Computers and the small firm: 1

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This paper describes the initial stages of a project being carried out by the Liverpool University Data Processing Research Unit for the Ministry of Technology, on the use of computers by small firms. Some preliminary results of the work are presented.

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Introduction

The Liverpool University Data Processing Research Unit was formed in May 1966 by the University of Liverpool in what is now the Department of Computational and Statistical Science, with the active collaboration of the Merseyside Productivity Association. The aims of the Unit are (i) to carry out research in applied computer science, business data processing and operations research, (ii) to teach these subjects, both externally and within the University and (iii) to undertake fieldwork and a certain amount of external consulting. The majority of these activities are carried out within the Merseyside area.

Shortly after its inception, the Unit was awarded a research contract by the Ministry of Technology. Although the objectives of the contract are various, they can be summarised generally as a fundamental study of the possible uses of computers by small firms, with particular reference to the Merseyside area. This paper is intended as the first of a series describing the results of work carried out by the Unit under this contract.

Preliminary details

The first stage in any such study is clearly to make a detailed analysis of the largest possible number of small firms that the period of the contract allows. The selection of appropriate firms, however, requires a precise definition of what is to be considered a 'small' firm. In the present study, the size of small firms investigated was dictated by practical considerations, generated by the need to survey, with a small team and in a relatively short period of time, a large enough number of firms to make it possible to draw statistical conclusions from the results. Thus, throughout this work, a 'small' firm is taken to mean a firm which is (just) small enough to be surveyed by an experienced analyst in two, or at most three, days. The level of detail required in the survey is, roughly, such as to make a reasonably realistic computer simulation of the operation of the firm possible. In practice, this definition has turned out to be satisfactory. From the point of view of the firm's use of a computer, staff size or annual turnover, for example, is considerably less important than the complexity of the internal organisation needed to control the firm. Apart from this, the majority of firms surveyed so far under this definition would not, of their own accord, have considered the use of computers. In most cases, however, clear-cut possible applications became apparent during the course of the surveys, especially if initial costs could be kept low. To give some idea of the range of firms considered in more familiar terms, the largest turnover was in the region of £5 million per annum, but this company handled an expensive product, so that it was not the largest company from the personnel point of view. The largest payroll belonged to an internationally known firm which employed 210 people. Because of the market value of the goods produced, the turnover in this case was less than £1m per annum. At the other end of the scale there were several firms with fewer than two dozen employees. Considering these firms alone, turnover varied from under £100,000 (the smallest to date, namely £90,000, did not come in this batch) to about £2m.

The majority of these companies carried on their business from one location, but 36% had more than one. In fact, one company surveyed had as many as six separate locations.

The reasons for the adoption of this empirical definition of a small firm are fairly obvious already. The general plan of the contract prescribed, essentially, that a reasonably large number of firms be examined with particular reference to their current operating procedures. The firms would then be classified, from the point of view of both systems and management science requirements. A set of software 'building blocks' were then to be designed allowing any firm fitting into the categories observed, to put together its own initial software package. This package should allow the firm to use a computer without having to make too radical a change in its management structure. Glaring inefficiencies in the original manual system employed by the firm could be quietly filtered out by judicious construction and choice of the software packages. Such a building-block approach naturally cannot make as efficient use of the computer as can individually written programs, but it removes at once two of the main deterrents to the small firm's use of a computer. These are (i) the need for a really radical reorganisation in the face of the computer, and (ii) the high initial software costs. Before any of this could be contemplated, of course, the detailed information on the current operating procedures of the

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firms was needed. Virtually no suitable data was found in the published literature. The first problem facing the Unit, then, was that of obtaining the information in sufficient quantity and detail to allow the survey to be carried out in time.

**Experimental methods**

The obvious technique to use in gathering the necessary basic information was to send out a suitable number of detailed questionnaires. In the face of complete lack of information, however, it was not found possible to design a set of questions which would be adequate. It was then decided that initially the information be gathered by means of personal visits by one or other of the Fellows of the Unit to suitable firms. It was at this point that the above definition of a small firm was adopted.

The pattern followed for the initial survey was as follows: Letters were sent out to firms which, on the basis of information available in various directories, appeared suitable. The letters requested permission to make a study of the firm, on the understanding that information obtained would be employed only as a statistic. Those firms agreeing to be surveyed were visited by one of the Fellows who would then write a detailed report on his return.

The response of the firms so far as been somewhat less than might have been expected, although the majority of firms agreeing to be surveyed have been most cooperative. At the time of writing over sixty firms have been approached. Of these, approximately one third have chosen not to reply to the initial request, whilst a further eight have for various reasons not wished to be surveyed. Two of the companies who were willing to co-operate had, unbeknown to the Unit, changed their address, so that they are now a considerable distance outside the area that could be covered. Hence although they are prepared to assist in the project the chance of the detailed surveys being carried out is somewhat slender.

The main difficulty arising from the relatively high number of refusals has been that of ensuring that as wide a variety of firms as possible is surveyed. On the basis of the results so far, it would appear that some industries are much more reluctant to allow a survey than others. To compensate for such biases it has been found necessary to send out a greater number of inquiries to firms in the reluctant groups. This has been found reasonably successful, and a breakdown of the distribution of firms surveyed among activities is given in **Table 1**.

As soon as a number of firms had been surveyed in this manner, the use of a questionnaire was again considered. However, a further and much more disturbing difficulty had now been discovered. On several occasions, different individuals within the same firm described substantially different versions of its operation, and the analyst was only able to arrive at a correct picture by the exercise of a certain tenacity. While this inaccuracy in the firm's own description of itself only occurred at a relatively detailed level, its occurrence was frequent enough to make any attempt at discovering the details

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**Table 1**

<table>
<thead>
<tr>
<th>Type of Business</th>
<th>Firms approached</th>
<th>No reply</th>
<th>Requests declined</th>
<th>Agreed to survey</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-perishable manufacturing</td>
<td>10</td>
<td>4</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>Engineering, steel stockists, erectors, etc.</td>
<td>11</td>
<td>5</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Oils, paints, chemicals</td>
<td>5</td>
<td></td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Food manufacturing and distribution</td>
<td>6</td>
<td></td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Sales of non-perishables, other than textiles and leather</td>
<td>7</td>
<td>1</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>Textiles and leather goods</td>
<td>8</td>
<td>2</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>Transport, importers</td>
<td>8</td>
<td>3</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Other categories</td>
<td>6</td>
<td>3</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>61</strong></td>
<td><strong>18</strong></td>
<td><strong>8</strong></td>
<td><strong>35</strong></td>
</tr>
</tbody>
</table>
of the firm's operation by questionnaire only most unreliable.

The fact remained that the 'personal visit' method of obtaining the information was much too slow to be continued in its original form. In order to speed up the process of making and reporting a survey, an attempt was then made to cut down the time spent in the preparation of the report. This consumed substantially more effort, in most cases, than the actual visits. Two devices were considered. The first of these was the use of a standard set of questions by the interviewer during the visit. This did not prove practical in actual use.

The second device considered was based on the observation that the core of a detailed report was a flow diagram showing the route of the central information. It was hoped that a relatively small number of 'standard' skeleton diagrams could be formed, based on the studies so far accumulated. These could then be filled in during the visits, and the reports could then consist simply of notes indicating departures from the various standard systems. This involved to some extent a (possibly premature) anticipation of the classification, and could not, of course, be done until a sufficient number of firms had been surveyed by the original method to make any such patterns evident. It was felt, however, that any increase in the speed of the surveys would be justified.

Preliminary results

The results obtained, once a serious effort was made to abstract standard skeletons, were something of a surprise. Contrary to the very prevalent myth that 'our firm is really quite different from any other', out of the 25 firms which had been surveyed in detail some 14 could be seen to fall into the same pattern and a further eight followed this basic pattern with one or perhaps two minor variations. In fact, only four skeletons were needed to cover the entire 25 and these four have large stretches in common. Differences arise, naturally, in the volumes of information flow, but this will in general affect the size of the computer needed rather than the overall system required. Such a variation in volume can be accounted for by parameter in the necessary software. It is interesting to note that on at least one occasion, deviations from these patterns were produced by essentially redundant procedures, which appeared to have been accidentally left over from earlier management information structures.

The two most frequent skeleton diagrams found so far (ignoring payroll, the 'system' for which is the same in almost all companies) are given in Figs. 1a and 1b: in the originals the standard narrative of each block was printed in small type, to leave space for modification manually during the interviews.

Fig. 1a represents the sales side of the firm and in the form shown is used in cases where orders received by the company require a considerable amount of effort by way of planning, quotations, etc., before manufacture of the items can start. In many cases, however, the business involves only selling from stock and consequently the portion above the broken horizontal line is replaced by three boxes only. The first of these gives information regarding the receipt of the customer's order, the second any interpretation which may be necessary, and the third the withdrawing of the items from stock. The first box in the lower portion is then restricted to the despatch side of the operation.

Fig. 1b illustrates the purchasing side of most small companies.

The use of the skeletons has proceeded very much as originally intended. The boxes in the skeleton initially contain a miniature legend, as shown, and are annotated by the analyst during the survey. In cases where two functions are done simultaneously a box is deleted. The report then consists of brief notes on the variations. Since there is some danger in such a procedure of the analyst forcing firms, which are in fact new variations, into one of the standard patterns, a close check is made to detect such new variations.
One result on the management science side, which may be mentioned at this stage, concerns the use of forecasting by such firms. In large firms there are a variety of forecasting problems, ranging from the now well known problems involving large numbers of items to the less frequently encountered problems involving a small number of seldom required but very expensive items (e.g. ships' propellers). The firms considered so far, cannot in general tie up very much capital in a small number of items, and consequently the majority deal with raw materials or goods which are readily accessible. The tendency is therefore not to use forecasting but merely to replace these commodities when stocks become low; the actual quantities bought depend as much on the storage space available as on the rate of consumption or the financial state of the company.

Where there was a long manufacturing lead time or where delivery delays were excessive, a small number of the companies involved did try to forecast future demand, but their forecasts were largely guesswork. For instance, in the machine tool trade, delivery delays of 1–2 years are not uncommon and if, during this period, the Chancellor of the Exchequer introduced a harsh budget the demand for an expensive item could vanish overnight. A forecasting package appears necessary here, but one of the biggest difficulties is the quantifying of the numerous factors which influence demand.

**Comments**

It is of course far too soon to draw general conclusions, although the very high proportion of firms surveyed so far falling into a single pattern, in spite of the variety of their activities, is too pronounced to be ignored. Several comments may be made but these should be regarded mainly as speculation.

First it should be noted that the use of skeleton patterns provides a ready-made classification scheme for small firms provided the number of different patterns observed remains fairly small as the survey proceeds. The results so far strongly suggest that this will, in fact, prove to be the case.

Further, such a classification scheme is ideally suited to the rearrangement of the firms into a computer based information system. In fact, if the number of distinct patterns remains sufficiently low it may even be possible to dispense with the original building-block plan altogether and produce instead a fully integrated system corresponding to each pattern. This would utilise the computer's potential fully. Such a possibility is obviously of considerable interest, although it may well involve a small amount of re-organisation of the firms themselves. Since it is not possible to perform experiments on actual firms, work has been proceeding on the simulation, on a computer, of the behaviour of a firm's 'standard' pattern. It is hoped to study the effect of various systems on the operations of the firms by this means. This work will be reported in a subsequent paper.

**Acknowledgements**

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