Introduction
Resource developing and exposing rich digital collections using a variety of repository technologies has been invested. In the UK this investment has resulted in unprecedented usage of institutional repositories, as evidenced by data from IRUS-UK (1). However, not all institutions have demonstrated commitment to exposing this scholarly content as optimally as possible, or rendering their repository as usable as possible. It is clear that many repositories have not enjoyed maintenance beyond the establishment of the repository itself and the ongoing development of its scholarly collection. Such institutions may work hard to promote their repository content but if little is done to optimise for discovery these repositories may remain relatively unexplored (2). A significant future challenge for repositories, and the Open Access movement more generally, is therefore to ensure user expectations are better met and, in so doing, improving index penetration of the content they wish to expose.

This poster reviews work undertaken on Strathprints (3), the University of Strathclyde institutional repository built on EPrints 3.3.13, to improve repository web visibility and user engagement, thereby improving usage. Expanding on previous brief reports (4) and using Strathprints as an exemplar, a summary of the approach adopted is provided, comparative search traffic data and usage metrics are analysed and conclusions drawn. Results are likely to positively inform repository practitioners and open scientists.

Background
To improve the usage and user engagement of Strathprints, a series of technical improvements were made to Strathprints in spring 2016 and their impact monitored during 2016/2017. Process improvements were also implemented. The principal improvements made included:

- Implementation of a refreshed Strathprints user interface (UI). Many repositories continue to demonstrate low levels of usability (5,6). Heuristic evaluation (7) of the Strathprints user interface (UI) was undertaken in early 2016 to direct UI changes intended to improve usability and user engagement.

- A “mobile first”, responsive re-engineering of Strathprints thus triggering important signals in PageRank and, later, heavier weighting in the “Penguin” updates (8).

- “White hat” improvements to the way Strathprints functions plus support for the Core Recommender and Altmetric API, both of which refer to users additional Strathprints content and promote user interactions.

- Implementation of a crawler friendly file-naming conventions for full-text deposits and improvements to search engine “friendliness”.

- Gradual cleaning of broken links within Strathprints thereby improving the “content health” of Strathprints and, again, triggering important signals for the Core Recommender and AltMetric API.

- Improved integration with social tools, including growth in social interactions which are the result of Tweets about recently deposited Strathprints content;

- Improve the repository digital object to metadata ratio. Since Strathprints exists in a hybrid IR/CRIS environment; it is important that deposited content is readily findable from an institutional CRIS to Strathprints. Implementation of a “connector–like” configuration was actioned to cultivate Strathprints as a full search destination for users and machines alike (9).

Data and results
The impact of repository improvements was measured and measured using a variety of metrics, including search traffic data from Google Search Console, COUNTER usage data from IRUS-UK and IRStats2, Google Analytics tracking data and routine statistical data from Strathprints itself. The periods examined were the year up to June 2016/2017, prior to the major changes being implemented, and the year up to June 2017/2018, after improvements were implemented. Strathprints demonstrated a 15% growth in COUNTER usage in 2016/2017, while COUNTER usage of 545,532, equivalent to a 48% increase in web traffic when compared to 2015/2016. By exposing their content to disparate search services, and the nature of repository capability, repositories encourage – and are conduits to – “horizontal” information seeking strategies (10). This is typically reflected in the relatively high “bounce rates” experienced by repositories.

The bounce rate in this study remained unchanged at 73% across both reporting periods. However, the average time users spent on Strathprints upon arrival in 2016/2017 was 01:29, up from 00:58 in 2015/2016 – so users, although continuing to bounce, typically spent 58% longer on Strathprints, indicative perhaps that improvements to the UI and Strathprints functionality was enough to persuade users to defer their bounce.

A more significant measure of repository discoverability lies in search metrics. Examining the effect of the improvements on Google searching more specifically improvements in ‘impressions’ and ‘clicks’ were observed at 62% (n=2,886,810) and 42% (n=287,262) respectively in 2016/2017 (via Google Analytics) compared to the 2015/2016 period, and a general upwards trend can be observed in Fig. 2. This is despite link decay resulting from a transfer of inbound links to the connected CRIS web front-end. (3). Total impressions in 2016/2017 were 5,686,664 and clicks 460,993.

To determine whether a correlation between clicks and COUNTER usage was present, Pearson’s correlation coefficient was calculated for both reporting periods. A strengthening of the correlation was detected, ranging from a weak relationship in 2015/2016 (r = 0.24) to a moderate-to-strong positive correlation in 2016/2017 (r = 0.66). This was confirmed via the t-statistic (t = 2.83, df = 12, p < 0.01), suggesting a high level of statistical significance. However, the coefficient of determination revealed data to be more nuanced (Fig 3 & 4). It was stronger in 2016/2017 (r² = 0.439) than 2015/2016 (r² = 0.059); clearly a significantly higher value but indicating that only circa 44% of the unique variance in COUNTER usage can be directly attributed to Google clicks.

Conclusion and future work
This small study provides persuasive evidence that specific enhancements to technical aspects of repositories, and surrounding process changes, can result in significant improvements to repository visibility, resulting in a greater web impact and consequent increases in content usage. Although indicators of user interactions were less clear, it can nevertheless be concluded that both web and search traffic, and COUNTER usage, can be significantly improved on the most important search and discovery tools, with correlations observable between Google search visibility and repository COUNTER usage. Data will continue to be monitored thereby providing the basis for longitudinal analysis and subsequent analysis in 2017/2018. Current work is seeking to action a series of infrastructural improvements, including a switch to InnoDB to improve DB performance and page loading, and HTTPS. Exploration of Accelerated Mobile Pages (AMP) is also currently underway.

References