicalities of mould-tools because of the equipment. Spark erosion is now a boon. Years ago when a cavity would consist of heaven knows how many bit and pieces to construct - but now you just blast it. I would say that spark erosion has make the biggest impact on mould making.

**Price, Quality, Time, Kaizen scoring explanation from questionnaire.**

Quality and delivery time and more important than price in our business; that’s not to say that continuous improvement and price and unimportant.

**Can you describe how the culture of your firm corresponds with the social culture in West Lothian?**
I have never really thought of this, we just situated here because the factory was empty - and that's it. We live locally in Torphichen. I started off in Bathgate, where I have a friend with a transport business, he loaned me part of his warehouse in 1976. We moved here in 1980. The SDA had this factory on their books, and we bought it for a song at the time.

All of our employees are local. Skilled men come more from Wishaw, that's because I met them in Modern Toys and brought them here.

What is your annual turnover, annual profit, and profit margin?

Turnover is £1.5 million and profit margin 10%.

What strategic opportunities for innovation and technological change do you face?

We aim to be up amongst the best. At the moment we do a lot of specialised manufacturing. Nothing is too difficult for us.

What constraints do you face in taking advantage of these strategic opportunities?

We don't feel constrained at all. We don't aim for any one particular market. We are really trade moulders. We will take on board any customer.

INTERNAL KNOWLEDGE GENERATION

What staff, budgets and time do you allocate to product research, development, and product design?

Most components the customers have in their mind what they want. We did set up a method of cheap tooling, one-offs i.e. trial tools. And we do sell that: making impression tools for a development component. Once we have proved it and they are happy with it, we would then do a moulding-tool, depending on the volume of work. We take that on board. If a company wants advice on the use of materials and the application of materials we offer it. We deal in all materials, there is no material we are not able to use - from the cheapest commercial materials to the most expensive; we've moulded them all. We have our Works Manager who is very clever technically on moulding and production. I met him also through Model Toys. He had served his time in Lanarkshire. A superb technician. He has only been with us ten years. But I always knew that he was the chap I wanted.
The customer tends to generate the drawings, but sometimes they will give you a mock-up. We always do the tool making.

**Can you give an e.g. of how and why a process innovation has occurred?**

CAD is important to us, we use Delka - it specialises in mould-making. We did a lot of research. My oldest son who runs the toolroom is technically very capable. He served his time with me. We sent him to Coatbridge College. He is very self-confident.

**Does process innovation arise from a planned and conscious strategy or respond to events and opportunities?**

In the toolroom we moved to CAD-CAM to keep up. In moulding changes arise from more machines to increase capacity.

**Has information technology stimulated process innovation?**

Mainly the CAD-CAM, though like everywhere we have upgraded our offices and the equipment.

**Do you operate a ‘design-for-manufacture’ system in product innovation?**

All the time whether we are producing moulds or advising customers on design and materials.

**How influential is your marketing expertise in product innovation?**

Not at all, we don’t do any marketing. We don’t have a company brochure.

**Have your suppliers stimulated innovation of product or process?**

Not really.

**Have your customers stimulated innovation of product or process?**

Customers come all the time with new products, so we advise them on changes in possible materials mix for the moulding.

**What motivates product and process innovation for this company?**
We have to keep up with the industry to stay in business.

NON-CUSTOMER KNOWLEDGE TRANSFERS

Can you give an example of how this company gets knowledge which may stimulate innovation from: big companies contacts higher education contacts SE, LIS, LEEL, The Business Shop, marketing agencies, financial bodies, trade associations, Competitors, scanning the environment of your business, other outside bodies.

Not at all until recently. LEEL have given us 15 days worth of consultancy. Apart from that no.

CUSTOMER KNOWLEDGE TRANSFER

Can you give an example of customers making suggestions which have improved your products and/or your processes?

By and large customers have a design in their mind. For example a new case for an instrument. They would do the drawing, we would discuss it. We might want to move some of the internal components and advise on how to get the best quality and aesthetics come into it a great deal. But really they have in their mind what they want.

How often does this happen, and how welcome are such suggestions?

If there is a flow of know between us and our customers, then it is from us to the customers rather than the other way around.

How have customers transferred their knowledge into your company: staff transfer, financial help, joint RD&D, equipment loan, worker-worker liaison, other ways?

None of these.

Why have customers transferred their knowledge into your company: crisis in your relationship with the customer, arising from the type of relations with customer e.g. vendor rating, a continuous improvement relationship with a customer?
Customers discuss their product with us to get it right. Sometimes this means them changing the layout inside the product, sometimes we advise them on materials etc.

How much easier is it to know what the final user of products wants, than to know what an intermediate customer wants?

We are always dealing with the final customer.

**LEARNING ORGANISATION FEATURES**

**Is this a ‘learning organisation’ - constantly generating, accumulating and socialising knowledge?**

I probably would say we are a learning organisation. We are all anxious to learn. This is unusual for a family owned and run firm. Passing on knowledge is just as important as gaining knowledge. We use what knowledge we get to serve the customer’s interests better.

A ‘learning organisation’ actively seeks out new knowledge and ways of doing things; can you give an example of this culture in your company?

One of our major contracts is for a product prepared by a design house. These people are looking for assistance in the component design. But they have in their minds a shape and form; we talk with them about materials (whether it should be very commercial or whatever). It depends on how they want to present their product in the end. This is a first-aid box, with all the internal bits and pieces, the volumes were quite good. We design the mould and then produce the moulded products.

It is suggested that a ‘learning organisation’ has leadership rather than management. Leadership constantly challenges the knowledge base of the organisation. Does this distinction make sense to you?

Well, we’ve built up this business - I suppose that’s leadership.

Can you give examples of how the following act as constraints on your company being a learning organisation: your financial structure or financial healthiness, the time-scales in which competition forces you to operate, the risks involved in continuous change and improvement, your business
environment, the knowledge base of your employees, the skills and capabilities within your company.

None of these are constraints. We keep up with the best in the industry.

How do you ‘scan’ for new knowledge of process innovations, products, and marketing opportunities?

Well, I'm not a great attendee at conferences; I've been to a few but I find I never get anything out of them - just guys talking about themselves really. We look at the trade journals. We obviously pick up a general feeling about what is going on. Mainly this comes from talking to people. A lot of stories come through the trade. For example we deal with a lot of material suppliers - there is a lot comes from the Reps. I never turn Reps away because I feel they are trying to do a job, and by talking to them I find out what's going on. How such-and-such a company is doing. You get the stories.

Who acts as a ‘gate keeper’ assessing how valid outside knowledge could be?

I suppose I do. On toolroom matters I would always discuss things with my son.

Who effectively takes the decision/risk on technology changes in this company? How are these decisions taken?

I do having regard for the long term interests of the company.

How effective are two-way communications within this company?

Quite effective, perhaps more with the toolroom than the moulding.

Do you use project teams to implement product and process innovation?

Not formal teams, we discuss the work schedule.

Does this company actively socialise knowledge? By what means?

Certainly in the toolroom the men are always chatting about work and making sure that every job is right.
SUPPLY CHAIN CONNECTIONS ALONG SUPPLY & VALUE CHAINS

What is the scope of your supply chain in terms of geography, technology and value of procurement budget?

We don't really buy locally - there is just one local agent. We buy from all over Britain. It depends upon where the materials are. We don't deal with many of the majors because we're not big enough. At one time we could go straight to manufacturers like ICI, but unless you are going to take five or ten ton at a time they refer you to their agent. There is only one materials producer we deal with directly.

Steel for the mould comes in a standard mould base. There are three major manufactures: one in Germany, one in Belgium and one in England. We tend to be patriotic if we can be. These are not price sensitive at all, more delivery time.

What percentage and amount of your turnover is value-added?

It depends on how you do the calculation. Our gross margins are about 20%.

Do you regard your suppliers as partners? Give an example.

Probably yes. Especially the local guy. We do help each other out - lending each other bags of materials for example.

Explain the type of trading relationships from your questionnaire answers.

80% of our materials purchases come through formally recorded supply agreements with agents.

Explain the type of inter-relationships from your questionnaire answers.

We don't loan equipment, staff or jointly train.

Are these inter-organisational or inter-personal relationships?

We very much have personal relationships. The whole plastics industry is a very small world, its amazing how many people you know and get to know.

Are you part of the tiering of a supply chain to an OEM?
Less than 10% of our output is for local OEMs. Probably because they haven't come to us. I mean, one thing we have never done is, we have never been out to sell. I started the business dealing with people I knew. Since then we have sold purely on recommendation. Apart from an advertisement in Yellow Pages, which more or less pays for itself. We seem to be busy enough to suit ourselves. We have a potential non-Executive Director who can't understand us on sales.

We are considering up-grading our sales efforts. Having just acquired this contract for venetian blinds. We feel that the last thing we want to do is not give good service. It is so important. You can lose face so quickly. At the moment we feel under no pressure to increase sales.

Is your own sourcing policy: single sourcing, multi-sourcing, competitive sourcing or spot sourcing? Which is your preference?

I would say multi-sourcing in the main.

Do you actively transfer knowledge backwards along your supply chain by transferring technical information to suppliers.

No.

Do you actively transfer knowledge backwards along your supply chain by involvement in business strategy changes of your suppliers.

No.

Would you say that your suppliers have a similar commitment to continuous improvement as yourself, or not? Give examples.

We get to know about new additives or types of materials for moulding, but other than that we really rely on the expertise within the company.

Do you actively transfer knowledge forwards along your value chain by transferring technical information and suggestions to customers.

All the time when discussing translating a design into a mould-tool and then a mould.
Do you actively transfer knowledge forwards along your value chain by any involvement in business strategy changes of your customers.

No, not at all.

What routes do your customers use to transfer knowledge to you e.g. staff loan, joint development, equipment loan, financial support.

None of these. We are the ones with the expertise.

What are your customers aims in improving the knowledge base of your company e.g. to improve price, delivery time, product quality.

Product quality and delivery time can be more important than price to our customers.

Would you say that your customers have a similar commitment to continuous improvement as yourself, or not? Give examples.

Its hard for us to say, we don't get involved in their business.

FOREIGN DIRECT INVESTOR TRADING

What allows you to successfully trade with major inward investors, or alternatively prevents you from doing so?

I would be interested in trading with local inward investors. As long as they worked along with us. We would need to discuss in great depth and find out what we would need to do. The last thing I would do is upset any of our existing customers.

How do you weight the potential advantages and disadvantages of becoming a preferred supplier to an inward investing OEM?

We know of a major competitor who recently took on such a big contract for Black and Decker that he threw out a lot of work, which we inherited a volume of it, albeit a couple of thousand mouldings a year. But its a couple of thousand mouldings for which you get a good price. Why not. You have to be very careful with this. You want to be as diverse as possible and not be in a situation where you would suffer too much from the loss of one customer. There was a time in 1984 where we did a lot of work for a company, they
Appendix Two:  
Empirical Data From Indigenous Companies

went bust owing us a lot of money. We were half the size we are now. This had a tremendous impact on us. Fortunately they were bought out and eventually we got our debt back, but only after some time. This made us very wary of going to bed with somebody who has that much influence over our company.

**How aware are you of FDI sourcing outwith West Lothian which you believe your company could successfully meet?**

I went along to Mitsubishi earlier this year. There was talk about a lot of work being available. But I have since learned that it was hawked around several companies, but the work has gone back to Japan.

**Is this company prepared to improve its capabilities to meet FDI supply chain requirements? What would you be prepared to do?**

We would be very worried about becoming a captive supplier. Though if the opportunity arises - what can you do? You have got to try and expand the business around that as well.

**Is trading with FDIs for some reason only a limited part of this company's growth strategy? If so why? If not - how broad a location of FDIs do you consider your potential market?**

We trade very little with these inward investors. I winds me up that so much of the supplies used by these companies are sourced outside of Britain. In all fairness, I suppose, when we started the company here in 1980, we got some grants and assistance - that was only initially. It infuriates me the amount of money they throw at foreign investors to get them here and we could do with a bit of a share of that money to allow us to keep up with the technology. We are spending a fortune on technology but not getting the assistance we should.

After-all we will be here employing people when some of the inward investors have gone. I remember Burroughs (Unisys) in Livingston, we did a lot of work for them for years. Just because their ten year period was up they pulled out and moved to France. Horrendous.

**Local FDIs are considered to be 'world-class' manufacturers, how important is it that this company learns from their best practice?**

Its not important at all. We are successfully in business on our own account.

**Working in supply-chain partnership may mean allowing an OEM to influence investment, product development and training**
strategies. How would this company balance this against organisational independence?

We would never risk losing our independence.

Developing a long-term supply chain partnership may involve investing a lot of personal time to build up trust. Is this your experience? Would you be prepared for such an investment?

If it benefited the company.

If developing a long-term supply relationship necessitated a large financial investment, would you be prepared to seek external funding to finance it?

We are wary of any loss of control.

If an OEM asked you to jointly develop a new product, the cost to you being significant, how would you respond?

We would look at anything.

Why can West Lothian owned manufacturers export so successfully, but trade so little with inward investors?

I don't really know, we are not exporters.

LOCAL NETWORK

Knowledge networks may stimulate innovation, improving competitive-ness. Are you part of one?

No, not at all. Our network is with our suppliers and customers, not this immediate area. Maybe our choosing not to sell ourselves has been to our disadvantage, I suppose. Probably if we really wanted we could go into Livingston and get work. We do work for four or five companies in Livingston. These are companies which have taken our name from Yellow Pages. That's about it.

We have about 100 customers. They tend to stay the same customers. We had one or two who came and went.

We belong to the Federation of Small Businesses, but you go to meetings there you find it is mainly shopkeepers and services.
Is a knowledge network amongst West Lothian-owned manufacturers an achievable goal?

We would probably give a new network a try. I know the local Council has had the odd show and conference. But I don't think product shows work. People need serious information about capabilities.

People still think we are plastic toy manufacturers because we once had for storage reasons two containers outside with toys written on it. They remember that but they never remember anything else about us.

Who would be the participants in a knowledge network of most use to your company?

People who could bring us business.

From a knowledge network what sort of knowledge would this company find most useful?

Knowledge of business opportunities.

Which organisation(s) should have the responsibility to further develop a West Lothian manufacturing knowledge network?

I suppose the Council and local enterprise company.

PUBLIC POLICY SUGGESTIONS

What could the local authority or the government do to improve the institutional framework facing West Lothian-owned manufacturers?

They should assist companies like this more. I often wonder whether these people actually take on board what we do. They think we are a toy making company. They have never been here so why should they think different. They don't know of our capabilities.

I didn't know there was a Business Shop. There is a local Directory.

How adequate are West Lothian training providers for your purposes? Is the information you put into, and receive from the labour market in West Lothian satisfactory?
Recruiting skilled toolmakers is a problem. We have taken on two apprentices and under the British Polymer Training Association send them to Bell College. They have moulding equipment there so its more relevant than courses at Napier which are too chemistry based.
HUNTING PARK ENGINEERING LTD

John Scott is the Chairman and Managing Director of Hunting Park Engineering Ltd. This interview took place in the company premises at Houston Industrial Estate, Livingston, on Friday 22 November 1996

Hunting Park Engineering is an older factory within a modern industry estate, along the road from a new NEC factory. It is currently investing £2 million on new offices and a manufacturing extension. Within the plant traditional engineering machine tools intersperse with modern heat treatment and press equipment.

COMPANY PROFILE

What are your products and your output profile?

Specialised forged pipe fittings for the energy industry.

Who are your customers? Describe a typical customer.

Major oil companies and stockists who supply to major oil companies.

Who are your competition? How intense is competition?

Mainly Italian.

What is your strategy for this business?

Not to move into bulk production. We have set ourselves up, whilst we are a manufacturing company, with the ethos of a service company. What we target basically is short delivery requirements for customers - where they have a short-fall, or they are looking for something quickly (they do that quite a lot in oil and gas and installations). Our manufacturing process is not the best in the world; it is the fastest for ones and two and threes off. So our strategy is one to keep it on that, to look for other products that would fit into that framework, and then the next layer is to put added-value on to these products. The added-value concept comes from people now wanting a “one-stop-shop.” So rather than just buying fittings and say can you make a bit of pipe and can you weld them all together - this is mainly the move towards white metals. Moving out of the carbon steels and moving into the stainlesses duplex type stainlesses which have better corrosion characteristics. As a result of that we are considering going down that added-value path of welded assemblies, pressure testing - with all the one
Appendix Two:
Empirical Data From Indigenous Companies

documentation. That’s the one thing that they are looking for, under a quality control umbrella. Because if they buy the fittings from here, and the pipe there and the flanges from someone else, they then have bits of documentation from all over the place that they have to knit together. If they come to a “one-stop-shop” it means we can do it all, and it meets our objective of added-value. We don’t necessarily want to grow the top-line, improving the bottom-line is our main thrust.

Can you describe the management structure?

It is unique. We have five Director-shareholders. It is unique in that we operate on a team basis. To illustrate the team basis - everyone gets the same salary and conditions. I am Managing Director but I get the same everyone else. That’s how we set this company off. One is on commercial and sales, one does export selling because he has contacts, but his main contribution is on the quality side. Another Director handles engineering: that’s engineering development, maintenance and design. Another Director does the financial side. And I sort of sit above it all and pull strings and make sure that I get involved in the forge programming and computer side.

With what systems is work organised?

Whilst our manufacturing processes are unsophisticated the systems are fairly sophisticated. For short term deliveries we have to locate materials which will meet the customer’s requirements, and do that quickly. Previously that was all done by paper. People were looking through test certificates, analysis of tests. Now within three seconds we can match to see if we have something in stock or if not we then send an analysis away to suppliers asking what they’ve got. This bit is still done on paper. I’m trying eventually to get this done down a wire enabling us to interrogate suppliers stocks for matching and then ordering. But suppliers are reluctant to allow access into their information. So our first system is material selection.

We then have shop loading systems which are related to orders and allocate resources accordingly. We use our own bespoke MRP system. We tailor it to show loading requirements in the key sectional areas. We have also another unique management view: that we have infinite capacity. This as you know is impossible. But we load on that basis to see what the customer demands. And then having seen what the customer demands we then engineering loading to actual possibilities.

At the beginning I said that the strategy for the company was to concentrate on the bottom-line. Alongside that, and it compliments the bottom-line, concentration is on the measurement of delivery performance. Because that’s what people are paying us for - the reliability of that, so we put a lot of
focused attention on delivery performance. We pull through value-added to meet delivery performance. We can see at any one time what is going through the forge.

As you see we are growing. We are putting in another manufacturing unit. It is the key sections we are looking at. The important word is ‘focus.’ It’s our management style. I was at one of the Council’s Economic Development Matrix functions, and I was set thinking on focus. Since we have gradually introduced a more focused approach to breaking manufacturing units down. Giving people focus. This has brought undoubted benefits to us. We get better results, our people are buying into this focus. It has been very successful and we will continue to do this. We are now looking at how we can break systems down, so that people can have the responsibilities. For example, we took out one of our fittings, a 6 inch fitting, this used to be put through with general products. It was always felt to be a ‘loss-leader’ - we didn’t have a handle this product. The costs of it were dreadful. So we said do we still keep doing these, can we do with out them. The general view was we had to do them as part of the range to attract larger orders. We took this product out and we put together in a small shop the forges and the machining section and the cutting section. They then all worked as a team, and were rewarded as a team. This has been remarkably successful. WE changed conventions about bonus payments to a group bonus payment rather than individual. That took a bit of bedding down, but I must say that is a successes. Previous specialists are now flexible. We have two ‘F’ words: focus and flexibility. Flexibility is important to us because we don’t know when the orders are coming in - or order book is generally very short.

What are the main processes you use?

I always say Hunting Park Engineering are blacksmiths - we take metal and basically heat it and bluter it. But behind that is the metallurgical aspect - this is the clever bit. We change the shape of metal in a fairly crude fashion, we then do sophisticated things in heat-treatment to change its properties to those the customer is looking for. Often these are mechanical characteristics: strength, impact values, weld-ability - these kind of things.

Designs are generally governed for us. We are manufacturing to American specifications and standards. The North Sea is governed by US standards. Customers still have their own idiosyncratic views: one metallurgist doesn’t think the same as another metallurgist. So the national specifications are overlaid with job-specific standards. The clever bit is analysing this and identifying how a bit of material to respond by heat treatment to meet the desired characteristics. The manufacturing (the bending of the metal and heating) is fairly crude.
How many permanent and casual employees do you have? How do you recruit and improve ‘quality’ employees?

We have 133 employees. Historically I suppose we pinched labour from other folk. The shopfloor skills we are looking for are no longer available in the labour market. We over the last three years we have successfully embarked upon taking boys into our own ‘apprenticeship’ scheme. These are boys we get out of Lothian Training [a local Youth Training provider of good quality] who are perhaps not on the top rung academically. They are perhaps that one stage down from University or Further Education entry. But they have practical ability. We bring them in here first of all as trainees and we pay marginally more than YT rates. We dangle the carrot that if they perform well over 12 weeks, we will take them on as a trainee i.e. job specific training for Hunting Park requirements. If they meet the trainee requirements which can take say nine months, we then send them for day release training. This is all specific training to Hunting Park requirements. We have had some hiccups, because young boys are young boys, but generally we are now getting excellent performance from these trainees. That is going to be a continued path for the workforce. Out in the staffing areas we generally just go to the market. But we have now started bring in young girls from Livingston Training on the same basis. Our biggest requirements are in sales processing and quality control documentation - we have brought in three or four girls through this route and are now holding fairly responsible positions.

Do you operate a participative or top-down employer model?

We try to involve and value people in our systems.

How is employment structured? Describe the teams or cellular manufacturing you use?

This is a difficult question for us - I'll have to think about it. We are structured fairly conventionally, I suppose. In part it depends on the styles of the individual managers. For example, our Quality Assurance manager is very much into team-building, emphasising job rotation and flexibility. This is easy in his area because people are doing similar jobs and we need flexibility for cover. Similarly in accounts were we use teams. But in production we are more structured into job skill (apart from the six inch fitting team I described). These are fairly conventional - you have a Foreman looking after a group.

Do you employees feel a mutual obligation to you?

Yes in the main. Not every employee. If you are looking at culture, we asked them to go through hoops quite extensively because of the nature of our
business, people come at five o’clock Friday, saying we need this for Sunday morning. There could be a plane sitting on the tarmac waiting to fly something to Norway. We have guys who will work Friday night, Saturday to do what it takes. They have grown up with that as a culture, that’s the culture we sell in the market place. The workforce comes along with us on that basis.

What motivates your workforce?

Job security. They feel that we will give them a fair shake. Because of our infinite loading capacity we have high requirements on occasion for overtime working. Consequently high remuneration, though this is a problem when it starts to go down the other side - people get used to the higher earnings. But I think the general thing is that we give them a fair shake. To illustrate this, we gave them all (staff and works - all employees) last year a £500 bonus each. Each, irrespective of their earning capacity. Five hundred pound was more significant to an apprentice than a chap on £30,000 a year. But the view was this structure was fair. The general response we got coming back was, “They didn’t have to do that.” Basically, we have had tough times as well as good times. In the tough times they have supported us. We have always said to them openly, come the good times we will share it around. There is a piece of cake we are trying to make bigger, we will not use a ‘fat-cats’ philosophy.

Price, Quality, Time, Kaizen scoring explanation from questionnaire.

Quality and delivery time are more important to us than price or continuous improvement.

Can you describe how the culture of your firm corresponds with the social culture in West Lothian?

Difficult. People always like success, irrespective of what environment they are in. There has been significant changes at Hunting Park in both our systems and buildings, expansion and increased rewards. Now people like that. We have been lucky to have had more success than failure. I would say that people now are quite happy to say I am associated with Hunting Park - we make things. As you know my culture is I want more people to make things rather than just provide services. For example, we are putting up this new office block. Our facilities as you see are not ideal, but people have to work in them. I’m not trying to set ourselves up as something we’re not but here is an example of the way we do things - it suits us. We have to look after our people, because its the people who are making it all happen. So our big new open plan office block will have new furniture but only for the central
office: all the fellow Directors will not take new furniture. We are trying to show that the new office is for them, because we believe that by doing that they will work better. We make them special and they respond. Of course, we have our fall-outs remember - its not all roses.

What is your annual turnover, annual profit, and profit margin?

Our turnover is £8.5 million.

What strategic opportunities for innovation and technological change do you face?

They revolve around focusing on emphasising the service outlook of the company in the value-adding products and areas of special expertise such as speed of delivery and metallurgy.

What constraints do you face in taking advantage of these strategic opportunities?

The main constraint is ourselves - we don't want to grow too fast. We have a great concern on this. In 1990 our turnover was £3 million, now it is £8.5 million. Over a five year term this is significant growth. We have asked ourselves, do we want to become a £100 million company? The general belief is that we don't want this. The company may have the potential to grow significantly. That's why we are looking at alliances. Our skills can perhaps take the company from small to say £20 million. But to take it from £20 million to £100 million you need different skills. You need different financial backing and so we concentrate on high gross margins, high added-values not simply turnover growth. I am in the process of looking at ditching some of our products at the moment to protect the niche we operate in. Moving to our core business and adding to the core business. Our core business is doing things quickly with quality. We take that culture and we move it into this added-value - welding it all together. We have to do this quickly. There are hundreds of fabricators out there who can stitch and weld things together. That's not our game, we have got to do this and do it well and do it very quickly. So we are then looking at a number of ways of achieving this. We think it will be organic but there may be some alliances whereby we will strive to bring people with that expertise on board - joining the two together.

INTERNAL KNOWLEDGE GENERATION

What staff, budgets and time do you allocate to product research, development, and product design?
There is not a lot on product change that we can do because its all defined by customers and manufacturing standards: an elbow is an elbow, a 'T' is a 'T.'

So the main concentration is process. We have just put up a new shop (60 meters by 20 meters) aimed at a specific new process for very heavy wall fittings. You have fittings that start off at an eighth of an inch or 4 inches, with half inch or 48 inch diameter. It is a huge range. We are classified as a short range manufacturer. So what we have recognised, particularly as we have moved towards white metals is this aspect of low schedule 120 which is a certain thickness, is that our current manufacturing techniques are not satisfactory. We know how to forge thinner wall fittings, and we are spending around half a million pounds to do this - we are aiming at a market that is satisfied at the moment, but it is satisfied by a different manufacturing process to ours. We believe that by this investment we will be able to go into this market and compete, but also using the Hunting Park ethos of quick deliveries take on the competition. So we are looking at a new market. Now markets go up and down, what we are looking at here is even in a stable market, Hunting Park has a chance to grow because we are targeting something we could not get into before. [This is part of a £4 million investment programme.]

**Does process innovation arise from a planned and conscious strategy or respond to events and opportunities?**

We are movers and shakers, we seek consciously to influence our destiny. This company was started ten years ago by two people: we now have nearly £10 million turnover and employ 133 people. The Directors see this company as our baby - sometimes the hardest job is getting them out of here.

**Has information technology stimulated process innovation?**

Fairly important for us. Of the five Directors, four of us have worked before together, for around 20 years. So what you have got here at Hunting Park is unique - people with lots and lots of experience in this particular field. You see way this office is structured, with a central meeting room. We use this room for customers and all meetings. Sometimes I am appalled at the level of competence of people who set themselves up as experts, coming in here and trying to specify. Whereas our guys know their business: a meeting can last eight hours, and for some guys it takes eight hours, but for our people the business could be over in an hour; because of their experience.

So, what we have got here, which is not in other companies is that we have all been brought up in making pipe fittings, knowing about the markets, the metallurgy, knowing about materials - lots of experience. A breadth of experience and the ability to apply it - that's the secret.
Do you operate a ‘design-for-manufacture’ system in product innovation?

We make to a customer design.

How influential is your marketing expertise in product innovation?

It is important that we listen to our customers and identify problems they have which we may be able to solve for them.

Have your suppliers stimulated innovation of product or process?

Very little is added to our knowledge base by suppliers.

Have your customers stimulated innovation of product or process?

A great deal. It is the customers who call the tune on specifications. The suppliers and manufacturers like us, who use this, we have to make the end product. The customer calls the tune, we then have to find a means of doing that, from the supply route available. There have been some new materials introduced, obviously, in the last five years. But suppliers are generally getting into line with a customer specification. What we are looking for are suppliers who can supply a base materials - so it is not improving knowledge, it is just getting us a bit of metal that we can then start knocking about. Customers certainly generate knowledge, because we have got to adapt to what the future market and customers dictating what the market will be.

What motivates product and process innovation for this company?

The growth of our bottom line, within our context of a manufacturing company using a service company ethos.

NON-CUSTOMER KNOWLEDGE TRANSFERS

Can you give an example of how this company gets knowledge which may stimulate innovation from: big companies contacts higher education contacts SE, LIS, LEEL, The Business Shop, marketing agencies, financial bodies, trade associations, Competitors, scanning the environment of your business, other outside bodies.
State agencies have helped us but not with knowledge only grant-aid. In the early days of the company we got RSA [Regional Selective Assistance] for some of the capital expenditure. That was significant in the development and growth the company - with out that we would still be here but not looking at expansion and employing 133 people. This is financial not knowledge.

The only knowledge aspect of support is through West Lothian Council’s Economic Development. We don’t have any tie in with LEEL or SE. We have had a lot of help from Stuart Borrowman [Economic Development Manager, West Lothian Council]. Many of the things he organises I find most interesting. I said to you earlier that my favourite ‘F’ word now is focus. That came just from going along to one of these meetings, and hearing it, and thinking about it. I’m just inquisitive, I don’t believe everything I hear out there, because I don’t think it always applies to us (sometimes I don’t think it applies in general) - there are a lot of guys out there who just open their mouths for the sake of doing so. But, this is an example of being inquisitive. I came back talking about focus, and everyone was able to buy into it quite readily. So I would say these sort of things can help smaller companies. That’s why I work on the Executive of the West Lothian Business Alliance. So largely, if there is knowledge it is coming from that. Matrix, who run some of these courses, one of our Directors went on to one of their fancy courses. This led from an Economic Development seminar.

**CUSTOMER KNOWLEDGE TRANSFER**

Can you give an example of customers making suggestions which have improved your products and/or your processes? How often does this happen, and how welcome are such suggestions?

I suppose you can see it in our factory daily. We are constantly learning from customers. When I say that people make to standards, it is such an immense range - people don’t understand the range of pipe fittings. It fantastic. Let me illustrate from our background. Italy are our number one major competitor. They organise themselves in a way whereby they say they do everything. They do but they don’t do everything. What they do is have little units, little alliances. A guy in his garage, or three man factory, they each do bits and pieces and feed them into each other. They are, if you like ‘badging’ them. That’s how they work. We are having to try to compete against that. One of the first things we have to try and do......we tried to form alliances with UK manufacturers saying “We’re specific, we are after short-term delivery, and we can do it better than you. You can make product cheaper than us, but not in the same time scale. Lets get together and we’ll compete as UK-united.” They didn’t want to know.
Customers keep asking us for a whole range of things, because of the massive range within the standards. In this we have to then find out from our customer what he is having the greatest difficulty getting from his supply route. Secondly, ones which he has an on-going requirement for on short-term deliveries. This is our constant chat. Just speaking to guys who say, if only we could get someone to do this. It can be as simple as that. We now have a range of products that people used to buy as castings, and that was the supply route. We said a forge is better than a casting: its stronger, you can reduce water.......we then came away and made a range of forgings. That's basically got us into a very attractive market.

How have customers transferred their knowledge into your company: staff transfer, financial help, joint RD&D, equipment loan, worker-worker liaison, other ways?

Customers don't give us technical advise they look to use to see how the product is to be made. They say this is what I want, I want this, with these characteristics etc. They don't say go and do it this way. They look to us to have that expertise - which we generally have.

Another example which is sad to relate. There is nobody making tube in this country any longer. So I have to go and get tube from non-UK sources. British Steel only make big welded diameter tube for gas pipelines - they don't make seam-less tube anymore. There used to be several companies in Scotland who made tube; this has all be wiped out because of this rationalisation. British Steel said I'll make railway lines and you can make tube. This is always one of my concerns because it is the French, Italians and Germans who have cartels going. Fortunately we go to stockists to get lots of our materials. Given this tube problem; how can we get tube, and how can we get it quickly, since the stockists don't have it. We are also moving into white metals (stainless and duplexes). So we came and said what we can do is we can get forged bar - solid. But how can we make that into tube. We developed a process to turn bar into tube. We now have shortened that supply route. We make tube to make a fitting, people are now asking us to make tube for tube. It is only small quantities, you can't turn miles of tube, but that's another thing where we saw a need. We had to satisfy a need to satisfy our fittings, but now we meet other needs. But a customer didn't come to us to say will you make tube, we had to do that ourselves. All they are doing is identifying a requirement.

Why have customers transferred their knowledge into your company: crisis in your relationship with the customer, arising from the type of relations with customer e.g. vendor rating, a continuous improvement relationship with a customer?
Appendix Two: Empirical Data From Indigenous Companies

We don’t have customers lending us money, design expertise, equipment or anything of that sort.

How much easier is it to know what the final user of products wants, than to know what an intermediate customer wants?

In the main we sell to final users.

LEARNING ORGANISATION FEATURES

Is this a ‘learning organisation’ - constantly generating, accumulating and socialising knowledge?

Yes we are a learning organisation. We look about. We each of two ears but only one mouth, using them in that ratio is the culture of Hunting Park. We go and listen to people, take it in, and then say how can we do it. We are very good at seeing an opportunity that only people don’t see. So that means that by learning we are out there exploring, its coming in and we’re doing something about it, to do it differently from everybody else - we have to do things different.

A ‘learning organisation’ actively seeks out new knowledge and ways of doing things; can you give an example of this culture in your company?

The team we have set up for six inch fittings, and our move into tube making are examples of this.

It is suggested that a ‘learning organisation’ has leadership rather than management. Leadership constantly challenges the knowledge base of the organisation. Does this distinction make sense to you?

First of all, I would put my hand up an say I am an excellent manager, not just a good one. But I allow people space, I don’t put handcuffs on them. You need hand-cuffs in certain divisions. I was asked to come into Hunting Park because it was getting too big. It is the team of five guys that makes the difference. We will sit down every lunch time and chat about what is happening. These are the most productive meetings we have. It is kept on a wide basis. We don’t concentrate on budgeting and resourcing, all that type of thing, we don’t spend a lot of time looking at it. I expect people to know that, if they have figures............At Board meetings we quickly go over if its a good result, if its a bad result, what we are going to do to improve it. But then we concentrate on strategic things - that’s the important thing. That people
are getting space to go and do things without coming back and asking me if it is all right. This comes back from my experience with PLCs. I thought I had movement and the ability to make things happen, because I like things to happen, and I took them to certain stages and found that my feet were chopped away or my arms were cut off - there is nothing more frustrating, because it had been thought through well.......That's why I give these guys space. One of my colleagues today told me that he was buying something. I said how much is that, £100,000 he replied. We had talked about it in general, we know we were going to do it, but he has gone away and acted. That's what I like. That's what worries me when you get an accountant sitting on the top of companies: it's not score keepers we need, it's batsmen to make runs. Sure you need someone at the end to make sure that it all hangs together, and I am not belittling that.

How do you 'scan' for new knowledge of products, processes and marketing opportunities?

In tubes for example, by listening to our customers. In the main customers come to us with their requirements - we offer the service of speedy delivery.

Who acts as a 'gate keeper' assessing how valid outside knowledge could be?

The Directors sit down and talk through ideas and suggestions.

Who effectively takes the decision/risk on technology changes in this company? How are these decisions taken?

Again the Directors.

How effective are two-way communications within this company?

Pretty good, we talk to our people as we walk around.

Do you use project teams to implement product and process innovation?

All the time, we draw in people to comment and be creative for every major initiative..

Does this company actively socialise knowledge? By what means?

Training, flexibility, job rotation, meetings and discussions.
SUPPLY CHAIN CONNECTIONS ALONG SUPPLY & VALUE CHAINS

What is the scope of your supply chain in terms of geography, technology and value of procurement budget?

The budget for raw materials is as flexible as our customer needs, if we don’t have it, we have to go and get it. In the main we use stockists like Murray International, Northern Surplus Steel or Tube Developments in Glasgow. Mainly stockists in the UK though we also have a tie up with a company in Norway who are stockists who supply us with tube and we supply them with fittings. In the main we are looking at, remember our quick delivery, to get tube stock and raw stock to sell. The stores that we hold [£0.25m] are generally remainders from other jobs. So from that point of view the norm is just going to a stockist and finding an ‘ask’ price. The ideal thing, which some of my colleagues would like to do is to be totally vertically integrated, but they would want to control it. They say, why don’t we go and buy an old redundant steel mill or a forge shop and convince people like West Lothian Council that this would be a good thing to do because it would bring lots of employment etc. By that we are then securing our supply chain. The only problem with that is the multi-million investment. We would be looking to bring not only the equipment but also the expertise - there are still people around who could make that work. But that’s us going to a £100 million company, because you can’t just supply Hunting Park - its too big a capacity. If you are then trying to paint a bigger picture, the one thing in all of that, that concerns me is globalisation that’s taking place and where does Hunting Park position itself within all these other changes that at going around. We are quite globalised in our customer base, but narrow in our supply chain.

What percentage and amount of your turnover is value-added?

Value-added can be measured in various ways. Our gross margin is defined by sales price, less any commissions, less raw materials, less labour costs. In the main it is almost all labour costs. Maintenance and the like are excluded. We are looking (this is not an absolute) at 40%; ideally I would like it to be 60%. The trick that we look at now is gross margin per hour. As we move into the more sophisticated materials, the material content becomes higher. So if we applied the same margin rules our prices would be out of the window. It doesn’t take us all that much longer to make something from a sophisticated material than from a carbon steel. So if you take the margin divided by the hours taken, since you must take a basic number of hours, our measure is gross margin per hour. This is edging towards activity based costing.
Do you regard your suppliers as partners? Give an example.

I have always had the philosophy that suppliers are more important to me than my customers. Because if I don’t have reliable suppliers I won’t have any customers. We work fairly closely with them and if you look at the profile of orders placed it is the same suppliers coming up. They have recognised that people have worked at giving us a reliable service. But we don’t go out and say lets sit down and have a partnership. There are moves in the oil industry to go down that route - these high-faluting management styles that I don’t understand - I had a guy sitting here trying to tell me you must draw out hidden agenda between suppliers and customers. These unsaid, hidden agendas must be brought on to the table, and you must not have hidden agendas. So if a staff member is unhappy he should have the ability to come and know he not going to have his nose bitten off or anything like that. you should all be working to the one end. This is the preaching that I got over dinner. This customer said this is a new style they were trying to adopt. He was a Malaysian who is a project manager. We don’t consciously do that, because I don’t understand it. You can’t just assume that everyone shares the same goals. Also I don’t like committees, I like decisions to be made. But I like people to be involved - its a fine balance as you know.

Explain the type of trading relationships from your questionnaire answers.

80% of our supplies come from the same 10 stockists.

Explain the type of inter-relationships from your questionnaire answers.

Of course, we measure what people can do for us, and the delivery performances. Bearing in mind if you are dealing with stockists, in the main they have either got it or they haven’t got it. It mean they physically. They are measured because they know if they let us down we will go and find someone else.

Our interesting supplier relations are not on the raw material side but on consumables. What we did there is we have an alliance if you like with a company we put on our own premises called Well-Tech Supplies. We outsource, and we have a chap there who is the managing director who supplies other companies in the area but his main function is to supply ourselves. That has proven to be very successful. He takes it upon himself to get the best deal for Hunter Park and gets the best deal for himself - a shared thing. For example, he has just done a deal for the gas. We were spending a lot of money with one of the national ones and we’ve come up with a better deal. Well-Tech successfully supplies other companies around the area. So
that has been a very interesting one, and again that came from one of these West Lothian Council seminars with all the buzz words about partnering.

**Are these inter-organisational or inter-personal relationships?**

We know the people, I would say our relationships are both inter-personal and inter-organisational.

**Are you part of the tiering of a supply chain to an OEM?**

No, in the main we deal directly with end-users.

**Is your own sourcing policy: single sourcing, multi-sourcing, competitive sourcing or spot sourcing? Which is your preference?**

We single source, but from a range of sources.

**What are the main differences between your supply chain, and those of your major customers?**

Our supply chain is mainly UK, but we trade globally. Our suppliers are small companies like our own, most of our customers are major operators.

**Do you actively transfer knowledge backwards along your supply chain by transferring technical information to suppliers.**

This is only applicable in consumables: can we get a longer life out of a cutting tool, can we do things better? But on the raw materials that's all pre-ordained by the customer's specification. What the customer wants is chemistry. Generally, bearing in mind that we are buying from stockists, the customer has been having a dialogue with the steel maker. The oil company turns out with a specification, he has made sure that he has a specification that is robust. Our customer's specification is based upon their dialogue with the steel maker. He therefore doesn't want to get caught with only one steel supplier or he will be pressed on prices. The steel-maker is only modifying his output because he has a big volume requirement. In our business we are not in big volume. So all these big volume runs for people who make fittings by the thousand rather than by the ones and two - what comes on to the supply chain are their surpluses. Generally that's what your stockists keep.

We deal with about ten stockists. We have tried getting each of them to allow us to interrogate their stocks over a computer line. What we have done (I got a grant from the Scottish Office) for Heriot-Watt to do a programme. What I want to do is sort the certification problem. This is a big problem for us. I can
supply you an item, but an enormous amount of paper accompanies it. What I wanted to do was get away from the paper. I developed this model on a lunch time napkin with a Professor at Herriot-Watt:

The supplier is Hunting Park, the customer is perhaps an oil company, in each triangle you have an inspection authority. The inspection authority has to make sure that what we receive at Hunting Park kosher and has been checked. If we supply that information to them, we then supply to the customer who ratifies to the inspection authority that the product is OK. Looking backward to the previous triangle Hunting Park was customer and not supplier; looking forward our customer may become a supplier. We had a Lloyds in here. This type of arrangement is the opportunity of a lifetime to eradicate paper. But Lloyds dropped it. What I was after was our ability to key information into the system rather than pay for the paper chase. Messages would be encoded (scanning would prove impossible) that would ensure security. We got funds for this project, and we have proved that it could work, we had Shell involved, but we were too small a fish to make that happen. It needed someone like the Shells of this world or the oil industry in general to establish the system with appropriate protocols. Then everyone in the industry would follow saving time and money. I am quite sure this will happen. On the Piper Alpha I could have been a Lloyds man......they had to look through all of their records - they looked through 75,000 pieces of paper, to try and find what he was looking for. This system could have been interrogated in seconds. Our proposal is similar to the electronic fund transfers used by wholesalers, retailers and banks. In our industry would always need the inspection authority for accreditation - the Lloyds inspector - because their are a lot of cowboys in this industry. Such a system could be used in house conveyancing.

Do you actively transfer knowledge backwards along your supply chain by involvement in business strategy changes of your suppliers.

We have done for Well-Tech but no - we are not involved in the business of our raw material suppliers.
What routes do you use to transfer knowledge to you suppliers e.g. staff loan, joint development, equipment loan, financial support.

None of these for raw materials. But in consumables we helped Well-Tech get started.

What is your aim in improving the knowledge base of your suppliers e.g. to improve price, delivery time, product quality.

All of these, it suits us that Well-Tech are located on our premises.

Would you say that your suppliers have a similar commitment to continuous improvement as yourself, or not? Give examples.

Somewhat, but the example I gave of our ability to interrogate their stocks was a disappointment.

Do you actively transfer knowledge forwards along your value chain by transferring technical information and suggestions to customers.

Yes when we discuss with them how their design is best implemented. But beyond that they know their own business.

Do you actively transfer knowledge forwards along your value chain by any involvement in business strategy changes of your customers.

No, many of our customers are the major oil companies.

What routes do your customers use to transfer knowledge to you e.g. staff loan, joint development, equipment loan, financial support.

None of these, we talk about their designs and specifications and agree upon an implementation route.

What are your customers aims in improving the knowledge base of your company e.g. to improve price, delivery time, product quality.

Delivery time is very important to them.
Would you say that your customers have a similar commitment to continuous improvement as yourself, or not? Give examples.

I would hope so. Their move into white metals indicates them taking a longer view on corrosion etc.

FOREIGN DIRECT INVESTOR TRADING

What can companies like your own in West Lothian learn from trading with the inward investing OEMs?

We are in a different industry from West Lothian's inward investors and do not trade with them.

Take a company like Hunting Park which has no connections with these OEMs at all. We are not in their supply chain, they don't supply us, we are remote. But you get other indigenous companies, at the other end of the spectrum who is targeting at these OEMs as a customer. I would say our business is not mass production, we are specialist manufacturers concentrating upon delivery times as a competitive advantage. Hunting Park is interested in what these people do but we are into different products, produces by different processes. If I was at the other end of the spectrum, and hoping to supply these companies I would want to buy into their culture, because that's what makes them tick, that's what they would be expecting you to do. So the first thing I would do would be to get along to these guys and say, look how can we become what you want, how can be benefit from what you can show us. Indigenous companies have got to get off their bums and go and ask and generally in my experience, if you go and ask people they are more than happy to help you. That's my concern. It may be true - do people go to the Motorola's of this world and say, we would like some help to become a supplier to you, a better supplier, a bigger supplier. What can we learn from you. You have to be active. If you show you are prepared to learn what they want, then you have a better chance of doing business with them.

We bring in these big companies, but they bring in behind them their own supply chains. What we should be looking at is OK we will bring in these big companies but we will have to structure it in such a way that indigenous companies will supply an agreed range of product. It seems to me, as you drive along the M8 that one company feeding off the other, between inward investors and indigenous companies can be a way forward. I have grave worries about screwdriver plants.

LOCAL NETWORK
Knowledge networks may stimulate innovation, improving competitive-ness. Are you part of one?

We are part of a network for a knowledge base, but not from a complimentary business relationship. When you look at Silicon Valley or my Italian model they are all geared to an end product, they are structured in that way because they think everyone benefits. The difficulty is the nature of the networking. In West Lothian there are companies who can form inter-trading partnerships. In Silicon Valley that model works because the companies are synergetic - they are all in the same type of industry. But without that overlay networking is far more difficult.

But networking is a very useful thing. I personally think that West Lothian should encourage.

We trade globally, and source mainly in the UK, but these are not networks, they are normal trading relationships. This may be bi-lateral partnerships but it is not a network. Partnering and networking are different.

From Hunting Park's point of view we have......this is special for me, but my colleagues go along with it. I think that Hunting Park takes a lot out of West Lothian and we have got to put something back in. I say to them, ten years ago there was only two of you, now you have 133, you have benefited from West Lothian - that's a plus. There are other guys now starting up, if things which could have been sort-circuited for you it would not have taken you ten years to get where you are. All you want is someone to speak to you. You have got to know people. Everything is done through people. That's the one big culture thing which has not come out today is that Hunting Park is about people. People have worked long and diligently to build this company. The West Lothian Business Alliance has now started a mentoring process and I actively participate. The loneliest situation can be that of the Managing Director. It is not the case here because fortunately we have a team with intellectual ability who you can talk to and formulate opinions. But the MD in a smaller company may not have that as a luxury. What he needs is someone to bounce ideas off, to listen, to be at the end of a phone. I am quite keen that we must encourage this type of thing - that's networking, and has to be encouraged.

PUBLIC POLICY SUGGESTIONS

What could the local authority or the government do to improve the institutional framework facing West Lothian-owned manufacturers?
The Council has to get in amongst its customers - I mean customers in the business sense. They have to know that the Council etc will respond to their needs. That has got to be part of the culture of the Council and government agencies. You have got to get public sector employees to develop a customer focus. That manufacturing companies are trying to adopt a service ethos - that means giving the customers what they want. You have got to work at that. Just saying fancy words doesn’t make it happen. The sooner we get into that. I take my hat off to the Council’s Economic Development and Business Alliance, not just because I am on the Committee. That’s a good partnership and it could be expanded upon. But this ethos has to spread. For example into the retail sector. You get very much tied into business, and people because they are so busy don’t have the time to go and sit and exchange ideas.

**How adequate are West Lothian training providers for your purposes?**

They are fine for our purposes, as I have outlined you have to customise trainees to the specific requirements of your business.

**Is the information you put into, and receive from the labour market in West Lothian satisfactory?**

We have no problems here.
MGK (Scotland) LTD

Simon Johnston is a director of MGK (Scotland) Ltd, which is situated near West Calder in West Lothian. He was interviewed on Friday, 15 November, 1996.

MGK is located in Polbeth, one of the most deprived communities in West Lothian. The factory which is located next to a Daks factory and new industrial units, shows its 25 year existence. Outside it appears a older 'metal bashing' concern. Inside the offices are divided between administration and design, leading into a warehouse and metal working centre. Its image belies its outputs.

COMPANY PROFILE

What are your products and your output profile?

Half of our turnover is wholesale. But our real added value is design of sites, layout plans, choice of interior design and materials. We are separated into three main areas of operation. One is the factory - which produces stillages, racking, partitioning and metal work-surfaces. The second one is purely resale. We don't see the goods, we don't touch them; we just say how much do you want. Take it in, mark it up. These goods don't even come in here. This is just a profit making exercise: though it includes careful examination of what the client wants. Often we don't even do the installation. Thirdly the actual design is our most complicated area. This includes not only workspaces and product flow artefacts, but also lighting, suspended ceilings, electrics, wall and floor covering, partitioning.

We are not simply metal bashers. This is only part of our operation. The guys in our factory never see most of our jobs. They believe they are the value adding element - it's not true. They barely pay for themselves. We are trying to address this at the moment. We are trying to get our factory being productive again. Because as you probably know we were set up a long time ago to manufacture stillages, racking, and storage for the automotive industry. They shut down. Leyland shut down, Albion shut down, Timex at Dundee shut down. These used to take about half a million a year from us. So where do we get our business from now. We have to diversify, we making platform trucks, trolleys, workbenches. We do all these kind of things as a side-line - we are not really concentrating on any one thing. We have to identify our core business. This may be in industrial design.

Who are your customers? Describe a typical customer.
They are in the microelectronics industry we don’t focus narrowly on one or two or three customers. We trade with the top companies in Scotland including: NEC, Mitsubishi, Sun, Motorola, Abbey Chemicals, Boehringer Mannheim UK, Burr-Brown, Canon, Ethicon, Frans Maas Logistics, Gore Associates, Highland Snacks, Jabil Circuits, Levi Strauss, Russell Corporation, Seiko Instruments, Techdyne and Wyman-Gordon.

Who are your competition? How intense is competition?

Though we don’t force it down customers throats, we always try to tell them - a lot of other people work from catalogues. It’s so easy isn’t it for our competitors to go to a catalogue or 150 pages, and they stick their own cover on the outside. So ABC Storage has got one, some one else has one in the west and some one else in Aberdeen. But exactly that same catalogue is distributed through 20 or 30 other people down south, so there is 25 or 30 across Britain supplying from the same catalogue. And occasionally the client is sitting there with two catalogues: identical apart from the outside cover. I think this is sad. Our value added is in design. We are not simply a shop-keeper. We are designing, helping clients build your work environment, as opposed to just saying “Pick a colour, pick a size, pick a shape. Will that do you?” Our best competitor is the same; they design as well as sell on equipment.

What is your strategy for this business?

This is difficult. We have a vision, we have an image of how you would like the company to be in three or five years time or even longer term - ten years time. And I always feel we don’t spend enough time in sharing these visions. It’s difficult - just getting the time.

Sometimes people say, MGK exists here, but what do you do Simon Johnston, you run Simon Johnston PLC within MGK and it sometimes seems that that is exactly what happens. But then I think, well the company is making money; if we all keep working like crazy, it brings the money in and keeps MGK going. Simon Johnston PLC seems to make a contribution. Overall our company does need a bit of direction. Are we going to be manufacturing, are we going to be exporting. There are so many areas of the home market we are not covering. We have to get our close markets covered.

We presently flounder around at £.2 million-ish. I would say we are likely to rise to over £1.5m. Our manufacturing is only one third to one half of our turnover. Once upon a time it was 80-85% of turnover. We need to keep the balance, why can’t we get all three sides of the business going in sync. We
are perhaps jack of all trades and master of none. We are on a turnover plateau. The leap to £3 million, beyond that turnover growth is easier.

Some companies grow almost by accident rather than design. Someone comes from miles away and says I want something; they accidentally sell something. They do it once and all of a sudden - growth. One job we declined to take. It was not technically difficult. But we would never do it again; the price wasn’t worth it for a one-off.

Nobody else has the category of tool handling, storage and partition specialists. It quite a mouth-full. People don’t understand. Why should people who are supplying shelving, walls and ceilings, and interior designs - things that would be taken care of by builders. But the builder doesn’t sell jib-crane. But we sell small trucks. Perhaps it is the case that our comparators are more ‘shop-fitters’ than metal working factories.

Can you describe the management structure?

We have three working directors. Two cover sales and design, one oversees administration and production.

With what systems is work organised?

Effectively our 14 employees work in flexible teams. Because we don’t use a lot of new technology most communications are by talking to each other.

What are the main processes you use?

Remember there are three sides to our business. In manufacturing the processes are metal cutting, bending, welding and spraying. For middle-man sales our processes are ordering, perhaps re-packaging, delivery and installation. In design we progress by drawings.

What range of technology is employed?

MGK is short of technology for both design and administration. Most of our technology is in the manufacturing side. There are you have seen we have good quality welding and machine shop equipment.

How many permanent and casual employees do you have?

We have 14 permanent works, we do not use casual labour.

Do you operate a participative or top-down employer model?
In a small company everybody talks to everybody else.

**How is employment structured?**

The five men in manufacturing work under a Foreman, everybody else pitches in.

**Describe the teams or cellular manufacturing you use?**

In both the manufacturing and administrative teams everybody is flexible, you have to be. As I say, everybody just pitches in.

**Do you employees feel a mutual obligation to you?**

Sure. Everybody knows how well or badly the company is doing - we’re all sailing in the same boat. We are committed to each other.

**How do you recruit and improve ‘quality’ employees?**

It’s very difficult for a small company. We’ve sent office and manufacturing staff on short up-dating courses. They then pass on what they have learned to the others. On the design side we pick things up and let the others know when we talk over jobs.

**What motivates your workforce?**

Job security is a major consideration. But we’ve been going for 25 years. In that time many companies around here have failed. There’s always a camaraderie in a small firm.

**Price, Quality, Time, Kaizen scoring explanation from questionnaire.**

Quality is our major concern, aiming to get repeat business and recommendations. Price is important of course and delivery time.

**Can you describe how the culture of your firm corresponds with the social culture in West Lothian?**

We are a West Lothian company, employing in the main West Lothian people. As a manufacturing company we fit well into things here.

**What is your annual turnover, annual profit, and profit margin?**

Turnover is £1.2 million, margins 12% and profit 5%.
What strategic opportunities for innovation and technological change do you face?

Design is very labour intensive. It means investing in people just as much as investing in manufacturing tools. Sometimes the designs we are expected to do are too much for us. Most of our design is done by hand. It would be nice to use CAD for design, presentations, costings. There are packages we could use - we don't have that kind of stuff, I would love to have some, when we can afford it. At the moment we look to our suppliers for design ideas. Oh God. If we have £10,000 to spend, and I wanted a new design package and someone else wants a new shutter door, what needs doing, we are not fools, the investment in the package would pay for itself. We'd say sorry it may be draughty this winter, it will be fully implemented next year when we've got the money. But this year it's quite important to grow the business.

What constraints do you face in taking advantage of these strategic opportunities?

Capital is short. To grow would involve adding to our skill base.

INTERNAL KNOWLEDGE GENERATION

What staff, budgets and time do you allocate to product research, development, and product design?

We are not in a position to do research. Every job we do is a design challenge.

Can you give an e.g. of how and why a process innovation has occurred?

Our difficulty is that we work in small batches so by time we see how to improve processes, we're moving on to the next job. Over time we pick up ideas for improvement.

Does process innovation arise from a planned and conscious strategy or respond to events and opportunities?

To events and opportunities since our work is job by job - perhaps 200 a year.

Has information technology stimulated process innovation?
Not yet, but we recognise this is a major area for opportunity for us.

**Do you operate a ‘design-for-manufacture’ system in product innovation?**

Our entire work is this. People ring us up with a problem not a detailed request. This may be we have these boxes that need shifting from there to there in a very sweet movement, without damaging or breaking it. It may have to be done in such a time, or effortlessly. The difficult with that particular machine or whatever that we are trying to move, may be that there is nothing to pick it up with. It hasn’t got sides - you can’t pick it up from the sides, you can’t pick it up from the top because it hasn’t got a top. They don’t have a base in some cases. So you’ve got to think about how are you going to handle it. So you address the design from there. There are plenty of people out there who manufacture different sorts of handling gear to do this. All we have got to do is join up available products with solutions to client’s problems. Often this means an existing products with AB&C removed and XY&Z added. A lot of the time it is taking a standard product and doctoring it a bit.

**Have your suppliers stimulated innovation of product or process?**

Yes, but not as much as our clients. We manufacture and design. We don’t apologise for this. It’s the rest of Scotland who need to apologise. They haven’t survived. BMC is no longer in Scotland - they haven’t survived. They didn’t move into computers when there were no longer required. We have diversified somewhat - are we survive and are still holding our place in the market, although it has changed. Every five years things are changing - you’ve got to keep evolving. Sometimes we feel that we are losing the place, were are we going? What are we going to look to do in ten years time?

**Have your customers stimulated innovation of product or process?**

Many of the inward investors look to established companies, larger than our own, with wonderful marketing tools. An new company comes to locate here and they flood them with literature. I think it is right to target a few people in the company and ask politely if you can be of service. But I’ve seen the way some people do it. But they get results. And I’m thinking well, you can only alienate a few people, some will just grasp the hook and they will take it. I have a feeling we still have to address our marketing side and how we go about that. It’s the back-up support of people making clients aware that we are still here; as opposed to we are here even though you haven’t used us before. We need to say: hey guys, you have been using us, we are still ready
to keep serving you. As well as, hey you haven’t used our business for 6 to 8 months – anything we can help you with.

What motivates product and process innovation for this company?

We want to grow, and growth will come from offering a wider range of solutions for our clients at more competitive prices.

NON-CUSTOMER KNOWLEDGE TRANSFERS

Can you give an example of how this company gets knowledge which may stimulate innovation from: big companies contacts higher education contacts SE, LIS, LEEL, The Business Shop, marketing agencies, financial bodies, trade associations, Competitors, scanning the environment of your business, other outside bodies.

We have never applied for a grant, or received any assistance. We like to be independent and in control of our own affairs. It seems to me that some of the big companies get assistance they don’t need. For example, Burroughs (Unisys) have moved all over Scotland getting grants to set up, but have still left. I know of another company in Fife who have done the same.

CUSTOMER KNOWLEDGE TRANSFER

Can you give an example of customers making suggestions which have improved your products and/or your processes?

Yes some customers work us hard. For example, Sun Microsystems. We do work for them, and it has to be perfect. I get a lot of job satisfaction from working with a company like Sun. They respect their suppliers, and want a superior quality of job done - they get that.

How often does this happen, and how welcome are such suggestions?

Every job we do involves listening to the customers problem and offering suggested solutions to their engineers. I find it particularly satisfying working for Mitsubishi and NEC where we get to do all of the installation.
How have customers transferred their knowledge into your company: staff transfer, financial help, joint RD&D, equipment loan, worker-worker liaison, other ways?

None of these really. We work with their people directly sharing ideas.

Why have customers transferred their knowledge into your company: crisis in your relationship with the customer, arising from the type of relations with customer e.g. vendor rating, a continuous improvement relationship with a customer?

A lot of our customers are repeat customers. They may have been buying else where or going through lean times. It would be lovely if every single company out there would give us the opportunity - but they don't. Vendor rating and continuous improvement are difficult when jobs are one-offs. But we try to be competitive on quality, price and time.

How much easier is it to know what the final user of products wants, than to know what an intermediate customer wants?

We are always dealing with the final user in our design work. Sometimes when companies use us to order equipment we can advise them of a better alternative, but without knowing the use they have in mind it's difficult.

LEARNING ORGANISATION FEATURES

Is this a 'learning organisation' - constantly generating, accumulating and socialising knowledge?

Yes, from most jobs we learn something, and try to put that to work in future jobs. For a big job we all get together and throw in ideas.

A 'learning organisation' actively seeks out new knowledge and ways of doing things; can you give an example of this culture in your company?

It's difficult in a small company. We keep abreast of what other people are making and selling, and see other peoples' installations. Every day we get product information and catalogues, we try to pick out what might be useful to us.

It is suggested that a 'learning organisation' has leadership rather than management. Leadership constantly challenges the
knowledge base of the organisation. Does this distinction make sense to you?

You have to have both. We can't afford to generate lots of work but lose money on it. On the other hand, we have to go out and sell ourselves.

Can you give examples of how the following act as constraints on your company being a learning organisation: your financial structure or financial healthiness, the time-scales in which competition forces you to operate, the risks involved in continuous change and improvement, your business environment, the knowledge base of your employees, the skills and capabilities within your company?

It is difficult for us to keep all the balls in the air at once: manufacturing, design and re-selling. We need a balance between them.

How do you 'scan' for new knowledge of products or process innovation?

As I say we watch what other people are doing, we read the trade literature, and we take note of any new products on offer.

How do you 'scan' for new knowledge of marketing opportunities?

We contact any new businesses locating in central Scotland. We let existing clients know of new product lines we come across, and we remind people of our existence and what we are capable of.

Who acts as a 'gate keeper' assessing how valid outside knowledge could be?

This is done collectively between the four Directors.

Who effectively takes the decision/risk on technology changes in this company? How are these decisions taken?

We all do, the Directors.

How effective are two-way communications within this company?

They have to be good.
Do you use project teams to implement product and process innovation?

I suppose so, but at a simple level. If we get a job that requires it, we all sit down and think about the best design and manufacturing solution.

Does this company actively socialise knowledge? By what means?

Well, in ways like I have described - being part of a team and sorting out problems.

SUPPLY CHAIN CONNECTIONS ALONG SUPPLY & VALUE CHAINS

What is the scope of your supply chain in terms of geography, technology and value of procurement budget?

On the manufacture side, most of our supplies come from central Scotland. On the re-selling side, we take from wherever - mainly down south.

What percentage and amount of your turnover is value-added?

25 to 30% of our turnover is value added.

Do you regard your suppliers as partners? Give an example.

To a limited extent. We need the right price and reliability, so that we can pass that on to our customers. But you don't always get it, being a small player.

Explain the type of inter-relationships from your questionnaire answers.

About 40% of our purchases are regularly with the same businesses, but always based on work we have been commissioned to do - we don't hold stock. The rest is purchased from whoever supplies what the customer wants.

Are these inter-organisational or inter-personal relationships?

A lot of business comes from trust and personal contacts. It is very much an intimate personal trust. MGK does exist. We all know that none of us are bigger than the company. We could each leave and take 10% of the
customers, but we still know there is always a company image there, regardless of the fact of individual personal connections.

Are you part of the tiering of a supply chain to an OEM?

No.

Is your own sourcing policy: single sourcing, multi-sourcing, competitive sourcing or spot sourcing? Which is your preference?

We buy what we need to fulfil orders, so it depends on what the customers wants.

What are the main differences between your supply chain, and those of your major customers?

Well most of our customers are repeat, but so are many of our suppliers. I suppose the main difference is that our supply chain brings in products through agents, whereas our value-chain deal directly with our customers.

Do you actively transfer knowledge backwards along your supply chain by transferring technical information to suppliers.

No.

Do you actively transfer knowledge backwards along your supply chain by involvement in business strategy changes of your suppliers.

No.

What routes do you use to transfer knowledge to you suppliers e.g. staff loan, joint development, equipment loan, financial support.

None of these. We are either buying in raw materials from metal or pipe producers, or ready-made equipment.

What is your aim in improving the knowledge base of your suppliers e.g. to improve price, delivery time, product quality.

None of these.
Would you say that your suppliers have a similar commitment to continuous improvement as yourself, or not? Give examples.

Well.....they let us know of new product lines. But when you are dealing direct with the customers, like we do, you have to be far more focused on improvement than our suppliers are.

Do you actively transfer knowledge forwards along your value chain by transferring technical information and suggestions to customers.

Yes, all the time - this is the heart of the value-added element of our business.

Do you actively transfer knowledge forwards along your value chain by any involvement in business strategy changes of your customers.

No. I don't think NEC need us to tell them how to conduct their business.

What routes do your customers use to transfer knowledge to you e.g. staff loan, joint development, equipment loan, financial support.

None of these - we discuss our suggestions and jointly arrive at an agreed solution.

What are your customers aims in improving the knowledge base of your company e.g. to improve price, delivery time, product quality.

They want quality installations.

Would you say that your customers have a similar commitment to continuous improvement as yourself, or not? Give examples.

Yes, Sun is a good example. We re-work suggestions time and time again until they are exactly right.

FOREIGN DIRECT INVESTOR TRADING

What allows you to successfully trade with major inward investors, or alternatively prevents you from doing so?
Often we are local and easily on hand. Sometimes we get recommendations from one customer to another.

**How do you weight the potential advantages and disadvantages of becoming a preferred supplier to an inward investing OEM?**

This can be a problem. At one stage we were doing so much work for Nissan in Sunderland that we had to sub-contract out. Then all of a sudden it dried up. We rang them and they said there was no problem. But that was it. We now try to keep a balance between the different parts of MGK’s operations.

**How aware are you of FDI sourcing outwith West Lothian which you believe your company could successfully meet?**

Sure. But we don’t just compete for work in West Lothian: we see ourselves taking on work from anywhere.

**Is this company prepared to improve its capabilities to meet FDI supply chain requirements? What would you be prepared to do?**

We want to improve our marketing and our design capabilities.

**Is trading with FDIs for some reason only a limited part of this company’s growth strategy? If so why? If not - how broad a location of FDIs do you consider your potential market?**

Many of the inward investors look to established companies, larger than our own, with wonderful marketing tools. An new company comes to locate here and they flood them with literature. I think it is right to target a few people in the company and ask politely if you can be of service. But I’ve seen the way some people do it. But they get results. And I’m thinking well, you can only alienate a few people, some will just grasp the hook and they will take it. I have a feeling we still have to address our marketing side and how we go about that. It’s the back-up support of people making clients aware that we are still here; as opposed to we are here even though you haven’t used us before. We need to say: hey guys, you have been using us, we are still ready to keep serving you. As well as, hey you haven’t used our business for 6 to 8 months - anything we can help you with.

**Local FDIs are considered to be ‘world-class’ manufacturers, how important is it that this company learns from their best practice?**

Absolutely important - we need to take on board best practices and these companies have some of the best practices in the world.
Working in supply-chain partnership may mean allowing an OEM to influence investment, product development and training strategies. How would this company balance this against organisational independence?

We’re supplying enabling products (racking, work-stations, product-flow devices). We respond to what the big microelectronics companies want. If what we do was so important to them they could do it themselves. It makes sense for them to use our expertise rather than employ expensive consultants or big in-house design teams.

Developing a long-term supply chain partnership may involve investing a lot of personal time to build up trust. Is this your experience? Would you be prepared for such an investment.

It is with (say) ten of our customers. The rest use our company but it isn’t a personal relationship.

If developing a long-term supply relationship necessitated a large financial investment, would you be prepared to seek external funding to finance it?

No. We grow on our own resources - ploughing profit back into the company. If we could get outside money without interference we might consider it.

If an OEM asked you to jointly develop a new product, the cost to you being significant, how would you respond?

No problem, provided we could afford to do it.

Why can West Lothian owned manufacturers export so successfully, but trade so little with inward investors?

The only export we do is one shipment to America, one shipment a year. If we were able to exploit export markets we would be keen to do so. The problem is that our products are too bulky and costly to be shipped abroad. A major export drive may be a non-starter for us. There are plenty of companies and agencies, based in London, in our industry who successfully export to places like the Middle East. They are constantly turning up manufacturing companies say “We need this. We can’t get it in Saudi, Kuwait, Jheddah - we need British supplies manufacturers to do it. We’ll pay for the carriage, that’s our problem.” India also the demand for intermediate technology is vast.
Yes we have done some export through agents down south. They worked fine with no problems. It is just getting yourself know which is the hard part, allowing yourself to be trusted - you have to be trusted. You are so far away from them, they are so far away from their client (though they probably have regular contact). When they say “We have this possibility of a job, do you want to visit.” I have to say, no thanks, get the business first and then I’ll come to visit. It’s a long way. The difficulty is first breaking into these markets, then ‘You’re the man.’

A lot of business comes from trust and personal contacts. It is very much an intimate personal trust. MGK does exist. We all know that none of us are bigger than the company. We could each leave and take 10% of the customers, but we still know there is always a company image there, regardless of the fact of individual personal connections.

To trade with these big companies you have to offer them something they don’t have themselves - in our case design and manufacturing capability.

**LOCAL NETWORK**

Knowledge networks may stimulate innovation, improving competitive-ness. Are you part of one?

The West Lothian Council run many networking events bringing people together. They tend to be back-slapping routine and not business. I like business to be business and pleasure to be pleasure and not mix the two. Four or five time out of ten you don’t really get on with these guys: they are much older or have different interests, or they already know each other. When I’m out at night I don’t thrust my business card at people.

Is a knowledge network amongst West Lothian-owned manufacturers an achievable goal?

Perhaps, but the big companies would have to take the lead.

Who would be the participants in a knowledge network of most use to your company?

If our customers were part of a network - we would be.

From a knowledge network what sort of knowledge would this company find most useful?
I suppose knowledge which would help our business, like what was happening and who was growing or changing.

**Which organisation(s) should have the responsibility to further develop a West Lothian manufacturing knowledge network?**

I think the big companies.

**What input from outside manufacturing companies in West Lothian would you like to see in a knowledge network?**

Just what business opportunities are likely to come about.

**How do you balance being in competition with other West Lothian manufacturers, and the possibility of sharing knowledge with them?**

Nobody else in West Lothian does what we do. Our nearest competitor is in Glasgow - unless people buy direct form the agents.

**PUBLIC POLICY SUGGESTIONS**

**What could the local authority or the government do to improve the institutional framework facing West Lothian-owned manufacturers?**

I suppose, particularly after our conversations, that we are not aware of some of the services, information and support on offer - these should to targeted at small companies like our own and market better.

**How adequate are West Lothian training providers for your purposes?**

I can't say since we have not used them.

**Is the information you put into, and receive from the labour market in West Lothian satisfactory?**

We have had no problems.
Appendix Two: Empirical Data From Indigenous Companies

SCOTFORMS COMPUTER STATIONERY LTD

Peter Laidlaw, a Director of Scotforms Computer Stationery, has responsibility for both Production and Finance, and was interviewed in the company premises at Brucefield Industrial Estate, Livingston on Tuesday, 26 November 1996.

Scotforms is located on the smart Brucefield Industry Estate. Covering 30,000 square feet its presents an impressive modern image. Inside the plant a clean, well organised environment signals a no-nonsense business, with staff who obviously take a pride in customer friendliness.

COMPANY PROFILE

What are your products and your output profile?

Products are business forms, computer forms, general printing and full colour printing, and a small amount of office supplies.

Who are your customers? Describe a typical customer.

A manufacturing company, typically employing about 100 people. Usually they are located in Scotland, we don’t do anything over the border - unless a customer has a branch there or has its buying operation up here.

We have 2,000 customers. This is a strength and a weakness. We are not dependent upon any one customer, on the other hand it’s hard work keeping so many happy, and adapting our systems to their requirements. Everyone expects their particularly needs to be met. We have what was called a management information system. I called it a ‘lack-of’ management information system. We had dramatically upgraded this, but its hard to suit all the customers. It is hard to interface with so many customer computer systems when many are only taking £5,000 per annum.

Who are your competition? How intense is competition?

Competition is national i.e. UK-wide. There are only two or three competitors in Scotland, and three or four over the border. There are several agents, who are buying and factoring over mobile phones, sticking on a margin, and sourcing from spare capacity. Competing against these people is very difficult, they have no overheads and choose their work carefully to fit with other people’s spare capacity. We do work for them ourselves, but at other times suffer because they can undercut our prices. Spare capacity arises in all printing firms during the early part of the month. Competition is getting
stiffer especially for added-value work. In the main our work comes to us proof ready. We don’t add value by laminating etc more by meeting delivery times at good prices.

What is your strategy for this business?

The business strategy is somewhat difficult. My partner and I get so little time to sit down and agree a way forward. We make strategy up as opportunities unfold for us. We have to improve our service, that’s just as important as getting out a quality job. We have recently taken over a small local printing company who sold office equipment - anything from staples to jars of coffee. That’s given us an added dimension. We like to develop a one to one relationship with customers, at least our main ones; remember we have nearly 2,000 customers. We need to grow the number of customers. Even Okai, probably our largest customer is only about 2.5% of our turnover. There is plenty of work in Scotland for us to try and get, then we’ll think of expanding over the border.

Working on our services is more important than prices. We have to adapt to the customers requirements - however daft these may appear to be. I don’t like some of the demands made on us by some of the foreign companies - but there is nothing you can do about it. You comply with their just-in-time or lose the business. The ‘world-class’ companies know like Okai or Sun Microsystems know that they call the shots. We learn a lot about other people’s business in printing - their systems. Our strategy has to be flexible - to go with the customers.

I’m not sure how far we would want to grow. Much more than our present size and it becomes a different organisation. May be that will happen for us, and may be we’ll like it when it happens - I don’t know.

Can you describe the management structure?

My partner looks after the sales and dispatch side of things. He also leads on computerisation. I look after finance and production. We run three shifts in the plant and have a Foreman for each shift.

With what systems is work organised?

Everything has to be as integrated as we can make it. So flexibility is important to us. Of course we have specialists - like the printers - but we see ourselves as one big team. We try to constantly improve our internal systems.

What are the main processes you use?
An order comes in and we check the design and colours. We use a range of full colour presses and smaller off-sets. Sometimes products require treatment such as folding and collation or binding. They are then packaged - often to suit customer requirements. They are then dispatched and invoiced.

What range of technology is employed?

As you have seen most of our machines are German and Japanese.

We have had to adapt traditional equipment to the service ethos. There is little here you would not find in many print shops. Printing machines have a fairly long life-span. The difference is in the manipulation of the image - we have spent quite a lot of money on that. Five years ago optical discs were leading-edge, now it's just routine to get work in on opticals. But look at how the price of this technology has fallen - you'll soon get free PCs with petrol.

As you have seen good but not top of the range printing equipment. Our design capacity is fairly advance with some new Power Macs. One clever process is for bank security. We treat paper with a chemical which allows customers using a magic marker to check if the correct form has been used - the paper turns black when it's touched with the magic marker. This is a security product which we are hoping to sell more of. Our folding and binding equipment is industry standard.

How many permanent and casual employees do you have?

We employ 44, some are part time, but we try not to use casual labour unless we are really pushed. We've had agency workers and they don't bother like our own people. I'd rather run overtime than bring them in.

Do you operate a participative or top-down employer model?

Small print shops like ourselves are pretty democratic. Anyone could walk through that door at any time.

How is employment structured?

We have recently taken over a small printing shop and are integrating them and their work into our systems. We are putting these new people through customer-care training.
We have specialisms. We have people who are skilled in graphics, and people who are skilled on the web presses. We could not take a finisher and put him onto graphics. We are trying to maximise flexibility by getting people to learn new things, but these specialisations impose limits.

When we started up the company we decided to leave it an open company. There are people in the union, others are not.

Effectively we have the office and three shifts. Each shift has a Foreman. He covers both printing and dispatch.

Describe the teams or cellular manufacturing you use?

Skilled work like printing always limits flexibility. Outside of the printing and maintenance we try to encourage flexibility - that’s very important to us.

Do you employees feel a mutual obligation to you?

I would say so. The old days of inflexibility in the printing industry are over. Here everyone recognises that keeping our customers happy keeps us all in work. So people understand when we ask them to do overtime or that little bit extra. We try to give people tasks and targets they can reach, but not backed up by threats.

We have our moments of course, but when you’re growing its easier to share out the gains, than to share out the misery when things aren’t going so good. We still have problems with individuals. Just today one of our men on the cutters.......I had to have him in because of absences. He had problems at home, so......we try to help. Hopefully it will work out. We help him and he’ll stick by us in future.

How do you recruit and improve ‘quality’ employees?

Most of our people are local. But experienced printers are hard to come by, and its getting harder. If any of our people left today, we would be in difficulty.

The rest of our people we take in and train. Most have been with us quite a while. So over a period people learn different jobs and can be moved around.

What motivates your workforce?

Job security, a decent rate of pay, and I would like to think that team spirit counts.
Price, Quality, Time, Kaizen scoring explanation from questionnaire.

Quality is taken for granted, it has to be there. Our big customers are very demanding on delivery time. Even if they have delayed getting the work to us. Price comes in next, especially for new customers.

Can you describe how the culture of your firm corresponds with the social culture in West Lothian?

We moved here from Edinburgh in 1983 because support grants were important in our expansion. But, yes, I would say we are a West Lothian business now. Many of our customers are in West Lothian, most of our workforce is from here. Livingston has been good for us.

What is your annual turnover, annual profit, and profit margin?

We turnover about £1.5 million a year. Most of our profit is ploughed back into the business. Depending on the mix of work we make around 8 to 9% return.

What strategic opportunities for innovation and technological change do you face?

There are always opportunities in printing. We tend to stay just behind the leaders, and not to waste money on frills we don't need. Scotforms is pretty well fitted out on the print side. Provided that runs OK, it is often the add-ons that add value. So I suppose paper processing and binding are areas we will invest in. We have just spent £50,000 on design equipment.

We are manufacturing a bespoke item, but providing a service. The margins within this vary from customer to customer. Inward investors mainly see us as manufacturers (design and delivery seem to be tag-ons) for them. We hope to increasingly be regarded as a service.

The big picture is different with information moving on to CD-Roms for catalogues and information storage and retrieval. But for many people that's a long way off, and businesses will still prefer paper.

What constraints do you face in taking advantage of these strategic opportunities?

It depends how far ahead you want to look. I can see us growing to a three to four million turnover in these premises and with most the our present
equipment. If we thought we could go to five to ten million we would need outside money. I'm not sure we want that.

The print industry is now specialised into niches. Nobody does everything, nobody can afford to. If other expanded into our markets that would be a big constraint on us.

The constraints are not technological: more financial and size of our market.

**INTERNAL KNOWLEDGE GENERATION**

What staff, budgets and time do you allocate to product research, development, and product design?

Research is the wrong word. But may be 10% of our time is spent re-designing products for particular customers.

We are always looking for new products - the ability to manufacture products already in the market but done elsewhere. Most of these ideas come from our customers.

Can you give an example of how and why a process innovation has occurred?

We started to print gift vouchers, and the customer concerned had a great deal of trouble with forgery. So we, along with a paper supplier developed a paper which is chemical processed - this changes colour when touched with a magic marker. We also introduced specialist numbering. This allows them to check if the voucher is valid. We hope this business will expand. The forger is a clever guy these days. This was partly stimulus from the ourselves, but also from the banks rather than our direct customer.

There are other things such as computer paper work which have been in the market for a while, we are trying to do. We have always let people do it first, and imitated. You lose less money that way.

Another thing is one-piece mailers. It makes use of laser printers. Our product is printed and gummed. The idea is that as an order form it can be put through a laser printer and just posted. The technology is in the sealer, not the printing. It's similar to some company payslips.

Does process innovation arise from a planned and conscious strategy or respond to events and opportunities?
Well I heard about the security paper and chased up a contact. But mainly we respond to suggestions from customers, or keep and eye on what they ask for, or what we think they need.

**Has information technology stimulated process innovation?**

Oh yes. We can only keep pace with 2,000 customers by using IT. Also, we didn't know the cost of some jobs until recently. Now we have a daily feedback from computer monitoring costing labour time and materials for every job. Most print companies don't have this, they don't know their margins. That's why so many go out of business - they pay to do work.

**Do you operate a 'design-for-manufacture' system in product innovation?**

Yes. That's our advantage over some print companies. We are printers who emphasise service. Not a service providing printing. They are amateurs. So every job we are asked to design bears the print run in mind. Not just that but the cutting and folding. Some of these people don't realise what skill they have.

**How influential is your marketing expertise in product innovation?**

Only in that we listen to what we can't do, as well as what we can. If Ray [Marketing Director] identifies a customer need, we see if we could do it. That's one of the main ways we have built up the value-added side of the business.

**Have your suppliers stimulated innovation of product or process?**

Paper, ink, machine parts, office consumables - these are bog-standard. No not really.

**Have your customers stimulated innovation of product or process?**

Much more so......by asking for new things, improved quality, better delivery service. We respond to all that. Our people were pleased as punch when we got ISO 9002. They see all this as expanding the business. They see too many other print companies going down.

**What motivates product and process innovation for this company?**
We want to increase our share of the market, but not by buying work. But by providing services the customer wants at a profit to us.

NON-CUSTOMER KNOWLEDGE TRANSFERS

Can you give an example of how this company gets knowledge which may stimulate innovation from: big companies contacts higher education contacts SE, LIS, LEEL, The Business Shop, marketing agencies, financial bodies, trade associations, Competitors, scanning the environment of your business, other outside bodies.

In 1983 when we moved here we got a 22% grant for capital equipment, and a very good deal on the premises, which we own. The old SDA were an investor for our first seven years. But we would be reluctant to repeat it - they got their pound of flesh when they sold their shares back to us. We were growing and they were taking the dividends.

We are a member of the trade association. But we are a very small part of the industry. You have got to keep your ears open to find out what's going on. There is little interaction between suppliers.

I've been along to some of the Council's business workshops - but I don't find them too useful. Sometimes I talk to people from the business alliance.

Our customers are the greatest source of ideas for us. None of these other bodies play have been of any help to us.

We used Stirling University for quality accreditation. They had six month placements. So they placed somebody with us. We took him on full time and he is still with us. This was very important to us to remain in the frame for many tenders. The quality programme has tightened us up.

CUSTOMER KNOWLEDGE TRANSFER

Can you give an example of customers making suggestions which have improved your products and/or your processes?

The security paper I mentioned was a problem a major retailer had. They use a lot of promotions, but found people just copied the discount slips. We heard of this, and I suggested to them that we might be able to used a processed paper as part of a solution. This new product line is just starting and we hope it will take off.
I would say on processes that all of our processes have benefited from customer suggestions. Okai’s insistence on delivery to the day, within the hour forced us to look closely at our work scheduling. That and the computerisation I mentioned showed us how inefficient we had been. These two things alone have probably added one or two percent to our margins.

How often does this happen, and how welcome are such suggestions?

It is happened more often, we would be happier. I’ve read about electronic debt settling - that would solve a lot of problems for us. We take on board any suggestions that improve our service. Virtually anyone can print, not everyone can offer a printing service.

How have customers transferred their knowledge into your company: staff transfer, financial help, joint RD&D, equipment loan, worker-worker liaison, other ways?

None of these things. Our customers are in entirely different business to us. They have some ideas, but we have the printing expertise.

Why have customers transferred their knowledge into your company: crisis in your relationship with the customer, arising from the type of relations with customer e.g. vendor rating, a continuous improvement relationship with a customer?

No. Its because they are demanding. Everything has changed since I served my time. Then print-shops could dictate terms and customers waited. Now the boot is on the other foot. Sometimes its hard. We deliver a specification for a job; often they don’t understand why a certain weight or quality of paper is necessary - they just trust us to know what we’re doing.

How much easier is it to know what the final user of products wants, than to know what an intermediate customer wants?

By and large we are selling to the final user. That’s always better because the feedback is direct, the relationship is direct, and payment is direct.

LEARNING ORGANISATION FEATURES

Is this a ‘learning organisation’ - constantly generating, accumulating and socialising knowledge?
Its not a term I would use, or I'm sure I fully understand, but yes. We like to learn and change with the times - that's our future. Skilled printers are worth their weight in gold - it takes years to understand all the foibles of the trade. We've managed to combine that with a service attitude. We're learning all the time. All our people want to learn - its not a threat, its a challenge, and security for the future. But we're building on a sound base - the core of this business is highly skilled.

We try to impart our knowledge to younger people. But some people don't want to learn new things. We try to create the atmosphere that progress is our friend not an enemy. One reason for bringing in someone to take work from Ray and myself is to give us more time to pass on what we know.

A 'learning organisation' actively seeks out new knowledge and ways of doing things; can you give an example of this culture in your company?

You have to listen to customers. To see what they are buying. I think we pick up more by hearing what we can't do than hearing what we can do.

It is suggested that a 'learning organisation' has leadership rather than management. Leadership constantly challenges the knowledge base of the organisation. Does this distinction make sense to you?

This is a big one for us. Ray and myself don't have a minute. We're thinking that we need to bring someone else in, perhaps to take over production management. We need more time to chew over where we're going.

Leadership......well we've built this up from nothing. There are days when I try to mull things over, minimising the routine things. Or going home in the car - having a think in the car.

Can you give examples of how the following act as constraints on your company being a 'learning organisation:' your financial structure or financial healthiness, the time-scales in which competition forces you to operate, the risks involved in continuous change and improvement, your business environment, the knowledge base of your employees, the skills and capabilities within your company.

We are lucky - I don't think skills are a constraint on Scotform's growth. Probably finance is the main constraint. But that depends on how far and how fast we decide to grow.
How do you ‘scan’ for new knowledge of products?

In the main, by listening to our customers, and knowing our limitations.

How do you ‘scan’ for new knowledge of process innovation?

Just the same.

How do you ‘scan’ for new knowledge of marketing opportunities?

We contact new companies, read the trade press. I spend half my day on the phone. Ray is out and about a lot of the time.

I would say we are often recommended by existing customers. Our real growth isn’t doing more for the same people, but expanding our customer base, so recommendations are important.

Who acts as a ‘gate keeper’ assessing how valid outside knowledge could be?

When we’ve got time, Ray and myself.

Who effectively takes the decision/risk on technology changes in this company? How are these decisions taken?

Again Ray and myself. I play with this [a calculator]. At the end of the day there are no certainties in business. Or life.

How effective are two-way communications within this company?

I would say very good. I’ve worked at places where people were afraid to talk or make a suggestion. It’s not like that at all here. Every few months we tell everyone what’s going on. If anything important happens we tell everyone. They’ll come back and ask questions and raise points. I’m a big believer in listening.

Do you use project teams to implement product and process innovation?

Not in a formal sense. But things are shared here. We have no prima-dononas. Someone designing a new job will talk it through when they need to. We expect that, and so does the shop.
Does this company actively socialise knowledge? By what means?

Strange words.

Yes, but with limitations. You can’t expect everyone to understand printing or the CAD and graphics stuff. But people here are not protective of what they know. We encourage questions, and we encourage answers. We certainly encourage flexibility. Everyone in the shop can operate cutting and folding and packaging machinery. So if we’re stuck, people can pitch in.

SUPPLY CHAIN CONNECTIONS ALONG SUPPLY & VALUE CHAINS

What is the scope of your supply chain in terms of geography, technology and value of procurement budget?

We buy paper, this is our main spend. We buy from four suppliers. Prices have gone down to the deck over the summer for carbonless paper and bonds-type papers which we use.

Part of the business we took over this year is a catalogue of office supplies. So that has dramatically widened our supply base.

What percentage and amount of your turnover is value-added?

Do you regard your suppliers as partners? Give an example.

No. We’re a small fish for our suppliers.

Explain the type of trading relationships from your questionnaire answers.

We have one formal supply agreement; that’s for machine parts and planned maintenance during shutdowns. With everything else we dip into a pool. We have three or four paper suppliers - we use Scottish if possible. And about the same number for chemicals, inks and binding fluids.

Are these inter-organisational or inter-personal relationships?

Both, but in the main business not personal.
Are you part of the tiering of a supply chain to an OEM?

No.

Is your own sourcing policy: single sourcing, multi-sourcing, competitive sourcing or spot sourcing? Which is your preference?

I would say competitive sourcing. But often not on price, but delivery time.

What are the main differences between your supply chain, and those of your major customers?

Look at this list of our customers. [Award plc, Bull, Burr-Brown, Canon, Daks, Digital, Frans Maas, Gore, Heat and Control, Levi Strauss, Mitsubishi, Motorola, Munro and Miller, NEC, Okai, Polbeth Packaging, Russell, Seagate, Scottish Gas, Scottish Power, Shin-Etsu, Silva, Sky, Sun, Shin-Etsu, Silva, Sky, Sun, Wymans]. We have 2,000 customers - these big ones maybe form 20% of our business. Its impossible for me to comment on their supply chains.

Our supply chain is probably narrower than most of our customers.

We deliberately support Scottish firms, because we believe in the future of Scotland - I don't suppose our customers are as sentimental.

Do you actively transfer knowledge backwards along your supply chain by transferring technical information to suppliers.

No, like I say, we are small fish for them. They might listen to larger customers not to us.

Maybe once every five years we get a new idea from our suppliers. Change for us is much more pulled by the customer than pushed by our suppliers.

Do you actively transfer knowledge backwards along your supply chain by involvement in business strategy changes of your suppliers.

Not at all.

What routes do you use to transfer knowledge to you suppliers for example by staff loan, joint development, equipment loan, financial support.

None of these.
Would you say that your suppliers have a similar commitment to continuous improvement as yourself, or not? Give examples.

That's an interesting question. Paper prices have gone down and that's helped us. But it's not because of mills improving, more because there is over-capacity. We just wonder how far down they can go, and how far up they'll go afterwards. Energy prices are the major cost in paper mills - we keep an eye on that.

Do you actively transfer knowledge forwards along your value chain by transferring technical information and suggestions to customers.

[Discussion on what constitutes a value chain]. Yes. We get to know their business processes and often make suggestions. These range from carbonised paper to smudge proofing, and storage temperatures.

Canon recently rejected a delivery. They said it jammed their printers. Ray went to investigate because we use the same paper in Canon printers ourselves. He found that they run tests on temperatures and humidity ranging from Norway to Southern Australia. But they hadn't told us that. It was simply a matter moving from 40 to 80 gram paper. Canon were delighted.

We recently had a problem of some smudging on a Okai order. This was probably the result of tugging on the press near the end of a reel. Okai asked us why we didn't check every document we printed. I couldn't believe it. They have no idea. It would be a human impossibility. But we learned a lesson for our scheduling.

Do you actively transfer knowledge forwards along your value chain by any involvement in business strategy changes of your customers.

No, never.

What routes do your customers use to transfer knowledge to you for example staff loan, joint development, equipment loan, financial support.

This never happens. We sometimes get visits. But they expect us to know our business.
What are your customers aims in improving the knowledge base of your company for example to improve price, delivery time, product quality.

They want reliability of delivery, at quality spec and contract price.

Would you say that your customers have a similar commitment to continuous improvement as yourself, or not? Give examples.

Some more than others. For example Sun Microsystems are a demanding customer, and Okai. They change their orders and designs, you can see how they are changing their business. A lot of the time we are vendor rated. Only rarely is this competitive - normally we are their single source.

FOREIGN DIRECT INVESTOR TRADING

What allows you to successfully trade with major inward investors, or alternatively prevents you from doing so?

Our experience is once you are a trusted supplier, you have loyalty. ‘Getting-in’ early is critical. Once you are the preferred supplier, you are difficult to shift.

How do you weight the potential advantages and disadvantages of becoming a preferred supplier to an inward investing OEM?

I can see how the Marks and Spencer syndrome could be a problem. But for us our largest customer only takes 2.5% of our turnover. Sometimes its outrageous. We got a fax from Okai, with a stiff delivery time. When we looked at the work it was all in Japanese. They had sent us the wrong discs.

For us the advantages greatly outweigh the disadvantages trading with the big foreign companies.

How aware are you of FDI sourcing outwith West Lothian which you believe your company could successfully meet?

Some of this happens, but not much. Not in the market we’re in. Obviously there is printing work we wouldn’t be interested in: glossies, laminates or film packaging.

Is this company prepared to improve its capabilities to meet FDI supply chain requirements? What would you be prepared to do?
Most certainly, and we have done. We pick up a lot of small work because of our design studio. Our security paper investment perhaps totalled £150,000. We would look at anything. I'm not saying we would do it, but we like to respond rather than turn work away.

We are constantly under pressure there is no doubt about that. In these last three or four years - all the time, you see the changes coming and try to anticipate them. It's as though they have all been on the same course. Because they all ask for the same things. The original just-in-time was a fad, it didn't work. But now it is working, and it puts us under pressure.

About ten years ago I remember sitting with a chap from William Stein, who was our main paper supplier. Banging the table that I could not get my reels. We had a real tiff. We did a lot of things that were innovative. We gave quotations out the same day, we pre-priced all work and that was it, we run a night shift for rushed jobs, we actually produced colour proofs (which was unheard of). All these things got us customers. Now it seems everyone is doing this. We look for new things to keep us a little bit different.

Being an owner-managed company in Scotland is a factor. All of our competition is down south or part of a bigger group. There is one small company in Perth. But we can respond to new ideas quicker than the competition.

Is trading with FDIs for some reason only a limited part of this company's growth strategy? If so why? If not - how broad a location of FDIs do you consider your potential market?

As I say around 25% of our work comes from these foreign companies. The rest from Scottish. We haven't sought work south of the border because we still have growth potential in Scotland. Also we would have to gear up our capacity. We have a fair coverage in central Scotland, but could double our turnover in Scotland in the next two to three years.

One of our salesmen specialises in opening up accounts with foreign companies, and trying to expand our business with them.

Local FDIs are considered to be 'world-class' manufacturers, how important is it that this company learns from their best practice?

This has been very important to us. We've learned a lot, and it helps us get business elsewhere.

We started up as a one-man-band more or less. We had to go through a steep learning curve to start with. Computer forms was growth industry in the
early 80s. We saw it as one way of starting up a business in printing which would give us a fairly rapid turnover increase. Also it was profitable. The days when we could dictate what we wanted to do are completely gone. Jobs used to be cost-plus, but not now. We now do whatever the customer asks, so long as the job is commercially prudent.

Working in supply-chain partnership may mean allowing an OEM to influence investment, product development and training strategies. How would this company balance this against organisational independence?

I don’t see it like that. You have to give customers what they want. So if we can create a new line for one customer, we can try and sell it to others. Sometimes we don’t understand why they demand what they do. If they spend more time explaining to us, we could perhaps help.

Developing a long-term supply chain partnership may involve investing a lot of personal time to build up trust. Is this your experience? Would you be prepared for such an investment.

Roy does most of that stuff. It’s not so much a personal relationship as being there if you’re needed. People trust you to deliver, and know that you’ll try, even when the request is unreasonable.

If developing a long-term supply relationship necessitated a large financial investment, would you be prepared to seek external funding to finance it?

Again, we’ve talked about this. I would say no today. But tomorrow who knows. I suppose it depends on who the financier is. We’ve built this company and would not give it up. But it may be that to grow beyond Scotland, we have to take in external finance.

If an OEM asked you to jointly develop a new product, the cost to you being significant, how would you respond?

Yes, so long as it made good business sense.

We weren’t left holding the baby - the market looked secure and likely to grow for whatever the product was. This may be the case with lamination. We are under pressure to offer lamination, and we might do so.

Why can West Lothian owned manufacturers export so successfully, but trade so little with inward investors?
I really don’t know. We can’t export because competition is so strong on the continent. Add that that travel cost and language problems and you have difficulty.

We could only export if we found some unique product we could patent. Equipment like ours is all over the world. For a company like ours to speculate, let’s say by bringing in a chemist to develop process would be too risky.

LOCAL NETWORK

Knowledge networks may stimulate innovation, improving competitive-ness. Are you part of one?

Not really. I used to go to the Business Alliance......but its time. Our main reference point are our customers. I suppose many of them are local.

I have been quite involved with the West Lothian Council’s management development programme. They had someone along from the Council going on about inward investors - some people think they are god. But I have to say that exposure to these people has completely changed our attitude towards customers. WE have a lot to learn from them, but the future of Scotland lies with indigenous companies not inward investors.

Is a knowledge network amongst West Lothian-owned manufacturers an achievable goal?

I’m sure it is.

Who would be the participants in a knowledge network of most use to your company?

Big companies and potential customers.

From a knowledge network what sort of knowledge would this company find most useful?

Products and how things are changing.

Which organisation(s) should have the responsibility to further develop a West Lothian manufacturing knowledge network?

Probably the Council. Or the Business Alliance if it grows. We would join and give it a try.
What input from outside manufacturing companies in West Lothian would you like to see in a knowledge network?

The more the merrier. But West Lothian is a queer place.

People here stick together, I don't know how welcome outsiders would be. You have to balance being useful with not becoming too large.

How do you balance being in competition with other West Lothian manufacturers, and the possibility of sharing knowledge with them?

We don't really have competition in West Lothian. The other print shops here have different specialities.

PUBLIC POLICY SUGGESTIONS

What could the local authority or the government do to improve the institutional framework facing West Lothian-owned manufacturers?

They could clear the snow better. [The interview took place amidst a downfall of snow, which though gritted froze and left many roads and pavement impassable.]

Maybe a Scottish Parliament will help things. Too much goes to the inward investors and too little to companies like our own.

There is certainly something in the argument that we don't get enough support as Scottish owned and managed companies. This is especially so if you are trying to be innovative. I soul search on this. I'm a bit ashamed of this story, but I once told the LDC, who had turned us down for a grant.....I said to them, I'd get one if I had slanty eyes. I don't think that public money should be thrown at companies. The government could have done more to ensure that these inward investors bought locally. Also they should support investment more by local companies. I know of many local companies who think the same.

How adequate are West Lothian training providers for your purposes?

Fine as far as it goes. Skilled printers are scare.
Is the information you put into, and receive from the labour market in West Lothian satisfactory?

Yes. The local labour exchange is always helpful.
Appendix Two:
Empirical Data From Indigenous Companies

TRIVET SHEET METAL LTD

Jim Bulloch, Chairman and Chief Executive, Wednesday 4 November 1966, at Raw Camps Industrial Estate, Kirknewton, West Lothian.

Raw Camps is a dilapidated industry area (an old railway yard), suitable for older ‘dirty’ industry. Trivet is situated upon land the company owns, presenting a traditional ‘metal bashing’ image to visitors. This image belies a modernly managed company, with a highly skilled workforce and top-of-the range equipment.

BACKGROUND

I am a sheet-metal worker, serving my apprenticeship in the shipyards at Glasgow. The difficult of trying to advance yourself in the world made me reject accepting my station as a ‘working man.’ The only way I could see into advancing myself beyond becoming Foreman, was to go into sales for McKellar-Watt. This moved me to Livingston. Eventually I was looking after their fleet and their training. I still felt that I was capable of better things and hence the decision to start a business. So, I gave them notice and came here. Initially I started looking for premises. In these days this was difficult (i.e. 1973). The LDC - who are a joke - only wanted to know the big companies like Cameron. They didn’t then produce small factory space. I got some advice from the Regional Council. He suggested that we could rent a piece of ground. Eventually we bought this ground after two years leasing it. It was the first of May that I started in 1973 - with no customers and no facility. I chapped doors to get business in sheet-metal which I knew. In the meantime I built the first factory unit: I dug the holes, poured the concrete, made the frame, and using off-cuts of sheet metal made our first building. By December I was up and running. A guy that I knew came into the business with some equipment. Our first job was with Uniroyal, cleaning out the ducting in the dirty plant. It was the dirtiest work I’ve ever seen - crawling through ducts lined with black plastic mud. They had signs up at the gate saying union cards must be shown. But nobody ever asked to see our cards - they were too afraid they would have to do the work. We developed from there. We got some assistance from the old SDA to build the larger factory. We struggled along for 17 years and after 17 years we build the third factory.

COMPANY PROFILE

What are your products and your output profile?
We provide ducting and sheet metal working, in the main for companies rather than individuals.

**Who are your customers? Describe a typical customer.**

We supply about 75 customers a year. Most of the customers return to us. Take Shin-et-Su - they have been a customer of ours since they came here. Our difficult is when we are working for a main contractor. Often we are not directly providing a product for the end-user. The box for the computer is entirely different from the ducting on the assembly line. Firms like Mitsubishi, who we deal with directly, come back time after time for sheet metal work - they know we bother and do a good job.

**Who are your competition? How intense is competition?**

There are may be 25 firms in Scotland who think they can do what we do. But only half of them can. Our difficulty is that in the recession people buy work and it becomes difficult to survive. Survival is OK but it's not enough. I'm a half full man, not a half empty man. It irks me when you work hard and the government is actively destroying industry.

**What is your strategy for this business?**

I did think about going into the metal box making like Livingston Precision Engineering have done. But that means mass production and lots of capital investment. If I wanted to go for growth it would mean a change of direction - I'm not averse to that. The difficulty we have, would be loss of control to raise the capital a change of direction would need. Say five years and five million pound for a paint line, finishing line and bigger bending machines. The problem is I would have nothing left of the company.

I would say that I

**Can you describe the management structure?**

I am it.

**With what systems is work organised?**

I get work in, do most of the design and let the men get on with production and installation.

**What are the main processes you use?**
Metal working has moved on. We now use CAD-CAM for drilling, bending and cutting metal.

**What range of technology is employed?**

Like I say for the amount of work we do, I try to use the most advanced equipment.

**How many permanent and casual employees do you have?**

I don’t employ casual labour, only time-served sheet-metal workers. Traditionally skilled men.

**Do you operate a participative or top-down employer model?**

Everyone here is a self-starter. Everyone can do the job, read the drawings and turn out the product.

**How is employment structured?**

I need flexible people. We now employ 30. I served my time in what we call a general sheet metal shop and that was a place where you did everything and anything. This is what we do here - we don’t specialise in a particular niche. You can get forced into that because of the skill shortage - forced to de-skill. That’s a retrograde step - I am old-fashioned enough to believe that. That’s fine if you’ve got a production line producing hundreds of thousands of the same items. But when you do many different and varied things that would be a problem. Our work doesn’t lend itself to that type of production.

**Describe the teams or cellular manufacturing you use?**

At any time we might have 10 or 12 jobs on the go.

**Do you employees feel a mutual obligation to you?**

We work as a team, people rarely leave here.

**How do you recruit and improve ‘quality’ employees?**

Men are recruited because they can do the job and want to exercise their skills.

**What motivates your workforce?**

Like anywhere: money, job satisfaction, and job security.
Can you describe how the culture of your firm corresponds with the social culture in West Lothian?

We fit well. We are manufacturers - that's the basis on West Lothian. But we still have an underclass. If people have no stake in the future they react. It worries me that so many people remain unemployed. The problem is that young don't have money to spend, don't have real training. For some people its as bad as the 20s and 30s - this angers me. We've learned nothing.

What is your annual turnover, annual profit, and profit margin?

We turnover £2 million a year. Margins vary with the job. Recently profits have fell with reduced turnover. Cameron Iron Works [a large foundry, recently closed] used to be worth £1 million a year to us.

What strategic opportunities for innovation and technological change do you face?

Some time ago I though of going into the computer-box business, like Livingston Precision Engineering. But capital is the problem. Its harder now that Livingston Precision Engineering, Lewis Grant and Strathclyde Fabricators are established. In fact people like Torbex are going out of business in this industry. Maybe I was right to stay out of it. Its hard to take work away from someone once they are strong.

INTERNAL KNOWLEDGE GENERATION

What staff, budgets and time do you allocate to product research, development, and product design?

People come to us both with specific requests for work, and with problems they want us to help solve. Each product is a different design. They have ventilation or extraction problems. Sometimes they come with a drawing.

Can you give an example of how and why a process innovation has occurred?

Every job is different. We used to get complaints about ventilation ducting letting in moisture of rattling. That why we went in for CAD-CAM. The exactness of the fit means a better job. This arose from comments from customers.
Does process innovation arise from a planned and conscious strategy or respond to events and opportunities?

Always from customers.

Has information technology stimulated process innovation?

I was brought up on slide rules. Look at this. [Demonstration of CAD]. I am convinced that this equipment has saved this company. We can not only offer design and re-design, but we use this for tender pricing.

Do you operate a ‘design-for-manufacture’ system in product innovation?

Always. And that’s the beauty of CAD-CAM. Often I talk in the shop about a design before we submit a tender, just to make sure we can deliver within budget. Often improvements are suggested.

How influential is your marketing expertise in product innovation?

Marketing is me. You have to be careful. Here’s a funny story. Several firms were asked to construct a new bell tower for Low Port Primary School. Most firms could never had done it. So we submitted a design and price and got the work. Because it was different we produced a Rolls Royce of a bell tower. But when we came to be paid the main contractor had gone bust. I try to be careful only to deal with people I can trust - ethics are important in business.

Have your suppliers stimulated innovation of product or process?

No.

Have your customers stimulated innovation of product or process?

Both. We buy equipment, and train staff to match our customers standards. Every job we do is different - we like customers to know we bother.

What motivates product and process innovation for this company?

I suppose customers and staying in business.

NON-CUSTOMER KNOWLEDGE TRANSFERS
Can you give an example of how this company gets knowledge which may stimulate innovation from: big companies contacts higher education contacts SE, LIS, LEEL, The Business Shop, marketing agencies, financial bodies, trade associations, Competitors, scanning the environment of your business, other outside bodies.

I would say not. The best way to look at that really is you operate by learning every day. You obviously talk to different people, not necessarily from ‘official’ bodies. You listen to bit of this and that. We try to find better ways to do things. I am fairly fortunate in that I have a reasonably analytical mind: you have to have to introduce CAD-CAM without formal training. We rely on our own people. Training and experience improves their skills rather than outside help.

CUSTOMER KNOWLEDGE TRANSFER

Can you give an example of customers making suggestions which have improved your products and/or your processes?

The depth of knowledge varies amongst our workforce. None have the same depth of knowledge as I have for example. That because I work closely with our customers at the early stages of job. It is in our interest to try and improve our skills as much as possible. We still take on apprentices.

How often does this happen, and how welcome are such suggestions?

With every new job we take on.

What routes do your customers use to transfer knowledge to you e.g. staff loan, joint development, equipment loan, financial support.

No, none of these. We just talk to each other. You have to stay along side people to make sure you are giving them what they want.

Why have customers transferred their knowledge into your company: crisis in your relationship with the customer, arising from the type of relations with customer e.g. vendor rating, a continuous improvement relationship with a customer?
Customers tell us what they want. We tell them what is possible, and what we think is best.

How much easier is it to know what the final user of products wants, than to know what an intermediate customer wants?

Our people like to deal with the men on the job; not the office or a contractor.

**LEARNING ORGANISATION FEATURES**

Is this a ‘learning organisation’ - constantly generating, accumulating and socialising knowledge?

I believe that all people are equal as people, but not in ability. So the difficult you get is you find that some people are capable of more. All of our people are skills but they vary in ingenuity. It's important to recognise peoples' limitations. I encourage people to either think things through and find new solutions, or to admit to their own limitations. I encourage people to try to put in the minimum input rather than the maximum input -doing things in such a way that they have to work a whole lot harder. Work smarter not harder!

A ‘learning organisation’ actively seeks out new knowledge and ways of doing things; can you give an example of this culture in your company?

In the old days people had inflexible attitudes. Everyone was paid the same: indifferent and hard working people. What we have done here is I assess them. They get variable rates of pay, and the pay rise is also linked to performance. To try and ensure that people are rewarded commensurably with effort and ability. All the guy who wants more money has to do is to improve his performance and he will automatically get more money. This gets away from the business that flexible workers get the same as those who are inflexible.

It is suggested that a ‘learning organisation’ has leadership rather than management. Leadership constantly challenges the knowledge base of the organisation. Does this distinction make sense to you?

I've always believed in talking about inputs and not outputs, of course with quality. I believe in quality assurance. We had quality before the Japanese came but poor industrial relations destroyed it. Unions and management failed to show true leadership. I am a great believer in sitting down and discussing things. You should be able to say, OK this is the situation. But
because of the historical distrust in adversarial industrial relations this can be lost.

What we have at Trivet is similar to what the Japanese have. We are trying to achieve flexibility and honesty in dealing with people. Having come from the shopfloor I know that the shop steward can be the laziest and biggest malcontent. This reinforces bad attitudes. I say here, 'The boat is called Trivet - don’t tell me that the hole is at my end of the boat.' The hole can be anywhere in the bloody boat - it still sinks. We discuss things and work out together the best way forward. People have to be encouraged to contribute - you can’t do this by waving a big stick, only by valuing people.

How have customers transferred their knowledge into your company: staff transfer, financial help, joint RD&D, equipment loan, worker-worker liaison, or other ways?

We work with the people on the job but have never had any loans of people or financial help. Some customers come to see our equipment.

How do you ‘scan’ for new knowledge of products or process innovations?

We talk to people. I’m not interested in some of the work that comes our way. We are not blacksmiths or precision engineers. You have to be careful to stick to what you are good at.

How do you ‘scan’ for new knowledge of marketing opportunities?

People ring me: they see our ads in magazines, or the local business directory, or get personal recommendations. By and large they come to us.

Who acts as a ‘gate keeper’ assessing how valid outside knowledge could be?

We’re not closed to any new ideas, we talk about them, together.

Who effectively takes the decision/risk on technology changes in this company? How are these decisions taken?

I do. But before taking any final decision I would always talk to the men.

How effective are two-way communications within this company?

You have to listen to people.
Do you use project teams to implement product and process innovation?

Every new job has a new team to do it. Sometimes this is all of us. Other times just one or two.

Does this company actively socialise knowledge? By what means?

Strange words. Everyone here is a craftsman. We talk about our jobs and this means everyone shares their best practice. If anyone has a 'trick' we all listen. Over the years you pick up a thing or two.

SUPPLY CHAIN CONNECTIONS ALONG SUPPLY & VALUE CHAINS

What is the scope of your supply chain in terms of geography, technology and value of procurement budget?

Our new machinery is German. Sheet metal we buy locally. Steel come either Brown and Glen in Edinburgh or Caledonian Steel in Wishart. Sometimes from other suppliers because they have what we need at that time. Because of our lead times - well if we were getting a fortnight to do a job that would be heaven. People want it tomorrow. So often we are picking up material rather than having it delivered. We buy about half a million pounds of sheet metal a year. I always buy from within Scotland.

What percentage and amount of your turnover is value-added?

About three quarters of our turnover.

Do you regard your suppliers as partners? Give an example.

Oh yes. Often they will make a special run or roll of steel for us, or work a week-end. They know that we all sink or swim together.

Explain the type of inter-relationships mentioned in the questionnaire answers.

95% of our purchases are spot because we don't hold stock - we only buy on the strength of a job to do.

Are these inter-organisational or inter-personal relationships?
Sure - you have to build up trust in business and you can only do that by knowing people. Then they'll go the extra mile for you.

Are you part of the tiering of a supply chain to an OEM?

It can be that we work for a main contractor. This is not our preferred option.

Is your own sourcing policy: single sourcing, multi-sourcing, competitive sourcing or spot sourcing? Which is your preference?

As I say we use a number of sources, but always spot purchase.

What are the main differences between your supply chain, and those of your major customers?

They can predict their work-flow easier than us.

Do you actively transfer knowledge backwards along your supply chain by transferring technical information to suppliers.

No.

Do you actively transfer knowledge backwards along your supply chain by involvement in business strategy changes of your suppliers.

No.

What routes do you use to transfer knowledge to you suppliers e.g. staff loan, joint development, equipment loan, financial support.

None of these.

What is your aim in improving the knowledge base of your suppliers e.g. to improve price, delivery time, product quality.

It depends what we are buying. If we were buying materials you may go along and say that needs 10 mill of mild steel - OK. At other times we need certificated material [for stress] and we stipulate our needs. None of our suppliers has ever suggested changes in materials to us. They assume that we know what we are doing.
Would you say that your suppliers have a similar commitment to continuous improvement as yourself, or not? Give examples.

They supply raw materials. If we were running a continuous production line and were looking for innovation or improvements in material OK. But because we are doing different things all the time, it doesn't lend itself to suppliers getting too involved in our work.

Do you actively transfer knowledge forwards along your value chain by transferring technical information and suggestions to customers.

All the time. The more complicated the problem the better I like it. We are often suggesting better layouts to customers.

Do you actively transfer knowledge forwards along your value chain by any involvement in business strategy changes of your customers.

No.

What routes do your customers use to transfer knowledge to you e.g. staff loan, joint development, equipment loan, financial support.

No. We talk through problems of design and re-design. Sometimes with senior people, other times with engineers. Some companies completely rely on us - they don't have in-house expertise.

What are your customers aims in improving the knowledge base of your company e.g. to improve price, delivery time, product quality.

Our customers want a quality product on time, price isn't that important.

Would you say that your customers have a similar commitment to continuous improvement as yourself, or not? Give examples.

Older companies need to improve their working environments, the newer ones are constantly changing as they buy new equipment or start new product lines or expand.

FOREIGN DIRECT INVESTOR TRADING
What allows you to successfully trade with major inward investors, or alternatively prevents you from doing so?

These multi-nationals come to us because we do a good job. They come here to invest money. I know they are doing this as an entrance to the EEC but that matters not. They are making a commitment to the area. We saw this first with Mitsubishi when they came into the area, then the NEC. The thing that sticks in my craw is OK you have these companies; but what is wrong with the indigenous people. I blame the City and the establishment for being averse to taking a risk. Why is hundreds of billions of UK money being invested abroad rather than here in our own companies.

How do you weight the potential advantages and disadvantages of becoming a preferred supplier to an inward investing OEM?

There are no disadvantages - it’s good to work with these companies. They want a quality product and are prepared to pay for it. These large companies rarely want to trade in manufactured goods with companies as small as us. We fill the niches without going for the bigger orders. Sometimes this is a problem - people who think that 12 pieces is a big order, but you can’t do that for the price you would make 12,000.

How aware are you of FDI sourcing outwith West Lothian which you believe your company could successfully meet?

I would say very little.

Is this company prepared to improve its capabilities to meet FDI supply chain requirements? What would you be prepared to do?

Yes and we have done. Look at our CAD-CAM and machining equipment. This is all to provide quality products.

Is trading with FDIs for some reason only a limited part of this company’s growth strategy? If so why? If not - how broad a location of FDIs do you consider your potential market?

We try to get work elsewhere but it’s difficult. Reputation counts.

Local FDIs are considered to be ‘world-class’ manufacturers, how important is it that this company learns from their best practice?

You don’t need to be a genius to know that one time the UK was strong economically. It was a long time ago but there was many things which used to be produced here. Suddenly you are not doing that any more. Look at the
The way Korea had grown so quickly. It's is a natural progression for these countries to develop their economy, to improve the life of their people. The trouble is in Britain we are falling behind through lack of investment.

Working in supply-chain partnership may mean allowing an OEM to influence investment, product development and training strategies. How would this company balance this against organisational independence?

How can you be independent of your customers. We have to meet their requirements. That's why we invest. That's why we train our people.

Developing a long-term supply chain partnership may involve investing a lot of personal time to build up trust. It this your experience? Would you be prepared for such an investment.

You have to spend time with your customers to make sure you are giving them what they want - no more and no less. Our customers listen to us, and we listen to them. As I say, trust is very important in business.

If developing a long-term supply relationship necessitated a large financial investment, would you be prepared to seek external funding to finance it?

We have done it.

If an OEM asked you to jointly develop a new product, the cost to you being significant, how would you respond?

Of course. But sometimes this means educating them about running a small business. We can't wait 90 days for payment. But I find they understand this.

Why can West Lothian owned manufacturers export so successfully, but trade so little with inward investors?

The government helps the foreign companies, but not the indigenous ones.

LOCAL NETWORK

Knowledge networks may stimulate innovation, improving competitive-ness. Are you part of one?

No. But having said that. There have been various things. There are people who go along to seminars on various aspects of setting up such partnerships.
What you find with a lot of them is “Very good!” and they pay lip-service to it. In fairness to that there are people who go to various meetings like myself. You obviously believe in networking. Some people are gregarious - that ain’t me. I am a loner not a joiner.

Is a knowledge network amongst West Lothian-owned manufacturers an achievable goal?

It may be, and it may help West Lothian businesses, but not me personally.

Who would be the participants in a knowledge network of most use to your company?

I joined the West Lothian Business Alliance for a short time. I can see why you think this is negative, because I’m not networking to get to know people and them to know you. But the people that I deal with are in my business network. I’m a doer rather than a talker.

From a knowledge network what sort of knowledge would this company find most useful?

As I say the main people I network with are within the company and our customers and suppliers.

Which organisation(s) should have the responsibility to further develop a West Lothian manufacturing knowledge network?

The Council organises some get-togethers. If we have time one of us goes.

What input from outside manufacturing companies in West Lothian would you like to see in a knowledge network?

I’d like to see government come here and justify some of what they get up to.

How do you balance being in competition with other West Lothian manufacturers, and the possibility of sharing knowledge with them?

We don’t - this is not a problem for us but it may be for others.

PUBLIC POLICY SUGGESTIONS
What could the local authority or the government do to improve the institutional framework facing West Lothian-owned manufacturers?

Personally, I think, people in Britain were brought up to “know their place.” I firmly believe you have to look at history to try to understand where we are at. The political system needs changing away from the adversarial system. It's not conducive to good management of either the economy or society. How can the government say things need changing when they have been at it for 17 years. Why isn't the economy sound? I can't understand people who vote Conservative. The City of London is far more important than manufacturing. I disagree with privatisation totally in as much as a private monopoly is the worst of all worlds.

How adequate are West Lothian training providers for your purposes?

The shortage of skilled workers is dire. Those in charge of training are more concerned with getting people off the unemployment register than giving them serious skills.

Is the information you put into, and receive from the labour market in West Lothian satisfactory?

It is very hard to get skilled men. We advertise locally but I can see the time when we will have to look farther afield.
Appendix Two:
Empirical Data From Indigenous Companies

WILSON BYARD PLC

Interview with Tony Flynn, Production Director of Wilson Byard, held in the company premises at Houston Industrial Estate, Livingston on Tuesday 19 November, 1996.

Wilson Byard is located in a smart industrial estate on the edge of Livingston. The premises (which are about to be upgraded and expanded) present a business-like image, without appearing opulent. The company owns both the land and the factory. Inside the a clean efficient looking workplace offers an image of a well organised company, doing well.

COMPANY PROFILE

What are your products and your output profile?

Wilson Byard occupy a unique position manufacturing both spiral piping and spiral pipe mills. Coating piping against deterioration is a current development within the company - we intend to invest £1.5 million in a new coating plant next year.

Our spiral welded steel pipes (40m to 300m diameter and 5mm to 25mm, to any length) are internally and externally welded, and coated to give suitable protective qualities depending on proposed use (water, oil, gas) and location (underground or under-sea). In robust tube form the pipes can be piled, as we have done at Sullem Voe, Dornoch Bridge and the Gallatta Bridge in Turkey.

They are competitively priced to buy, inexpensive to run, and operative training takes only four weeks. Designs are customised to meet customer requirements of coil steel to be used.

Who are your customers? Describe a typical customer.

We have been going for 30 years serving water, gas, oil, nuclear and other utilities with piping.

We have mills in 31 countries. Customers include Motherwell Bridge in Scotland, Hall Longmore and Group Five Pipe in South Africa, Fosters and Thompson Piping in the US, Soltuca in Venezuela, Habas in Turkey. Current orders are from Indonesia and China.

Who are your competition? How intense is competition?
Our main competitor is British Steel. They don't make spiral pipes but they can make conventional seamless tubing which does the same job. Anything over the 40" size is better made in spiral. There are other people in Scotland who produce spiral piping but they don't it in a competitive manner.

On the mill side. There are very few companies competing with our mills; there is an American PRP - their mills are much the same as ours. They make a mill that is much more expensive than ours. Our mill is cheaper because of the way we construct it and set it up, ours is cheaper to buy and cheaper to run. This is attractive particularly for developing countries. The Germans used to make mills but they were exceptionally dear, and they have priced themselves out of the game.

**What is your strategy for this business?**

To grow the pipe making side of the business in the UK up to our capacity of 50,000 tonnes a year, and to develop the coating plant planned for next year. One the mill side to grow by exporting, particularly to the developing countries.

**Can you describe the management structure?**

We have eleven people in administration and three Directors. A Contracts Manager, and Engineer/Draftsman, Accountant, and Production Manager. We have a production foreman.

**With what systems is work organised?**

We are gearing up towards full computerisation. We currently use computers for recording and of course in administration. Recent, we spend £38,000 on CAD equipment to provide drawings, measurement and costings.

**What are the main processes you use?**

As I say to you, we are basically a pipe making company. Everyone here can work on pipe manufacture. The jobs run themselves around delivery dates. We are all flexibly deployed around the jobs in hand. For example, we've got all the welding procedures pre-set, we give them to the client with the quote for the job.

**What range of technology is employed?**

For piping we take coil steel, mill it, weld it. If necessary we bend and shape the pipes - often these are 72 feet long and four feet in diameter. We might produce seven pipes of this size per shift.
For the mills we shape and weld the frame, and assemble the motor, gearing and instrumentation.

How many permanent and casual employees do you have?

Most of our squad are actually semi-skilled people. We have a few fitters and four or five welders. When they come in here the welders are all qualified - I never bring in untrained welders. That's the one department we keep right. We also have qualify our men on the spiral piping - which is quite simple. The rest of the operators are TEPAS skilled, some are specialised in testing or dispatching etc.

Do you operate a participative or top-down employer model?

I feel we are participative. We share information about the company, and regularly meet to discuss where the company is going.

How is employment structured?

In the factory we have men who specialise in testing, welding and assembly but with general flexibility amongst all employees.

Describe the teams or cellular manufacturing you use?

Our two product areas run separately most of the time. Within each area men rotate and work as needed.

Do you employees feel a mutual obligation to you?

I would say so - about half of our thirty employees have been with us over twenty years.

How do you recruit and improve 'quality' employees?

We recruit either by personal recommendation from existing employees or via the local labour exchange. May be because of the wages we pay, we have no difficulty in recruiting or keeping staff. Training is given on the job. For specialist jobs we recruit training men; for example fitting, electrics and welding.

What motivates your workforce?

We pay above the district average. All men, we have never ventured into that domain yet.
Price, Quality, Time, Kaizen scoring explanation from questionnaire.

Our products are equally sensitive to quality and price but delivery time is also very important. Customers also want to see improvement in the products.

Can you describe how the culture of your firm corresponds with the social culture in West Lothian?

Most of our people are West Lothian people, though we have some from Edinburgh and a few from the west. We are a West Lothian company, but we still have some people from Edinburgh - the company originated there. Its like everything else, you try to keep the labour force happy. If you are going to employ more people, you sometimes get the chance to bring in people on recommendation. Our people are not going to bring someone in who is not going to pull their weight. In the past we have had to lay people off, but we always try to employ them again. Over the last few years this has not happened, and I don't see any problem in the next year. About half of our workforce forms a nucleus who have been with us over 20 years.

What is your annual turnover, annual profit, and profit margin?

Last year our turnover was £8 million, gross margins 20% and profits 6%.

What strategic opportunities for innovation and technological change do you face?

We are about to undertake a major expansion. We have already recruited a qualified engineer to help install and run this plant. One point five million will be spent on this coating plant. It will give a plastic coating to pipes which are to be laid underground to carry water.

What constraints do you face in taking advantage of these strategic opportunities?

The growth of this coated pipe business depends upon Water Authorities accepting that the product is in their best interest. On the mill side, we sell more and less developed countries - our product has to suit both markets and not become too sophisticated.
What staff, budgets and time do you allocate to product research, development, and product design?

Up until 1990 we were kind of staggering for about ten years. We were run in those days by Costain the civil engineers. They used us just as a wee company in Scotland who were handy to make a pipe or whatever. So they didn't spend any money on us. They never invested anything in the Company. When they folded us up, somebody in Ayrshire took us over for a very short period. We then took it over and in each of the last 6 to 7 years we have boosted output and invested. This company now has a hunger to change for the better rather than any resistance to change.

Can you give an example of how and why a process innovation has occurred?

This is very important to us. Having been in a position to go overseas and see how other people operate, it is amazing, even in Indonesia, Korea, China - they are all doing the same thing: moving forward all the time investing money.

For example in we weld the spiral piping both internally and externally to high standards withstanding 35,000 pounds of pressure. Welding on the spiral side, we do at twice the speed of our competitors - 55 to 60 inches a minute. We have moved from single wire, to twin wire (which was too small) and now on to tandem with two wires on each welding head. This is exceptionally fast welding, very specialised.

Does process innovation arise from a planned and conscious strategy or respond to events and opportunities?

Process changes have to be planned for a long time ahead. For example we have been working for some years toward the building of an extension and creation of a coating plant.

Has information technology stimulated process innovation?

Yes, we now use CAD all the time for design, costings, and project management.

Do you operate a 'design-for-manufacture' system in product innovation?

Yes. We have suppliers of sub-assembled units for machined parts, gears and electrical instrumentation on the mills. Our designs fit around our manufacturing capability - the frame of the mill.
How influential is your marketing expertise in product innovation?

By and large customers come to us. But we listen to them and their problems. This is why we are installing a coating plant - to add value for our customers.

Have your suppliers stimulated innovation of product or process?

When we are selling mills for example to China, we don’t just sell them and install them. I keep in touch with them all, and we try to get them involved in ‘Tandem’ because spiral pipe they can produce the more chance they will buy more mills. Each mill sold is worth about $2 million.

Have your customers stimulated innovation of product or process?

Yes. Take the mills. Our South African customer has designed and installed several improvements which they pass on to us.

What motivates product and process innovation for this company?

We have to be globally competitive in both sourcing and sales. This company is not afraid of change, we want change and improvement to grow.

NON-CUSTOMER KNOWLEDGE TRANSFERS

Can you give an example of how this company gets knowledge which may stimulate innovation from: big companies contacts higher education contacts SE, LIS, LEEL, The Business Shop, marketing agencies, financial bodies, trade associations, Competitors, scanning the environment of your business, other outside bodies.

We have never had any assistance from any of these, maybe it is because we have never went forward and asked for it.

CUSTOMER KNOWLEDGE TRANSFER

Can you give an example of customers making suggestions which have improved your products and/or your processes?
On the pipe side we have actually got a better knowledge than our customers. We can tell them what they need. That's the game now, they use our knowledge. Their people tell us what they want and we advise them. This can be ridiculous: we have been beat in tendering only to find that other people make a mess of it. Our reputation now counts for a lot.

Often our mill users make suggestions. Like the ones I mentioned from South Africa.

How often does this happen, and how welcome are such suggestions?

Oh yes! One of the main companies we had quite a help from, but in others the things they asked us to do were wrong is Group Five in South Africa, who we have sold five mills to. They have give us a few ideas, have even designed bits for their own mills and passed them on to us. We work hand in hand with them to improve our product. All of the time we lift the phone to each other and share what we know.

How have customers transferred their knowledge into your company: staff transfer, financial help, joint RD&D, equipment loan, worker-worker liaison, other ways?

Not at all on the pipe side. Yes in our mill manufacturing, but we have to be careful not to create too sophisticated a product for some of our markets.

Why have customers transferred their knowledge into your company: crisis in your relationship with the customer, arising from the type of relations with customer e.g. vendor rating, a continuous improvement relationship with a customer?

Customers using our mills are not in competition with our pipe sales. Again many of our mills are sold as one-offs. We do improve our product but not as a result of vendor rating or anything like that. Our customers are delighted with the product.

How much easier is it to know what the final user of products wants, than to know what an intermediate customer wants?

In both pipes and mills we sell to the final customer. Where we have acted as a sub-contractor for other this has not been a problem.

LEARNING ORGANISATION FEATURES
Is this a ‘learning organisation’ - constantly generating, accumulating and socialising knowledge?

We are a learning organisation - we learn every day. We have moved beyond the old type of organisation which didn’t want to learn.

A ‘learning organisation’ actively seeks out new knowledge and ways of doing things; can you give an example of this culture in your company?

Yes. We travel all over the world. If we come across things which would improve our operation we bring the ideas back, discuss them and introduce them.

It is suggested that a ‘learning organisation’ has leadership rather than management. Leadership constantly challenges the knowledge base of the organisation. Does this distinction make sense to you?

Five years ago this company was on the rocks. We (the management) bought it with the assistance of 3i. We put ourselves on the line. That was leadership. Since then we have grown every year, and are now expanding further - that’s leadership as well.

Can you give examples of how the following act as constraints on your company being a learning organisation: your financial structure or financial healthiness, the time-scales in which competition forces you to operate, the risks involved in continuous change and improvement, your business environment, the knowledge base of your employees, the skills and capabilities within your company.

None of these. We produce capital products spiral piping and mills. Each product has different limits on it. One the pipe side our customers are mainly the Water Authorities. We want to introduce coated piping. Its a better product and we hope to persuade them to use it as standard. That's why we're investing £1.5 million next year in the new plant. Our limit in piping is customer acceptance.

One the mills, there are still things that we can do to develop them. But we have to look at it from the viewpoint of; is this what the guy in Indonesia or China is wanting. He doesn't want too sophisticated a product. Our mills are intermediate technology. On the other hand, like in South Africa, some of the people we deal with want a more sophisticated product and we work with
them to achieve that. We have to keep a good relationship with all of our customers.

**How do you 'scan' for new knowledge of products and process innovation or marketing opportunities?**

For our work people come to us. We have a Sale Director who seeks out business opportunities, but by and large people in Europe come to us. We were approached by Trafalgar House to sub-contract on a major bridge project in Portugal. We had never done anything like this before. But we completed our work, on site for ten weeks, on time and with a profit.

One the mill side, there are things we can do, and we are doing them. Many of the improvements in 'bought-in' sub-assemblies are brought to us by suppliers. We alter and improve our frame and assembly accordingly.

**Who acts as a 'gate keeper' assessing how valid outside knowledge could be?**

If a customer approached us with a suggestion, maybe the first thing we would do would be to bring them over here, we have done that in the past. And we have went over there to discuss suggestions. Within our company the Directors would consider any major innovation.

**Who effectively takes the decision/risk on technology changes in this company? How are these decisions taken?**

Collectively by the Directors in consultation I suppose with the financial backers. But we have no problem - this is a growing company, making significant investment.

**How effective are two-way communications within this company?**

We run a very open organisation. Apart from the formal meetings, we've all worked together for a long time - people feel part of the company and know where it is going.

**Do you use project teams to implement product and process innovation?**

Yes, we have a project team for the coating plant. One the mill side we are taking up some space outside the plant for production, we have a team for that. We operate with flexibility to get the work out.
Does this company actively socialise knowledge? By what means?

We have periodic meetings with everyone. The MD hands around a period statement outlining orders, proposed investments, our financial position etc. We keep in touch with the men. This is not a secret society. We try to keep the men informed about where we are going - big things and small things. I started off down there and remember when employees did not have information shared with them.

SUPPLY CHAIN CONNECTIONS ALONG SUPPLY & VALUE CHAINS

What is the scope of your supply chain in terms of geography, technology and value of procurement budget?

Over the last six years we have got a few different companies to provide the components for the mill. The reason being, they are familiar with our product - its a better situation.

What percentage and amount of your turnover is value-added?

Around 50%.

Do you regard your suppliers as partners? Give an example.

Coil steel is coil steel. Since British Steel have become our major competitor in the UK we source from all over Europe. Coil steel is made to a British Standard, which applies right through Europe as well. So price is important in sourcing steel.

We do get some help making the mills when it comes to drives, gear boxes and controls where people that we deal with sometimes come up with good suggestions, and we look at them. And sometimes we implement them. We have got a good relationship with the main suppliers. We don’t keep machining capability. We sub-contract all of our machining, and buy all the selanoids and gear boxes in. We build the main frame and then assemble the whole thing. Nine time out of ten we can buy in components for the mill cheaper than we could make them. We did try some machining in-house at one time, but it proved more expensive.

Explain the type of trading relationships from your questionnaire answers.
We used to buy all coil steel from British Steel. But they are now our major competitor. Now we buy rolls from wherever - all over Europe. The price we pay for steel is important for our selling price for pipes.

We have longer term supply relations with sub-assemblies for the mills. These are far closer relations where we know the people we are dealing with.

**Explain the type of inter-relationships from your questionnaire answers.**

Well, take the gear boxes. We buy the gear boxes from Browns. They recommend a gear box to us. Over the last two or three years we have been using the same double drive gear box. You can’t just change them overnight, they are £65,000 each, but they last forever.

**Are these inter-organisational or inter-personal relationships?**

Yes, as I say, we have closer personal relationships on the supply side for mill sub-assemblies.

**Are you part of the tiering of a supply chain to an OEM?**

No.

**Is your own sourcing policy: single sourcing, multi-sourcing, competitive sourcing or spot sourcing? Which is your preference?**

We do our best to constantly improve price and quality from our suppliers, but remember our product is an expensive capital product, many of our orders to suppliers are small to them.

**What are the main differences between your supply chain, and those of your major customers?**

On the pipe side our customers have a much broader supply chain than we do. With the mills our customers vary in the size of their operation so some with have broader supply chains and others quite narrow ones like us.

**Do you actively transfer knowledge backwards along your supply chain by transferring technical information to suppliers?**

Not on the coil steel side. But on the mill side, yes, we discuss with suppliers suggestions.
Do you actively transfer knowledge backwards along your supply chain by involvement in business strategy changes of your suppliers.

No.

What routes do you use to transfer knowledge to you suppliers e.g. staff loan, joint development, equipment loan, financial support.

No, none of these.

What is your aim in improving the knowledge base of your suppliers e.g. to improve price, delivery time, product quality.

Like everyone, we want to improve prices and quality.

Would you say that your suppliers have a similar commitment to continuous improvement as yourself, or not? Give examples.

I would say yes. Most the companies we deal with like Araba, Link-Co, Newbearer are the type of companies who seek continuous improvement.

60% of our supply comes from Scotland, most of the rest is from England.

Do you actively transfer knowledge forwards along your value chain by transferring technical information and suggestions to customers.

Yes, we do this on every job, on both sides of our business.

Do you actively transfer knowledge forwards along your value chain by any involvement in business strategy changes of your customers.

No. Though with the mills we discuss training and staffing requirements with customers. They see how we service our customers in Britain

What routes do your customers use to transfer knowledge to you e.g. staff loan, joint development, equipment loan, financial support.
I would say joint planning. On the pipe side we hold lengthy project planning meetings with customers. For mills each mill is made to the particular requirements of the customer.

What are your customers aims in improving the knowledge base of your company e.g. to improve price, delivery time, product quality.

It varies. On the mill side some are moving into new lines of business, other adding capacity. With pipes if may be, for example Yorkshire Water are addressing crisis problems, others may be expanding their business. Everyone is bothered about quality and price.

Would you say that your customers have a similar commitment to continuous improvement as yourself, or not? Give examples.

By and large yes. But its not an end in itself. Its no use us selling an over-sophisticated mill in a country where parts or maintenance could be a problem.

FOREIGN DIRECT INVESTOR TRADING

What allows you to successfully trade with major inward investors, or alternatively prevents you from doing so?

We don’t trade with the inward investors in this country, and trade little with multi-national companies abroad. Having said that the main thrust of this company’s growth will be through exports.

As a one-off, we did act as a sub-contractor to Trafalgar House building bridge in Portugal. It was one-off: how many new bridges do you get in Europe? This venture was successful technically and commercially.

How do you weight the potential advantages and disadvantages of becoming a preferred supplier to an inward investing OEM?

Controlling your own business is very important - control your own destiny.

How aware are you of FDI sourcing outwith West Lothian which you believe your company could successfully meet?

No.
Is this company prepared to improve its capabilities to meet FDI supply chain requirements? What would you be prepared to do?

We would look at any business opportunity. For example, steel for our new extension will be rolled by ourselves.

Is trading with FDIs for some reason only a limited part of this company’s growth strategy? If so why? If not - how broad a location of FDIs do you consider your potential market?

It is not part of our operation at all. Even abroad we sell to indigenous companies rather than multi-nationals.

Local FDIs are considered to be 'world-class' manufacturers, how important is it that this company learns from their best practice?

We are not reliant upon inward investors to show us how to improve. We improve ourselves. I've seen the Japanese companies here. I've even seen the Japanese spiral pipe mills - they're not much different from ours. I don't want to make too much comment about Japanese investors. I strongly resent the support given to inward investors compared to the lack of support for companies such as this. Most companies like us will also resent this. They may only be here for a short period of time; but we pay for the support they get. We are about to spend a lot of money, for a small company, but we get no support.

Working in supply-chain partnership may mean allowing an OEM to influence investment, product development and training strategies. How would this company balance this against organisational independence?

Any loss of independence would be a worry to us.

Developing a long-term supply chain partnership may involve investing a lot of personal time to build up trust. Is this your experience? Would you be prepared for such an investment.

Of course we have invested heavily in developing good relations, and it pays off.

If developing a long-term supply relationship necessitated a large financial investment, would you be prepared to seek external funding to finance it?
We would look at it. I suppose this is what we are doing with the new coating plant.

If an OEM asked you to jointly develop a new product, the cost to you being significant, how would you respond?

We would examine it in the same way as any other business proposition.

Why can West Lothian owned manufacturers export so successfully, but trade so little with inward investors?

You would have to ask them.

LOCAL NETWORK

Knowledge networks may stimulate innovation, improving competitive-ness. Are you part of one?

No, I think we are unique in this area. We used to participate in the West Lothian Business Alliance, but not recently. I did go to one or two of the meetings in Livingston a few years ago, but I must admit I didn’t get anything great out of it. I didn’t learn anything.

Is a knowledge network amongst West Lothian-owned manufacturers an achievable goal?

I don’t know.

Who would be the participants in a knowledge network of most use to your company?

For us our suppliers and customers - our connections are not really in West Lothian.

From a knowledge network what sort of knowledge would this company find most useful?

Things to do with our business and its future.

Which organisation(s) should have the responsibility to further develop a West Lothian manufacturing knowledge network?

I don’t know, like I say, our connections are global, not just West Lothian.
Appendix Two: Empirical Data From Indigenous Companies

What input from outside manufacturing companies in West Lothian would you like to see in a knowledge network?

If something developed that could help our company we would participate.

How do you balance being in competition with other West Lothian manufacturers, and the possibility of sharing knowledge with them?

No company in West Lothian is in the same business as ourselves.

PUBLIC POLICY SUGGESTIONS

What could the local authority or the government do to improve the institutional framework facing West Lothian-owned manufacturers?

Our experience with 3I has been more than satisfactory, but beyond that we rely upon our own resources.

How adequate are West Lothian training providers for your purposes?

Fine. We have no problems recruiting the skills we need.

Is the information you put into, and receive from the labour market in West Lothian satisfactory?

Relationships with the local employment services are reasonable, they send me down reasonable people when I ask them.
Appendix Three

THEORETICAL JUSTIFICATION OF RESEARCH METHOD

This appendix presents three sets of arguments relevant to and referenced by the thesis. In each case, their inclusion in the main body of the thesis would interrupt the flow of the argument. A philosophical of the research method is presented in section A.3.1, elucidating section 1.6.1 in chapter one. Section two details the institutional approach outlined in section 1.6.2 of the thesis. The third section of this appendix (A.3.3), further elucidates some of the arguments in section 6.9 of chapter six on the evolving nature of British regional policy.

A.3.1 THESIS RESEARCH METHOD

This research employs a realistic and grounded method: one that is repeatable, consistent, fair and open minded, and generates theory from empirical data (Easterby-Smith et al, 1991; Glaser and Strauss, 1967; and Gummesson, 1991). Researching a broad topic entails reference to wide ‘communities of assumptions’ (Etzioni, 1968:173). A broad array of social groups affect and are affected by the technological change entailed in the diffusion of lean production. Theoretical knowledge is significant where it is coherent and useful (Douglas, 1987:76). Yet coherence is problematic in broadly scoped research. Avoiding the twin dangers of rigidity in method, and ‘pick-n-mix’ eclecticism, requires a careful deployment of method. This section argues for a critical realism in method, drawing heavily upon the work of Bhaskar (1977 and 1986). The method employed here is eclectic, in the sense of choosing appropriate approaches from the diversity of options and seeking to justify an absence of mutual exclusivity.

My research method is eclectic and notes Popper’s advice to researchers.

Simply try your best to solve your problems and do not try in advance to make your concepts or formulations more precise in the fond hope that this will provide you with an arsenal for future use in tackling problems which have not yet arisen. (1992:30)

This research does not use a falsificationist method. This is the view that social theory not founded on a falsificationist method is prophetic or
metaphysical and cannot be scientifically predictive (Popper 1991; 1969:Ch. 1; 1989:Ch. 2; 1959:Ch. 1 and von Mises, 1960:37). From this perspective, truth can never be established, rather hypotheses not refuted become strengthened as theory. Popper's aims, as Blaug argues (1994:109) is that the 'informative content' of theory rests upon objective truth rather than usefulness of meaning. Popper's critics point out that society is dynamic and in disequilibria (Andersen, 1996), that theoretical advances have not adopted this method in practice, that alternative 'rationalities' are possible (Biderman and Scharfstein, 1989; Taylor, 1982:87) and that an absence of conclusive falsification regresses into scepticism (Chalmers, 1994: 60; Hausman, 1992). Since my research aims to understand current events and to influence policy-making, like Coombs et al, it asks why lean production diffuses seeking relevance for today's actors for tomorrow's outcomes. Rather than test specific hypotheses, this research aims to understand dynamic inter-organisational relationships and processes (Ahne, 1990:91). Like Boland (1992), I prefer a method which balances theoretical longevity with the need to guide action. Over time, as Polanyi (1958:18) points out, it is future scientists who ascribe significance to theory, that is validates or not the researchers constructed theory.

Notwithstanding Walkerdine's (1988:169) weariness of 'sterile debate about realism and relativism' it is important to negotiate a consciously defensible research method. Falsificationism has become associated with positivist methods in social science. This may be unfair, though Popper emphasises positivist methods. Austrian institutionalists (with the exception of Schumpeter) decried positivism arguing that predicting tomorrow from yesterday entails an inductive fallacy. The epistemic problem with positivism is the danger of conflating sensory perception with actual events and metaphoric interpretation - the imputation of causality. Gummesson (1991:55) suggests that for s/he who has a hammer, every problem is a nail, meaning that the strength of hypothesis-free research is the open-mindedness and grounded theory generation it allows. Care has been taken in the analysis chapters of this thesis to avoid precipitate generalisation. Ascribing causality from patterned social behaviour is thwart with difficulty, particular where 'situational experimental control' is assumed (this is not the case in this research). This research weaves in positivist facts when postulating conjunctural change. 'Facts' however constituted are first order questions of validity, as opposed to lower order questions arising from conceptual difficulty and interpretation (Ryan, 1970). Triangulation (of empirical findings with grounded theory and general theory), in this research helps overcome the false choice between qualitative and quantitative method. Glaser and Strauss, (1967:17) argue that grounded research is realistic whether it uses qualitative or
quantitative method provided that deductions have the reinforcement of triangulated.

Kuhn's (1962) general argument is well known (Barnes, 1982). A 'normal science' resolves puzzles within terms legitimate to a scientific community, as puzzles become irresolvable within these terms, a new paradigm emerges revolutionising legitimacy. The irresolvability of puzzles within a paradigm of normal science, is evidenced by 'pronounced professional insecurity' with an inability to solve puzzles whilst identifying an increasing number of 'anomalies' resulting in a 'shift of professional allegiances,' (Chalmers, 1994:90). Fay (1975) suggests that discoveries featuring in Kuhn's work can be re-interpreted in a more complex manner on the basis of recently emerged evidence illustrating that important work in several areas considered by Kuhn were undertaken outside the periodisation and intellectual phasing which Kuhn suggested. Barnes states:

By introducing a social dimension, and relating the status of scientific knowledge to the contingent judgement of specific communities of people, Kuhn undermined a whole range of philosophical arguments designed to secure a privileged epistemological or ontological status for science. (1982:12).

If the danger in adopting Popper's method is regress into scepticism, the danger from Kuhn's approach is relativism. Chalmers comments:

...Lakatos aimed to give a rationalist account of science but failed, whilst Kuhn denied that he aimed to give a relativist account of science but gave one nevertheless. (1994:109)

If knowledge is a social product (Berger and Luckmann, 1966:81), with meaning changes over time and space, in addition to 'enactment' changing, (Weick, 1979:164); then Feyerabend's claim that science has no superiority over other forms of knowledge appears valid. Feyerabend, (1993:268) argues that anti-rationalism differs from relativism (though he accepts the epithet in the sense of relations with other scientists working on similar problems). His central argument is that there is no system or procedures called 'scientific method' the absence of the use of which make knowledge less valid. Each body of knowledge has techniques (which historical example shows) are applicable to it, yet may be inapplicable to other sciences. Therefore, for one science to regard its body of knowledge as superior to that of another science, is prejudicial rather than based on quality of knowledge. Gellner poses the question to those advocating relativism in method: 'where does absence of objective reality leave us?' He comments (1985:83) that Feyerabend's view that in method anything goes, also means that anything stays - astrology has the
same validity as physics. ‘Strong’ relativism denies any pre-supposition of commonly shared standards of truth and inference, making discourse impossible, and disempowers actors. Scientific discourse presumes a ‘principle of Charity’: common standards for assessing truth exist.

Relativism in this thesis is distinguished from what Lukes (1982:261) refers to as ‘perspectivism’: that one’s perspective attaches particular significance or meaning to events; this is not methodological relativism, merely a recognition that different vantage points may engender different rationalities. This research is within ‘social shaping of technology’ thesis developed at Edinburgh University (MacKenzie and Wajcman, 1985). It also shares Freeman’s (1992) view that technological change is occurring within a changing technological paradigm. General theory benefits from Kuhn’s sociology of knowledge approach: for example labour process debate was stultified until Burawoy (1979) introduced subjectivity of interpretation.

Defining a paradigm and identifying paradigmal shifts are problematic. The discussion on the nature of paradigms and example of Harvey’s work on blood circulation in Fisher is instructive (1988:Ch. 8). A full exposition of the development of the philosophy of scientific method and scientific realism is given in Losee (1993:Ch. 18). Masterman (1970:61) outlines the twenty one ways in which Kuhn himself used the word paradigm.

This thesis employs ‘action theory’ in the sense that role, relationship, structure and process assist understanding (Bowey, 1976:66), but without the implied lack of generalisability in action theory. Callon (1980) is an example of an absence of generalisability from a social action approach insisting that only a posteriori ‘interpretative flexibility’ is possible. Context specific methodology or ‘situational logic’ are methods used by deconstructivists (Best, 1994). This thesis seeks to introduce a quality of reflexivity from grounded research, which can make generalisation significant and relevant (Beck, 1992). Such reflexivity makes necessary an admission (and justification) of values, rather than the denial of their existence (Capra, 1983:197). Making values explicit is a central in the work of John Rawls, (1971:4) and his later outline of contractarian theory (1990). Reflexivity is used here in Giden’s sense (1994) meaning avoiding presumption of preferences in agencies of, and direction of change. Reflexivity can overcome agent-structure problems as Hodgson (1993) and rational choice theorists (Elster, 1979) demonstrate. Habermas (1984:63) uses the term ‘communicative action’ to describe reflexivity oriented towards action (White, 1994:25). Trigg (1993), however, points to the danger of reflexivity itself becoming an ideology and therefore a bias. Chapters Twelve and Thirteen of this thesis seek to overcome this objection by triangulating between empirical results,
grounded theory and general theory. Triangulation is a term borrowed from cartography in which three points of reference are the minimum needed to ensure spatial accuracy. Campbell (1973:51) suggests that grounded theory always needs referencing to both empirical results and general theory. Alternatively, Gummesson (1991:30) envisages triangularity between time periods or organisations.

This research is trans-disciplinary, and stresses triangulation and reflexivity. Inhibitions on discourse between paradigms would severely constrain this work. Kuhn states that:

\[
\text{the competition between paradigms is not the sort of battle that can be resolved by proof. ...(and).......normal-scientific tradition that emerges from a scientific revolution is not only incompatible but often actually incommensurable with that which has gone before. (1962:V)}
\]

A scientific work cannot be poly-paradigmatic in this 1962 version of Kuhn's theory. Hassard (1993:80) suggests that in later version of his theory Kuhn rejected incommensurability, an interpretation which Barnes disputes. In Barnes's view (1982:65) incommensurability is the view that 'revolutionary' theories cannot be expressed using the concepts of pre-revolutionary theories. This thesis takes the view that few such discontinuities occur, and genuine incommensurability (the therefore disabled dialogue) is rare. This work is multi-paradigmal, not in the sense of Burrell and Morgan (1979) who seek to 'hold' the assumptions of constructivism whilst using a functionalist analysis but in the sense that reflexivity makes necessary discourse between findings from a variety of disciplines using a variety of methods. For example, this research draws upon the findings of a range of theoretical contributions without necessarily denying their methodological validity, (though validity may be denied when conflict between grounded theory and empirical results occurs). The epistemological basis of this thesis draws from both Popperian and Kuhnian method.

**Realism: moderated relativism and positivism**

This section argues that this thesis employs a 'realist' method explaining this in terms of triangulation, reflexivity and 'groundedness.' Realism in research method does not stand counter-posed to un-realism but to an absence of triangulation, reflexivity and grounding. Lawson comments:

\[
\text{A realist perspective has it that methods of social science, in their design, etc., should also take account of (including being continually modified by) insights elaborated (which may also be}
\]
continually revised) concerning the nature of social material. (1994:259)

Gellner carries this argument further suggesting that:

The situation simply is that science is consensual, and the philosophy of science is not. (1985:120)

The realist approach to social research has its intellectual origins in the work of Michael Polanyi who argues that accepting the mind-body dichotomy is at the base of natural science methodology, a dichotomy he rejects.

The prevailing conception of science, based on the disjunction of subjectivity and objectivity, seeks - and must seek at all costs - to eliminate from science such passionate, personal human appraisals. (1958:15)

Building his theory of tacit knowledge, he suggests

Everywhere, at all mental levels, it is not the functions of the articulate logical operations but the tacit powers of the mind that are decisive. (Polanyi, 1959:19)

Reasoning with 'universal intent' to find truths, cannot be reduced to an exercise in hermeneutics or falsificationism. It requires a commitment to discovery, the truth-hood of which is accepted or rejected by a scientific community.

The facts of biology and medicine, for example, can only be recognised as a rule only by experts possessing both special skill for examining the objects in question and a special connoisseurship for identifying particular specimens. The exercise of such an art is a tacit feat of intelligence which cannot ever be fully specified in terms of explicit rules. (Polanyi, 1959:23)

The notion of a 'scientific community' or 'invisible college' is criticised as mystifying the nature of verification by Katouzian (1980:165). Rorty (1989:73), agrees suggesting that where there is radical and continuous doubt about the vocabulary being used, these doubts cannot be overcome within the argument being addressed. For Polanyi language is a tool of communicating common analyses rather than a constraint upon discourse. His biographer Scott states:
At the heart of all knowledge, he insists, however exact, however much it uses formal procedure, there is this element of personal judgement depending on an unformalisable intuition, a skilled integration of unspecifiable particulars. (1996:52)

From both qualitative and quantitative data this work has generated conceptual categories which are outlined in Chapters Twelve and Thirteen. These concepts look back to the information from which they were generated and look forward to re-integration with general theory (Dretske, 1981:214). This is a process of familiarisation, reflection, re-conceptualising, cataloguing, re-coding and re-evaluation in the light of general theory (Easterby-Smith et al, 1991). This process includes referencing culture and habitus: an attempt to avoid what Drummond (1993:Ch. 3) calls a 'cathartic evaluation' of actor to object: the derivation of meaning only from structures rather than also from the intentionality of subjects.

A final comment on the difficulty of extrapolation and prediction from empirical results: Freeman (1992:218) poetically comments:

A trend is a trend, is a trend,  
But when and how does it bend?  
Does it rise to the sky?  
Or lie down and die?  
Or asymptote on to the end?

His view that theory is necessarily predictive, is shared by Katouzian, (1980:135). But what is the nature of a prediction? Bhaskar (1977) suggests that social formations become explicable by enduring critical realism: ‘deep’ social institutions are ‘knowable’ more by their intransitive character and results over time then direct observation. Predictive theory in this sense starts by being explanatory rather than predictive. It acts as a predictive force for actors needing to act, always recognising that apparently truthful theory may be proven wrong by events (Collier, 1998).

Only pure inductivists believe tomorrow is predictable from today. Induction is scientific reasoning from observation, often drawing generalised conclusions, or predicting, as Hume did, that the future will resemble the past. However, only in linear extrapolations are previous regularities guides to the future. The ‘inductive fallacy’ is that induction is a circular argument reliant for verification upon previous inferences. Induction therefore, relies upon degrees of probability. The final chapters in this thesis balance the findings of this research with general theory: they do not presume a ‘God’s-eye’ view of change. Trigg (1993:107) outlining the impossibility of objectivity, asks, is there a rationality independent of
circumstances of rationalist: a conception independent of all conceptions. All theory has to address change over time, and its significance is tested over time Snooks (1993:21).

A.3.2 AN INSTITUTIONAL APPROACH TO ANALYSING TECHNOLOGICAL CHANGE

This section justifies the use of an institutionalist approach in this thesis and clarifies the meaning of this approach. The section begins by referring to diagram 1.3 in Chapter One which serves both to define terms and provides an overview of how different levels of institutions and institutional analysis inter-relate. It is argued that neo-liberal theory contains a strong institutionalist base, which makes it superior to neo-classical theory for longitudinal studies. However, it is also argued that neo-liberalism de-centres technological change and has a limited programmatic base, making it unsuitable as a research tool for this enquiry. Universality and quantitative depth in neo-classical theory are highlighted, arguing that the lack of dynamism and the exogenous representation of technological change make the neo-classical approach inappropriate for investigating complex social events such as the diffusion of a technological system. A third section identifies the strengths of evolutionary theory. These include a non-deterministic institutional perspective which avoids predicated conclusions and dynamism. It is argued, however, that the biological metaphor, and the absence of a programmatic base narrows the use of evolutionary theory. A final section differentiates institutional theory from evolutionary theory. In summary this section concludes that institutional theory is an appropriate research tool to address the research questions this thesis addresses.

A guide to the conceptual categories and terms in the institutional approach adopted in this thesis

Section 1.2.1 uses diagram 1.3 to illustrate the nature and content of the institutional approach adopted in this thesis. Column one of diagram 1.3 suggests seven key conceptual categories used throughout this work and defined in this appendix. These terms vary in levels of aggregation and of abstraction. In column two the content of these terms is summarised, in column three their level of aggregation outlined, and in column four their level of abstraction indicated. Column five indicates the dominant form of institutions operative for particular levels of aggregation, and in column six the key actors at each level of aggregation.
This diagram is a guide rather than a map. Mode of regulation is indicated to be international regularities and dispositions at an abstract level of analysis featuring TNEs, supra-state bodies and international agencies characterised by market, hierarchy and network relationships. Institutional arrangements operate at a NSI level of aggregation and whilst remaining abstract appear more influential to decision makers. Institutions and social systems are still more concrete.. Such direct influence is clearly seen within an environment where face-to-face suggests that at this level of aggregations these institutional settlements directly influence and are influenced by actors. Inter-organisational patterns of contact and behaviour are the face-to-face concrete inter-relationships between actor organisations.

**Neo-Liberal theory**

Fukuyama (1992) suggests that the apogee of 'directional history' exists in the hegemony of neo-liberal economic and social ideas. This section presents the classic ideas of neo-liberal thinking, focusing upon theories of technological change. Austrian or neo-liberal theory rejects the marginalism and rationality of neo-classical economics, in favour of what von Mises (1969:14) terms ‘praxeology’ - cumulatively reinforced patterning of behaviour. Technology appears exogenous to von Mises's (1949:235) catallactic primacy of market exchanges. Rationality, he suggests, has no place in this theoretical system (Moss, 1976), which rejects both positivism and general equilibrium (Rothbard, 1976:67). For example, criticising neo-classical theory from a neo-liberal perspective, Moss (1981) argues that the 'efficient market hypothesis' is untestable and redundant. Hayek, who like Schumpeter, opposed Keynesian demand management (Galbraith, 1991:195), rejects most forms of state intervention in markets including subsidising technological research (Steel, 1993:165). Neo-liberal theory also discards normative value-judgements, it roots are in Popperian ‘falsificationist’ methodology and an atomistic form of methodological individualism (Shand, 1990; Blaug, 1994:109).

The strength of neo-liberal theory is its attention to cumulative patterning of behaviour rather than the *homo economicus* assumptions of neo-classical thought (Snooks, 1993:207). Indeed, Hodgson (1993:153) argues that modern institutional economics draws heavily upon the Austrian tradition, though Caldwell (1994:137) criticises neo-liberal economics for a lack of realism. Schumpeter is differentiated from the neo-liberal tradition by centrally locating technological change in his system (Deans, 1978:191). However, other features of Schumpeter's system - principally the form of methodological individualism he uses - leave the general analysis 'totalising' rather than grounded in actual social activity (Best, 1994:25). The Austrians, Chalmers (1994:113) suggests, hold the view that
knowledge has properties transcending the individuals holding the knowledge. Gellner (1985:41) dismisses this view as a ‘continuity thesis’ of naturalistically progressing science. Neo-liberal theory regard other theoretical approaches as necessarily false, and giving rise to falsehoods. Incommensurability is a justification for denial of discourse, which may be interpreted as an ideology (Lecourt, 1975; Masterman, 1970). A strength of socially rooted methodological individualism is the absence of hedonistic assumptions found in neo-classical economics (Roll, 1962:386). Trigg (1993:156) makes the point that Austrians are prepared to construct an individual, but not a social explanation of the world. However, unproved truth over social matters, if socially accepted, can significantly shape behaviour (Warburton, 1992:96). A research method seeking ‘physical’ science regularities is unlikely to make sense of dynamic and complex human relations involved in technological change (Mirowski, 1994:50). Such understanding is more likely from a method featuring social construction (Berger and Luckmann, 1966:81).

This research continually refers to grounded habitus to overcome problems inherent in operating at several level of aggregation. Another protection against determinism and functionalism is the use of rational choice methodological individualism which Elster (1985: 5) defines as:

"...the doctrine that all social phenomena - their structure and their change - are in principle explicable in ways that only involve subjects - their properties, their goals, their beliefs and their actions.

Methodological individualism has atomist antecedency and can be used to minimise the dependency or causality of human action upon social relations, denying that aggregated regularities of behaviour diminish individual rational choice (Popper, 1991:323). Alternatively, Elster argues that ‘rational choice’ theory an be re-interpreted as being based upon methodological individualism. His theory is designed to explain ‘imperfect rationality’ arising, he suggests, when decisions are filtrated firstly by choice of structural constraints, and secondly by intentional choice from the remaining possibilities.

Elster argues that Weberian parametric rationality, and strategic rationality (von Neumann), each imply predicated outcomes (the outcome is a necessary deduction from the assumed choices and decision process). Elster (1979:117) suggests that parametric rationality involves predicated choices but based upon irrational expectations and assumptions. Strategic rationality, has no expectations and assumptions and may not result in rational choice conclusions. In parametric-rationality the agent believes themself to be free, but knows the environment is made up of
other agents like himself; in strategic-rationality ‘game’ players believe that everyone else has the same rationality and information. Rational choice presumes bounded rationality reasoning appropriate to the cognitive agent, appropriateness being a reference to structural and transactional constraints upon perfect rationality - bounded rationality is necessarily imperfect rationality. Elster (1979) defends ‘satisficing’ and bounded rationality, arguing that structures ‘bind’ against a range of (irrational) choices, and intuitively individual actors exclude other choices. Elster’s advocacy of methodological individualism for Marxists is rejected by Burawoy (1995:191) who argues that ‘classes’ are not reducible to individual rational choice. However, Elster is supported by other Marxists and example being Warren (1995:231).

A neo-liberal approach is an inadequate research tool for research into social change. Its inadequacy for this research is importantly associated with its inability to make sense of ‘first order’ issues of fact and events technological change Ryan (1970). Whatever power neo-liberal theory has it is in the arena of ‘circular flows’ of allocative product markets, rather than the more unaccustomed flows of technology innovation (O’Sullivan, 1995:374). Neo-liberal theory interprets technological change as exogenous to both market decisions and individual entrepreneur’s decisions (Quinn, 1988:162). Policy prescriptions flowing from the neo-liberal view exorcise active state intervention in technology development (Reid, 1987:95) - these it is argued would create market distortions (Chang, 1994:57).

This section has argued that analysing technological changes requires analytical tools offering greater social profoundness than neo-liberalism and a wider frame of policy. In short neo-liberalism precludes other forms of governance than market and hierarchy, it is methodologically limited, and has a restrictive policy programme.

Neo-classical theory

Neo-classicism is perhaps the dominant theory of economics. Its core precepts have built up over a century, beginning with Jevon’s market-driven argument that price and value do not equate (Roll, 1962:318). Walras added hedonistic maximising behavioural assumptions facilitating quantification of equilibrium as an allocative mechanism, and heralding the advent of econometrics. Pareto introduced aggregation which generalised equilibrium, and Keynes re-focused equilibrium aggregation from micro to macro analysis. Lawson (1994:257) suggests that only in normative economics does this otherwise closed system open itself to socially originated alternate rationality. Using price as the key variable, the
Appendix Three: Theoretical Questions Associated With This Research

neo-classical system predicates conclusions from its assumptions (Merton et al, 1959:53).

Numerous general critiques of neo-classical economics exist (Hausman, 1992). As an allocative system relying upon the uni-dimensional variable of price the hedonistic rationality of neo-classical theory is strongly criticised (Marsden, 1986; Sen, 1979). The closed nature of the system makes it difficult to analyse complex markets such as for labour and capital (Argyris, 1973; Katouzian, 1980). Bendix (1956) criticises the dominant role ascribed to managers in this system. Recent work by Clark (1993) argues that viewing people as a factors of production or human capital unnecessarily limits analysis. Colander (1992) suggests that the abstract deductive method of the neo-classical system predicates outcomes, and is therefore inappropriate for analysing complex social issues.

For technology studies in particular the appropriateness of the neo-classical approach has been challenged. Coombs et al (1987) conclude that the neo-classical framework is redundant as a research tool in technology studies. They argue that it ascribes an exogenous role to technology, inadequately moves between levels of aggregation, and that its perfect competition modelling distorts market analysis when markets are regulated by institutional arrangements. Beck (1992) argues that the universal nature of the model and its lack of reflexivity makes the model inappropriate for its central task - assessing risk. Audretsch (1995) finds little evidence of predicted inter-industry capital movements. Decisions on technological change can only be explained with reference to a more sophisticated approach taking account of institutional, including social and cultural factors (Crevoisier and Maillat, 1991:Ch. 1). Lacking an inter-temporal dynamism, suggests Snooks (1993), the neo-classical system has little value in explaining a world of rapid economic change: he argues that economics is the slowest moving science addressing the fastest changing area of social activity. Authors ranging from Collingridge (1980), to Freeman (1982), including MacKenzie and Wajcman (1985) have criticised the neo-classical system for excluding social considerations from decisions on technological choices, each arguing that institutional factors are often of greater consideration than price. Kuznets (1966:9) suggests:

The epochal innovation that distinguishes the modern economic epoch is the extended application of science to problems of economic production.

He argues that technology creates a non-proportionality of output relative to resource input by adding knowledge: centrally and endogenously locating technology within his theory of economic development. Machulp (1967) and Heertje (1977) systematically present the case against factor
substitutability and centrally locating the role of knowledge in technological change.

Omerod (1994) has recently announced the ‘death of economics’ a statement justified by criticisms of the neo-classical system. This thesis, however, argues that economics - and in particular an understanding of technological change - remains vibrant as a general research programme, and is best done from an institutional approach.

The strengths of the neo-classical framework are its universal applicability, simplicity and opportunities it provides for econometric quantification. This section has argued that outweighing these strengths, in assessing neo-classical theory’s usefulness as a tool in studying technological change are its denial of non-proportionality, exogenous view of technology, lack of centrality accorded to technological change, aggregation difficulties and behaviourally rationalist assumptions which predicate conclusions. These weaknesses deprive neo-classical theory of the richness and depth of grounding desirable in studying technological change.

The strengths of evolutionary theory

This section argues that the evolutionary economics framework is an inadequate tool for use in this research on technological diffusion. It outlines the basic premises and strengths of evolutionary economics in the broad tradition of Schumpeter. Following a critical assessment of the use of the biological metaphor by evolutionary economics, as presented by Nelson and Winter, it is suggested that the theory is most appropriate for research into innovation rather than diffusion, and for ‘economic space’ which is less (rather than more) sensitive to actor’s conscious intervention. Secondly, this section argues that without its own policy framework, evolutionary economics is synthesised with a range of other theories containing widely differing policy frameworks. It is argued that this could result in eclectic theoretical conflation, and that an institutional economics approach can retain the advantages of the evolutionary theory without incurring the disadvantages. Thirdly, an argument is presented differentiating an institutional from an evolutionary approach to analysing the diffusion of technology. Finally, this section examines the use of evolutionary economics theory as an econometric model, arguing that this is a more tendentious exercise than Nelson and Winter have suggested.

Schumpeter comments in a later work (1987:82):

....the essential point to grasp is that in dealing with capitalism we are dealing with an evolutionary process.
Dynamism for Schumpeter (1939) is ‘jerky’ and emerges from the attitude of entrepreneurs and their psychological propensity to invest. Psychological pessimism he argues is particularly important at the bottom of the economic cycle where deploying technologies which create economic growth compete between today’s profit and the tomorrow’s profit. The density or swarming of innovations create an up-turn in the economic cycle on the basis of a technological discontinuity and expectation of profit from the investment of savings. It is in explaining this the shape and direction of this diffusion that this section is arguing the superiority of institutional approach to the evolutionary. Unusually for a theorist located in the neo-liberal tradition Schumpeter encouraged his students to seek a positivist verification of this theory, but remained within the neo-liberal tradition in rejecting the use of any biological analogy (Andersen, 1996:Ch. 2; Hodgson, 1993:139).

Modern evolutionary economics is the result of three departures from Schumpeter’s theoretical system. Firstly, in 1950 Alchian sought to justify the biological analogy arguing that a population-constrained entrepreneurial choice operates based upon imperfect information and introducing rule bound behaviour (Witt, 1993:65). Secondly, the evolutionary approach in economics has since come to represent a biological analogy (transmission, variation, selection, success and segregation). Finally, work by Nelson and Winter (1982) has introduced econometric modelling into this theoretical framework.

Evolutionary economics strength is its emphasis upon normed behaviour, as opposed to neo-classical hedonistic assumptions which give rise to predicated conclusions. Evolutionary theory is also characterised by bounded and imperfect information and learned behaviour and norms, these provide both stability and transmission of routines. Cumulative learning and assumed exogenous technology choices provide variation in evolutionary economics. Endogeneity of technological choice within a ‘natural trajectory’ is a selection mechanism capable of explaining both evolving technological innovation and more rarely ‘radical’ discontinuities. Between equilibria, successful innovation is rewarded by company growth and profit, segregating - for survival - the strongest actors (Andersen, 1996:15; Witt, 1993:Ch. 1). It is the openness of evolutionary economics which attracts theorists as apart as Capra(1983) or Bijker (1992) and Williamson (1975) who each identify with its approach. This openness arises from an absence of a predicated policy programme, evolutionary economics focuses upon process not (policy) input nor normative (output).

The weaknesses of evolutionary theory
This section now examines three aspects of evolutionary economics in which it appears inferior to an institutionalist approach: its use of the biological metaphor; the absence of a policy programme in evolutionary economics inviting a synthesis with a broad range of policy frameworks; and finally predictive modelling.

Outside of formal philosophy metaphors are often used - as illustrative rather than literal conceptual guides. Analogy (a looser term than metaphor) is used here to mean evocation of similarity or likeness. Metaphor is a ‘harder’ term meaning to encapsulate a vision of future change and transformation. Metaphor appears more mysterious than analogy because it is an early (pre-mapping) conceptual stage of what might be. Metaphoric musing appears to be a basic ingredient of humanity. Dawkins (1986:195) suggests that ‘The human mind is an inveterate analogiser.’ Capra (1983:93) traces the release of science from the use of mechanical analogies as the ‘turning point’ in modern science. Freeman (1992:123), however, warns against economics leaping from one metaphoric based method to another:

> It would be as dangerous for economics to take over wholesale the models of biology as it was to make too much of equilibrium models derived from physics.

He emphasises the need for interactivity but also coherence between actors and structures, between technology and organisational form. In a similar vein Campbell (1973:54) warns against accentuating the biological metaphor, preferring instead triangulation between metaphor, grounded and deduced theory. Noble’s basic point that the selected technology cannot per se be presumed to have been the best option (1984:144), echoes Popper’s (1992:24) criticism of Darwinian biology as irrefutable. Noble however is making the weaker point than Popper: that alternative decisions may have proven more successful over a different time and social frame of assessment.

When an metaphor has to be scrutinised, explained and justified some of its illustrative power is lost, Polanyi (1958:175) comments:

> Knowledge can be true or false, while action can only be successful or unsuccessful, right or wrong. It follows that an observing which prepares a contriving must seek knowledge that is not merely true, but is also useful as a guide to a practical performance. It must strive for applicable knowledge.

Dawkin’s (1986:223) criticism of the biological metaphor is the lack of purposiveness attributed to humans, and its irreversibility as a change
mechanism. He suggests that in biology there is no more evidence for a Lamarckian (learning) progression, than a punctuationist (accidental discontinuity) progression. Dawkins also suggests that biology is not a predictive science. Hodgson defends the biological metaphor arguing that ontogenological selection occurs by a Lamarckian process in technological change, the key environmental influence being market competition. Ontogeny is genetic selection influenced by the environment as opposed to phylogeny which is genetic selection arising from population change. A major difficulty with the biological analogy is that heterochrony (changes in development period of appearance of features present in ancestors) is a major unresolved debate in biology. This is similar to the nature-nurture debate in psychology. Phyletic and ontogenic information may influence biological patterning, the difficulty is proving the weight of each within particular time scales, and with what recapitulation (Gould, 1977). Hodgson (1993:197) dismisses as Panglossian (a view he attributes to neo-liberals) the argument that the selected must by definition be the most efficient. Here Hodgson's defence of the biological metaphor breaks down. Lamarckian cumulative learning by cells is an unconscious response to contingency. Human - and as will be argued later - organisational learning (or forgetting), arises from conscious intent: the process is not merely a response to contingency it is also self-referential. Elster (1979:18) in criticising the application of the biological analogy to economics, makes the crucial point: there is little 'strategic' interaction or intentionality in relations between animals and their environment - this is a defining feature of humanity.

Schumpeter, and evolutionary economists focus primarily on product 'evolution' (variation) rather than 'ecology' (diffusion) of technology. Witt points to an important methodological difference between the two foci: innovation involves pre-revelation analysis, diffusion post-revelation (1993:91). Initial innovation is necessarily less of a social and structural event than diffusion, as such diffusion requires a greater social content to analysis than innovation. Schumpeter's major disciple Goodwin (1951) identified this very problem when he attempted to model 'railroadisation.' Whilst social factors shape the form, pace and success of innovation, modelling diffusion entails a vast array of social assumptions which are more problematic than epidemiological studies. In these (for example) contact dependency, time-lags and density dependency, can be deduced from previous studies. Schumpeter (1939:412) focused upon product innovation rather than diffusion, indeed he comment that 'one must be right at given dates,' is interpreted by Andersen as indicating his rejection of diffusion modelling (1996:89). Diffusion analysis necessitates a theoretical base giving more depth to both structure and social forces than the biological metaphor. This conclusion does not make the evolutionary metaphor invalid. Within a bounded field explaining the shape and pace
of particular technological innovation (a specific artefact or a particular product or process innovation) it remains useful to consider transmission, variation, selection and success in a dynamic context without predication.

Evolutionary economics is assessed above as a metaphor, and below as a model - can it be assessed as a theory? The danger of metaphoric theorisation is that it remains a black box - evocative rather than predictive: a metaphor is saying things are 'as if this was the case,' a theory is expected to say 'from this theory this is predicted' (Ryan, 1979:Ch. 4). A classificatory framework seeks a lower order of verification from observation than a theory, as might a metaphoric theory. In both cases any verification less rigorous than a theory might expect would be a dis-service to the progress of knowledge.

Assessing the theory of evolutionary economics is made difficult because it is a process theory, an 'enabling theory.' Evolutionary economics does not stand alone making predictions, rather it invites synthesis with other theories (ranging from Marxist to Austrian). Each synthesised theory brings with it a range of epistemological and political baggage which may not be declared, making judgement of the synthesised conclusions difficult (and particularly an assessment of evolutionary economics). The openness of evolutionary economics is both a strength and a weakness. A strength in that the pace and direction of technological change cannot be predicted. Thus where social consciousness is taken as an example of self-fulfilment in prediction the biological analogy is strong, and provided synthesising theories declare their presumptions evolutionary economics remains a practical research tool.

A later section will argue that - as a sub-set of evolutionary economics - Institutional theory is a more appropriate theory to guide this research: diffusion of technological systems critically responds to consciousness, social structures, and governance patterns. The following section substantiates the proposition that institutional theory retains the positive features of its parent. It must explain and reconcile: dynamism (both evolution and discontinuity), within a context of stability (order, structure and transmission mechanism), without resort to simple chance or reductionist determinism. The next section on Institutional theory will address each of these issues. This section continues by exploring the implications for evolutionary economics of an absence of policy programme.

Perhaps the major achievement of Nelson and Winter's work, is not the exposition of evolutionary as opposed to neo-classical theory, but the extrapolation from this theory of a model. Early attempts at constituting a Schumpeterian model to predict the evolution of technological change
Appendix Three:
Theoretical Questions Associated With This Research

(such as Goodwin), were rejected by Schumpeter and practitioners as crude. Similarly, early 'growth pole' (Perroux, 1969), 'forward-linkages' (Hirschman, 1958) and 'development blocks' (Dahmén, 1988) models failed to capture the complexity of technological evolution (Andersen, 1996:65). Developments in logistic equations and computing power enabled Nelson and Winter to propose a working model of evolutionary innovation. The model has been diagrammatically summarised (at the level of an industry) by Andersen, (diagram A3.1). This representation of Nelson and Winter's model indicates the programme covers short-term matters on the left, innovation top and right and actual investment decisions in the bottom section. It is reproduced to illustrate the complexity of incorporating social characteristics into a computation. Definitional problems abound, but may be overcome. The difficult is assessing business uncertainties - which unlike risk are un-quantifiable. Examples of this include radical alterations to the regulatory environment, industry exit or entry, satisficing behaviour, implementation of technology difficulties, or customer service. These are not arguments against modelling per se; merely to indicate how far from translation into an acceptable model the theory of evolutionary economics is. Mirowski's prediction (1983) that the Nelson and Winter model does not form a research programme appears to have been borne out by the absence of empirically modelled results.

Diagram A3.1, Source: Andersen, 1996:104

This section has indicated that the strengths of evolutionary theory lie in its openness, central location of technological decisions as endogenous to
actors. Such decisions occur in a dynamic context which usefully assesses from the biological metaphor transmission, variation, selection, and success and segregation. It is suggested that the biological metaphor makes the theory more suitable as a research tool for innovation than diffusion, since the latter process is more dependent upon social consciousness and structures. Evolutionary theory is categorised as an ‘enabling’ theory, synthesising with other theories in analysis - the importance of other theories declaring both epistemological and programmatic baggage has been stressed. The section has indicated the difficulties in translating evolutionary theory into a model of technological change, arguing that this translation has yet to be successfully made. Finally, some prescriptive standards for Institutional theory have been identified, if it is to be judged a superior research tool for investigating the diffusion of technological systems.

Institutional and evolutionary theory

Only in Robinson Crusoe metaphors is economic activity a-social, indeed interactive engagement between people is an essential feature of all social actions. Such actions require co-ordination - from basic rules (for example product standards) to complex behaviour (for example product innovation) - institutions perform this co-ordination. This section reviews institutional theory relevant to this research work. Differentiating institution from organisation is not a matter of scoping level but the degree of abstraction (see diagram 1.3). Institutional analysis explores rules which bind interactivity that organisations in concrete form deliver.

Hodgson (1993:Ch. 1) has states that:

........... there is no clear frontier between evolutionary economics and institutional economics.

A primary purpose of this section is to establish such a frontier. This section outlines classical and modern institutional theory, critically assessing current analyses. The key concept of ‘governance’ is introduced and given meaning in a critical review of Williamson’s work on markets and hierarchies. Issues posed at the end of the previous section are returned to: can institutional theory retain the positive features of evolutionary theory, whilst explaining dynamism, stability without recourse to determinism or mere chance. In conclusion, the section draws linkages to globalisation, regionalism, regimes of accumulation, national systems of innovation and technological diffusion.

Waller (1988:113) traces institutional economics to Peirce’s pragmatic view that individuals avoid constant decision by non-reflexive habituated
behaviour. Veblen later employed this idea to explain consumption patterns by other sensitivities than marginal utility or price (1953). Fundamental to institutionalism is the proposition that individual behaviour is normed - a view which contends the self-interested rationalist propositions of neo-classical theory (Elster, 1989:99). Selznick (1948:25) illustrated the use of the institution approach to holistically represent economic processes. Arrow (1974:Ch. 2) has pointed out that economic behaviour is shaped by, but also in turn shapes institutional norming. He argues that non-price signalling is more important in some instances than price-borne information. Dewey (1939) adopted a similar pragmatic fallibilism theory of social institutions. As indicated above, patterning of behaviour is used by neo-liberals to justify the natural order of market relations and to dispute interference in that order.

Institutions guide actions by 'self-actuating dispositions,' providing the transmission and reinforcement mechanisms, variation opportunities, occasions for selection, and assessment of success and segregation which were outlined above as parameters in evolutionary theory. Modern institutionalists place less emphasis upon habituation, and focus upon normed behaviour within a socially constructed (alterable) context. The degree of conscious intent suggested in the institutional forms varies with the theorist. For example, Galbraith (1969) argues that major corporations premeditatedly shape product demand by advertising. Elster (1989), alternatively, emphasises that conformity arising from signation, is merely a recognition of an alternative rational choice - the choice to use bounded rationality. Institutions provide both structure and information flow, and at any moment in time it is the individual actor who is the invariant variable. Technological choices are then individually shaped, but within the 'path- dependency' of an institutional setting (Dosi, 1988). The outcome of such choices may be a vicious-cycle of 'institutional ossification' and economic decline, or the virtuous cycle of innovation and growth (Hodgson, 1989). Commons (1961:8) in his classic work on institutional economics suggests that institutional theory contains 'nothing new:' all economic theories can synthesise with institutionalism if they are premised upon indeterminacy of analytical outcome, endogeneity of decisions, behavioural realism and are temporally diachronic. Chapter Five of this thesis illustrates the application of this approach to understanding labour markets and culture.

The frontier between evolutionary and institutional economics is intention and purposiveness: human intervention altering behaviour patterns. Classic institutional theorists emphasise habituation rather than 'rational market man' choices or consciously contrived intervention. This thesis envisages a modern form a institutionalism in which actors strive to construct congenial 'supply-side' arrangements suiting their purpose
Appendix Three: Theoretical Questions Associated With This Research

(Streeck, 1992). These may take the form of markets, networks or hierarchies but invariably are negotiated between actors; what Castells (1997a) refers to as a networked society. Intentional purpose is the frontier between evolutionary and institutional economics, it is also the point at which section A3.2.5 suggests that the biological metaphor employed in evolutionary economics breaks down.

The application of institutional theory

Illustrating the power of institutionalist analysis, this section now presents perhaps the most powerful concept of institutional theory - governance. The co-ordination of economic actions, and in particular diffusion occurs within an institutional setting. Institutional arrangements and formations are governed by rules, routines, structures and patterned behaviour - a governance system. Neo-classical and neo-liberal theories focus upon one type of governance - market relations and competition. Institutional theory suggests a continuum of governance: principally markets, networks, hierarchies and the state.

Williamson (1975:254), who:

...........like Commons, regard the transaction as 'the ultimate unit of economic investigation.'

addressed the same questions as Coarse - how to explain the preference for hierarchical deployment of resources instead of allocation by market relations, how to explain rather than simply describe vertical integration as a preferred allocative mechanism to the market. Williamson does this by modelling firms on bounded rationality, opportunism and dignity; arguing that (outside of small transactions) frequency, asset specificity, and opportunism transaction costs tend to make hierarchy a more efficient governance mechanism than the market. He concludes his 1975 analysis:

The organisational failures approach to economic organisation emphasises that it its transactions rather than technology that mainly determine the efficacy of exchange by one mode of organisation as compared with another. (1975:248)

Accepting these conclusions, Kay (1984:186), developed Williamson’s ‘information impactedness’ within hierarchies to conclude:

Thus bounded rationality and the existence of product market linkages represent the two major sources of objection to neo-classical theory.
Using this institutional approach Williamson’s achievement has been to successfully challenge the neo-classical and neo-liberal presumption that market relations are the main (or only) rational governance system for allocating resources. This analysis has been severely criticised within institutional theory leading Williamson to later (1985:Ch. 12) accept that user/producer interactions, ‘organised markets’ (within TNEs and in oligopolistic competition), and ‘management as a constituency’ create governance structures which are neither market nor hierarchy, nor solely driven by transaction cost analysis. This section aims to illustrate the richness for analysis of governance, within institutional theory, as a research tool for understanding diffusion of technological systems.

Karl Polanyi (1957) emphasised the value creating, in addition to value distributional role of the state, principally by encouraging innovation. Pitelis (1991:93), from a Marxist viewpoint, builds upon Williamson’s analysis emphasising the role of the state in governance systems:

> The state is one of the three major institutions of capitalism, the others being the price mechanism and the private hierarchy. All three, I claim, are alternative, but complementary, institutional devices designed to exploit the benefits from the division of labour, in order to derive maximum possible benefits for their ‘principals.

Synthesising national systems of innovation and a socio-technical constituency approach (Chapter Eight) illustrates the importance of the state in encouraging and shaping technology diffusion in Japan. Alternatively, Rosenberg and Birdzell (1986) suggest that capitalism succeeds because of the move from state (centralised) to firm (de-centralised) governance. Numerous authors have stressed the importance of user/producer interface in both innovation and diffusion of technology (von Hippel, 1978, Fleck, 1988) and partnering (Rackham, 1996). Other institutional theorists focus upon diffusion within (Nohria and Ghoshal, 1997) and between multi-national enterprises (Prahalad and Doz, 1987). The Upsalla IMP-group studies of interactive incremental commitment (Håkansson, 1982) has stimulated analysis of networks (formal and informal), (Sako, 1994). Governance in networks is affected both by their goals and the degree of dependency and interdependency; what Weick calls ‘causal circuitry,’ (Weick, 1979:77). Diffusion may be both encouraged and shaped by supplier networks, across sectors - for example manufacturing and finance: Santarelli (1995) suggests the diffusion of new financial instruments is a major explanatory cause of long-waves. Knowledge networks are particularly important for technology diffusion (Nonaka and Takeuchi, 1995). Marklund’s (1994) empirical study in Sweden suggests that knowledge networking reduces transaction costs.
Governance implies intentionality of the participants, which between actors necessarily involves ends and means conflict - all governance systems contain power relations (Francis et al, 1993). Labour process debate has focused upon the exercise of power within hierarchical governance, and impact of technological change on skills and industrial relations (Harris, 1987). Network analysis focuses upon horizontal relations between actors (Hollingsworth, Schmitter and Streeck, 1994), especially customer-supplier relations encouraging technology diffusion to achieve continuously improvement (Imai, 1986). The power of the state is an important influence on the pace and type of technology diffused (Schwartz, 1994). Molina (1993) has developed a socio-technical constituency template with which to analyse shifting power relations shaping technological innovation and diffusion.

The above summary of governance as a research tool is intended to illustrate the breadth and depth of institutional theory. Many of the theories above will feature in the following ‘institutionalist’ literature review of networking, national systems of innovation, accumulation regimes and diffusion. In turn outlining the institutional perspective in contrast to neo-liberal, neo-classical and as a specific sub-set of evolutionary theory is a foundation from which to review literature on lean production, learning organisations and clustering.

Inter-organisational and inter-institutional networks are analysed in this paper using the socio-technical constituencies approach developed by Molina. This section outlines the socio-technical constituencies (STC) approach, and links with Chapter Eight which argues that networks and clusters may be differentiated by the ‘depth’ of knowledge networking which they enjoy.

The socio-technical constituencies approach is an inter-organisational tool of analysis ‘a single process of interpenetration of technical, socio-economic, political and cultural factors,’ (see section 8.1.4 and diagram 8.1). This is a highly flexible tool of analysis. Actors and resources may feature is several constituencies, the technology (T) which the STC seeks to shape may be a product, process or system, participants may vary in the purpose for which they participate in the STC, and conflict may occur over goals and resource allocation. As with all evolutionary-based theories STC does not predicate outcomes, or assume that actors act with rational intent. Moving outward from the centre of the STC the approach indicates (expects) conflict within organisations, between organisations and between types of institutions over purpose. Formal and informal governance of the STC may vary. Often this occurs in a ‘battle for ideas,’ enabling ‘light-weight’ actors in terms of control over resources to ‘punch
Appendix Three: Theoretical Questions Associated With This Research

beyond their weight.” Moving further out from the centre of the STC diagram 8.1 indicates that STCs interact with each other, to shape and re-shape modes of regulation and institution arrangements - it is at this level that the STC approach potentially interfaces with Regulation theory. STCs are success to the extent that actors align resource deployment (including knowledge) to achieve an outcome acceptable to constituency actors. It is understanding alignment processes which makes STC a powerful tool: the approach consciously seeks to identify mis-alignment and points to ways of achieving re-alignment of actors, resources and purpose.

Note that the STC approach is both ‘out-to-in’ and ‘in-to-out;’ this is its strength when analysing bounded technologies. However, when used to analyse broader technologies - such as the lean production technological system - some ‘boundedness’ needed. If not the whole array of social goals and resources would need to be encapsulated in the model. Hence this paper, has introduces the view that alignment to a globally dominant regime of accumulation and mode of regulation may help when using STC to analyse broad systemic technologies. These comments are intended to complement the diamond of alignment developed by Molina. The diamond of alignment is a development of the STC approach with which to analyse clustering, (Chapter Eight). This approach involves sensitively assessing governance techniques, the goals in functionality and cost of the networking, the purposiveness of the network as perceived by its constituents, and the relation of the proposed cluster to existing product or process clusters. Chapters Twelve and Thirteen returns to these tools when analysing the results of this research.

The above survey indicates the power of institutional theory. Can it retain the advantages of evolutionary theory - explaining dynamism and stability without recourse to determinism or mere chance? The strengths of evolutionary theory are dynamism and unpredicated outcomes. The surveys of culture and labour markets from an institutionalist perspective illustrate patterning of behaviour without determinism. In both cases theories without an evolutionary perspective have been criticised for an absence of structuration and consciousness. This perspective allows governance systems to be dynamic and holistic. Power, consciousness and habitus can prominently feature in such analyses.

This section concludes that it is possible to differentiate institutional from evolutionary theory. Evolutionary theory has strengths particularly in analysis of innovation and at a narrow level of scoping. However, for analysis of diffusion at a broad level of scoping, institutional theory is a superior tool. This paper is written within the boundaries of the ‘social shaping of technology’ heralded by MacKenzie and Wajcman twelve years ago. Much of the work of this ‘school’ has focused upon product
innovation. Particularly successful are the new models of 'innofusion' and 'socio-technical constituencies' which have been developed. The institutionalist perspective in this thesis focuses upon diffusion rather than innovation using an 'out-to-in' method.

The first part of Appendix A3.2 has surveyed literature from both classical and neo-institutionalist theory. It has argued that institutional theory is a differentiated sub-set of evolution theory, and whilst retaining the advantages of evolutionary theory is a superior tool for analysing diffusion from a broad level of scoping. This has been accomplished using labour markets and culture as demonstrative examples of institutional theory - dynamically and without predication - but centrally featuring structures, can analyse complex social factors. It is further argued that the concept of governance introduces power and consciousness centrally to analysis in a superior way to evolutionary theory. Since these factors figure prominently in diffusion process, it has been argued that the institutional perspective is a superior vehicle for analysing the diffusion of lean production systems into West Lothian then evolutionary theory. Finally, it is argued that an institutional approach easily synthesises into the social shaping of technology school of technology studies.

A.3.2 BRITISH REGIONAL POLICY AND MARKET ALIGNMENT

British regional policy, informed by Adjustment theory, has traditionally addressed 'demand-side' policy objectives, paying little attention to the 'supply-side' adjustment of the technological basis of regions (Amin and Thrift, 1995). These policy objectives have included equity (of employment and incomes) and efficiency of resource distribution (infrastructural investment and government expenditure), and have sought to adjust regional disparities within a context of national economic growth. Adjustment interventions prominently feature free health provision, education and social benefits.¹

¹ Both the costs and benefits of regional policy are difficult to compute as Armstrong and Taylor (1993) have shown. Necessarily this is the case in terms of social cost-benefits; however, abstruse issues arise including leakage from regional economies and indefinite leverage arising from supplementary inputs. This is perhaps particularly the case when policy instruments have been (general) fiscal rather than (focused) monetary measures. The last twenty years have witnessed frequent changes in policy instruments further complicating assessments of regional policy effectiveness in Britain (Temple, 1994).
Command economies easily move people to jobs. In market economies political and social pressures interpose demands that jobs be moved to people (Livingston is an example), with individuals seeking contradictory social and economic outcomes from the same 'discursive space' (Giddens, 1994:91). Scotland in general and West Lothian in particular has seen a full gamut of regional policy strategies over recent years (Fothergill and Guy, 1990). British Leyland located into Bathgate under a directive planning strategy in 1962 - an example of a growth pole that failed. The LDC and Locate in Scotland (LIS) used inducement policies to successfully attract inward investors into the area. These have included direct subsidy, alleviation of planning restrictions, and amenity and infrastructural-led growth. In recent years, SE has opted for indicative planning featuring privately funded projects. For example, its clustering policy attempts to create an innovative milieu around the Cadence development. Most recently the EU has taken an increasing role in regional policy and pursuing subsidiarity and the Europe of the Regions agenda seeks to focus upon sub-national regeneration and growth which centrally features issues of technology and its diffusion.2

The market versus state intervention debate on industrial policy (see Chang, 1994), currently takes EU-policy dimensions (see Dunford et al., 1981; Malmberg 1994; Amin 1999) often linking to debate on cluster building (Cooke 1992:Ch.1). This debate on cluster building like earlier interventionist analyses, is often posed in terms of social imbalances and inequities (for example Massey 1984), and manufacturing versus service industrial strategies (Massey 1988; Cook and Healey, 1995). Cooke (1990:77) suggests that the ability to intervene in markets by influencing industrial location have been weakened by the growth of TNEs. The labour processes debate expounds upon control and collectivity as opposed to flexibility and individuation (Allen 1988). Amin and Robins (1990) for example argue that non-transferable local knowledge inhibits regional adjustments, and Blair (1995) argues that implanted technology transfers offer little leverage in terms of local knowledge of technology generation.

'Locale' in Giddens' view (1994:118) is a positive unit for bottom-up analysis. Cooke (1989), however, suggests that Giddens under-states the social content of spatiality, preferring 'community' as an analytical unit. West Lothian, in Cooke's terms, has physical contiguity, claiming a cultural togetherness as a manufacturing area distinct from adjoining areas. In this

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2 See, for example, Douthwaite, 1996 who, using a flexible specialisation approach to localised economic development argues that 'intermediate' technology may create more sustainable economic growth than more advanced technology, which is likely to be controlled from outside an area. Douthwaite justifies his argument with examples from Ireland. Other examples include the Grameen Bank in Bangladesh, see Yunus, 1998.
sense West Lothian as a unit of analysis has ‘social capital’ as well as being a spatial entity (Cooke 1995). Later this thesis returns to these issues connecting them to the themes of knowledge of technology and its diffusion. Barnes and Ledebur (1998) argue that a new paradigm of regionally focused economic analysis envisages both horizontal and vertical linkages from the viewpoint of a region. Horizontally this approach recognises polycentric social connections (including political and governance systems and open labour markets), and vertically the interdependent linkages between physical, information and financial of regions with higher levels of analysis.

Amin (1999) has called for ‘bottom-up’ economic development initiatives paying attention to technological heritage and localised institutions. This section has shown the difficulties (not impossibilities) of aligning sub-national regional competences and institutions, with the technological regime required succeeding in global markets. How far this is sustainably achievable forms the content of chapter eleven, which analyses the dynamic alignment of West Lothian to dynamic global technologies and markets. Such an analysis is one of processes at an international, national and regional level. This section has argued that conceptualising technological strategy at a sub-national (locale) regional level is possible, and indeed desirable given the need to maintain legitimacy of public institutions, in particular as they set out a vision of technological change.

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3 Economic re-structuring has provoked renewed interest in localised economic initiatives by authors such as Cockburn, (1979) and Bowles, Gordon, and Weisskopf, (1983). Indeed, Marshall suggests that long-wave analysis is only meaningful if grounded at a regional level and provided that events within the sub-region cannot be wholly conditioned by actions at the level of the larger unit (1987:228).