SUMMARY

Basic cost curves for fire brigades in England and Wales are presented. The relationships are used to investigate the financial consequences of enlarging present brigade responsibilities in terms of the scope of service at present provided. The results indicate that small adjacent County Borough brigades are intrinsically uneconomic, and in addition, the advantages stemming from amalgamations involving County brigades arise mainly from the centralisation of common facilities.

INTRODUCTION

The usefulness of fundamental cost curves depends largely on their being expressed in physically meaningful terms, and for the present investigation, brigade annual running costs have been correlated with the number of operational men. The costs are expected to be influenced by both the variety and the level of service provided, therefore a second important cost curve should represent the investment required to provide present standards of fire cover. A measure of this operational effort can be taken as the pump density although the different risks are not in fact spread uniformly throughout brigade areas. These approximations do, however, suffice for a tentative examination of the basic concepts, and also for the assessment of the costs of hypothetically reorganised units within the existing division of brigades into County Borough and County areas.

County Borough Brigades

The overall proportion of retained men in County Borough brigades is 3%, thus a measure of size can be taken as the actual whole-time strength. The figure for the annual running costs comprises sums for both the continuous operational activities, and also the capital expenditure paid from revenue or as debt. The cost curve derived is shown in figure 1.

FIGURE 1

County Boroughs - England and Wales (1965-66)
Annual Running Cost vs. Operational Strength

Although most brigades comprise between 50 and 200 men the strong linear relation is maintained throughout the range. Least squares fits obtained from
figures for the last three years give:-

<table>
<thead>
<tr>
<th>Year</th>
<th>Cost p.a. (£ 000's)</th>
<th>Intercept</th>
<th>Slope</th>
</tr>
</thead>
<tbody>
<tr>
<td>1963-64</td>
<td>1.23x (Men) - 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1964-65</td>
<td>1.55x (Men) - 27</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1965-66</td>
<td>1.42x (Men) - 2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

the intercept and slope for 1964-65 being noticeably different.

As the overall cost is so closely proportional to the operational strength, there is no inherent financial advantage attached to brigade size as such, however, differences must be expected in the service provided.

Consider, for example, two adjacent single-station County Borough brigades, each represented by as in (a). The same geographical area could be given cover by two other possible brigade arrangements shown in (b) and (c):

(a) \( \begin{array}{c} X \\ X \end{array} \) i.e. two autonomous brigades.
(b) \( \begin{array}{c} X \\ X \\ X \end{array} \) i.e. one autonomous brigade with the same two stations.
(c) \( \begin{array}{c} X \end{array} \) i.e. one autonomous brigade with a single, large station.

In order to provide exactly the same type of fire cover in passing from (a) to (b) there would be initially a marginal reduction in the total establishment which would be caused by a centralisation of non-firefighting activities. From figure 1 it can be deduced that this saving would be at the rate of £1,400 for every unit of personnel exceeding the new requirements. A comparison of brigades in relation to the average number of men per station shown diagramatically in figure 2, however, indicates that in practice there are further considerations.

**FIGURE 2**

*Average number of men per station (1963-66)*

The same minimum standards of fire cover must be observed, thus the large drop in station complement when brigades have two or more stations is almost certainly due to a difference in the variety of the service provided. For example, multi-station brigades can provide different types of appliances (requiring fewer men), and there is more flexibility in mobilisation procedures. Making use of figure 1, the comparison of two average single-station brigades (2 x 66 men = £182,000) and one average two-station brigade (2 x 49 men = £136,000), gives a difference of £46,000, or 26%. Under these conditions, therefore, it appears that there are economies to be made by combining small brigades.

The effect of replacing two stations by a large single station, as shown in diagram (c), can be examined by measuring the cost per man as the station size is increased.
The unambiguous negative trend, illustrated in figure 3, indicates that larger stations are slightly more economical. However, the number of real situations to which this could be applied is probably small given the attendance times required by the present standards of fire cover.

County Borough Brigades - Cost density Curve

The cost of maintaining these levels of cover is illustrated in the second cost curve for County Borough brigades which is shown below:

The "cost density" curve gives some indication of the influence of various standards of cover, and hence attendance times, on the financial investment required. Due to the lack of complete data, however, no account has been taken of section 2 and section 12 arrangements. The majority of points suggest a linear relationship, but at the higher pump densities the variance increases and there are insufficient points to confirm any upward trend.
County Brigades

An important feature of the manning of County brigades is the extensive dependence on retained personnel. Considerably lower costs are therefore expected and as shown in figure 5, these can be expressed as the cost per man as the proportion of whole-time men changes.

FIGURE 5
County Brigades - England and Wales (1965-66)
Annual Cost per Man vs. Proportion of Whole-Time Men

The least square fits for each of the last three years gives the total annual running costs for brigades as:

1963-64  COST p.a. (£ 000's) = (0.0116 x (% W-T Men) + 0.261) x Men
1964-65  " " = (0.0134 x (% W-T Men) + 0.263) x Men
1965-66  " " = (0.0142 x (% W-T Men) + 0.279) x Men

The overall average of whole-time men is 42%, hence knowing the total number of men the annual running cost of all the brigades can be obtained directly. To calculate the cost of new organisations based on combinations of existing County brigades, the percentage whole-time men must be computed. Reference to figure 5 then yields the new cost of each man.

It is important to note that the linearity of this curve implies that whatever the composition of the constituent brigades, combination will not alter the running costs. Savings will therefore arise only by the reduction in establishment which would follow from centralising common facilities. An indication of the magnitudes involved can be obtained by considering the combination of two typical County brigades, each of 200 men (42% of which are whole-time). If it is assumed that a 5% reduction in manpower can be made, then figure 5 shows that the saving is £18,000 p.a., or 5.2%.

County Brigades - Cost Density Curve

The derived cost density curve is shown below in figure 6.
In order to obtain some degree of homogeneity only brigades with B and C risks have been included (representing some 88% of the total). Again, no account has been taken of Section 2 and Section 12 arrangements. The two cost density curves for Counties and County Borough brigades cannot be compared due to the difference in composition and the large discrepancy in pump density.

**County Borough and County Brigades.**

Several County Brigades have within their boundaries large whole-time stations in addition to County Boroughs. It would therefore be realistic to consider combinations between such brigades. The proportion of whole-time men in County brigades is effectively increased in this type of combination and the new cost can be obtained from figure 5, adopting exactly the same procedure as for the amalgamation of County brigades.

As an example, consider the combination of typical County Borough brigades (66 men) and typical County brigades (each of 200 men, 42% whole-time), in the following configuration, where $\text{xx}$ represents a County Brigade.

<table>
<thead>
<tr>
<th>Configuration</th>
<th>COST p.a.</th>
<th>DIFFERENCE from (d)</th>
<th>% saving</th>
</tr>
</thead>
<tbody>
<tr>
<td>(d)</td>
<td>£536,000</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>(e)</td>
<td>£586,000</td>
<td>-9.3%</td>
<td>-12.7%</td>
</tr>
<tr>
<td>(f)</td>
<td>£576,000</td>
<td>+7.5%</td>
<td>+1.9%</td>
</tr>
</tbody>
</table>
Thus it appears that average County Borough-County amalgamations are uneconomical, although the discrepancy would be largely negated if a 5% reduction in personnel is postulated. It is important to note that the situation depends on the composition of the component brigades. Moreover, cost curves must be reviewed periodically since their constituents represented in figures 1 and 5 are not wholly dependent on the same factors to the same degree.

CONCLUSIONS

From currently available data it has been possible to construct fundamental cost curves. Primarily, quantitative assessments can now be made of the financial investment required to maintain brigades of given operational strength. The effort itself is determined by the type of service offered, and as the cost density curves have been expressed in terms of pump density only, the cost of the initial firefighting force can be evaluated.

Organisational re-arrangements necessarily include many intangible aspects which cannot be included in a semi-rigorous analysis of the type of schemes proposed. Further progress in the context of such investigations is dependent upon the development of the concept of the level of service to be provided, that is, how comprehensive should be the range of activities for various degrees of fire cover.

W. H. H. HOYLE

September 1967