# Quality Assurance in the Textile Industry: Part I

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## Introduction

The paper *The United Kingdom Textile Industry — a Plan for Action*[1] reported a decline in the performance of the industry, and it concluded that an improvement in competitiveness was required to arrest and reverse the decline. In the government White Paper *Standards, Quality and International Competitiveness*[2] it was suggested that quality is now the most important factor in competitiveness and that it will be the prime consideration in future decisions concerning government purchasing. In today's industrial world it is clear that firms must compete against each other, not only in terms of price and delivery, but primarily in quality. To do so, it is essential that an acceptable quality management system operates within and throughout an organisation, with the full support of senior management.

For industry as a whole, the costs of quality have been estimated at between 4-15 per cent of turnover and in some cases as high as 30 per cent[3]. It has been shown by Crosby[4] and others that good quality management practices can lead to a substantial reduction in these costs and in the long term enhance competitiveness and market share.

The first step in any nationwide, or even industry-wide, effort to improve quality is to discover how quality management is currently being carried out. Previous work by the Production Management Group at the Bradford University Management Centre has provided a great deal of information on the practice and management of quality control in manufacturing industry generally[5,6,7,8]. This research is concerned with an examination of the practice of quality management in the textile industry. It was carried out in three stages, which represent different levels of investigation:

(1) A postal questionnaire, to examine the overall state of quality management in the industry.

(2) In-company interviews, to provide further detailed information on a sample of companies, and to prepare the ground for the next stage.

(3) In-company work, to give in-depth examination of quality systems and to develop semi-quantitative assessment procedures.

This article deals with the results of the first stage, the postal questionnaire, one of the most frequently used methods of collecting data from large samples to determine existing situations and identify trends or patterns in industrial

management. This method has been used extensively by the Bradford Group [5,6,7,8]. Large amounts of data can be collected using questionnaires, but several inherent weaknesses have been identified and these must be recognised when reading and interpreting the results which appear in this paper.

(1) No sample can ever be said to be completely random because only people who are interested in the questionnaire will answer it.

(2) Respondents will tend to answer questions in a manner which will show them in the best possible light.

(3) The necessarily brief nature of the questionnaire does not facilitate the exploration of the attitudes and prejudices involved in the development of quality control systems.

(4) Open questions such as "why does your firm not use SQC techniques?" tend to have a low response rate.

These factors have been considered throughout the design of the research, and in particular the use of the postal questionnaire.

## The Survey and Framework for Analysis

The research was designed to examine quality management practices and their associations with company background. Evidence concerning the former was gathered under four categories: (a) organisation of quality; (b) the quality system; (c) quality control; (d) quality costs.

Comparisons were made of the results obtained under these four sub-divisions with the descriptions of the participating firms, which in turn concerned four particular aspects:

(1) The sector of the textile industry in which the company operates.

(2) Company size, as measured by number of employees.

(3) Size of the unit to which the questionnaire was addressed, as measured by number of employees.

(4) Nationality of company ownership.

A secondary part of the investigation concerned the inter-relationships between the four aspects of quality systems, i.e. organisation of quality, the quality system, quality control and quality costs. Hence, savings in quality costs may be associated with good process control and good quality systems; good quality systems may lead to good quality procedures, etc.

Four hundred textile companies were selected to take part in the survey in late 1984. The source for sampling the industry was Kompass[9] with stratification of the sample according to the actual proportions of firms within each of the sectors of the textile industry. The survey sample was divided into two groups of 300 and 100 firms respectively, to allow research on the effects of response rates to mail surveys of prenotification by telephone. The details of the work have been published elsewhere[10]. An initial overall response rate of 32 per cent (129 replies) was achieved. After the various follow-up treatments, this was increased to

46 per cent (183 replies) and this forms the basis of the analysis reported here.

The distribution of responses by industry sector is shown in Figure 1. Figure 2 shows the sample distribution of company size in terms of number of employees in the unit to which the questionnaire was addressed and in the company within the UK. Of the respondents, 93 per cent represented British-owned companies. The other nationalities comprised North American companies (1 per cent), French (0.5 per cent), German (1 per cent) and others (2.5 per cent). Two per cent did not reply to this question.

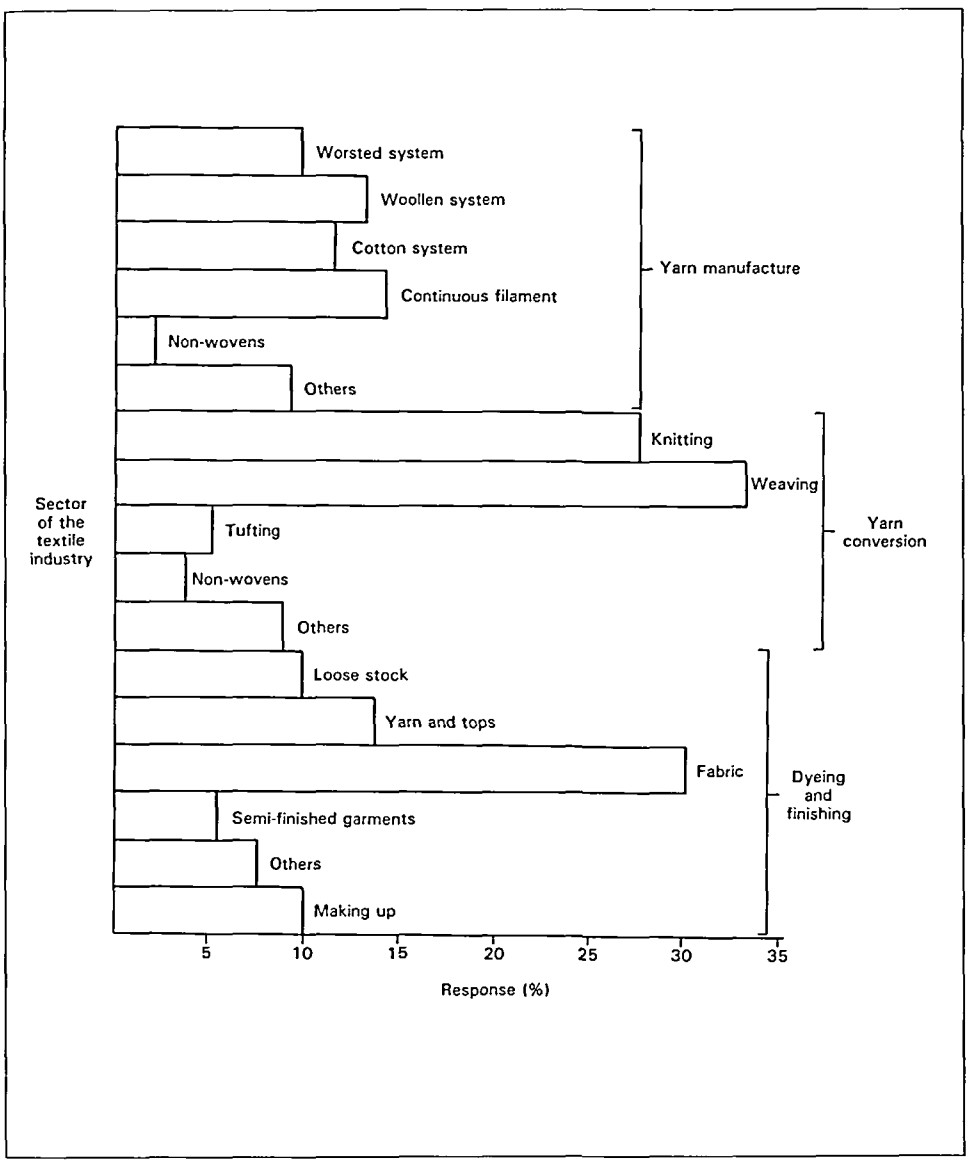



**Figure 1.**
Distribution of Response throughout the Sectors of the Textile Industry

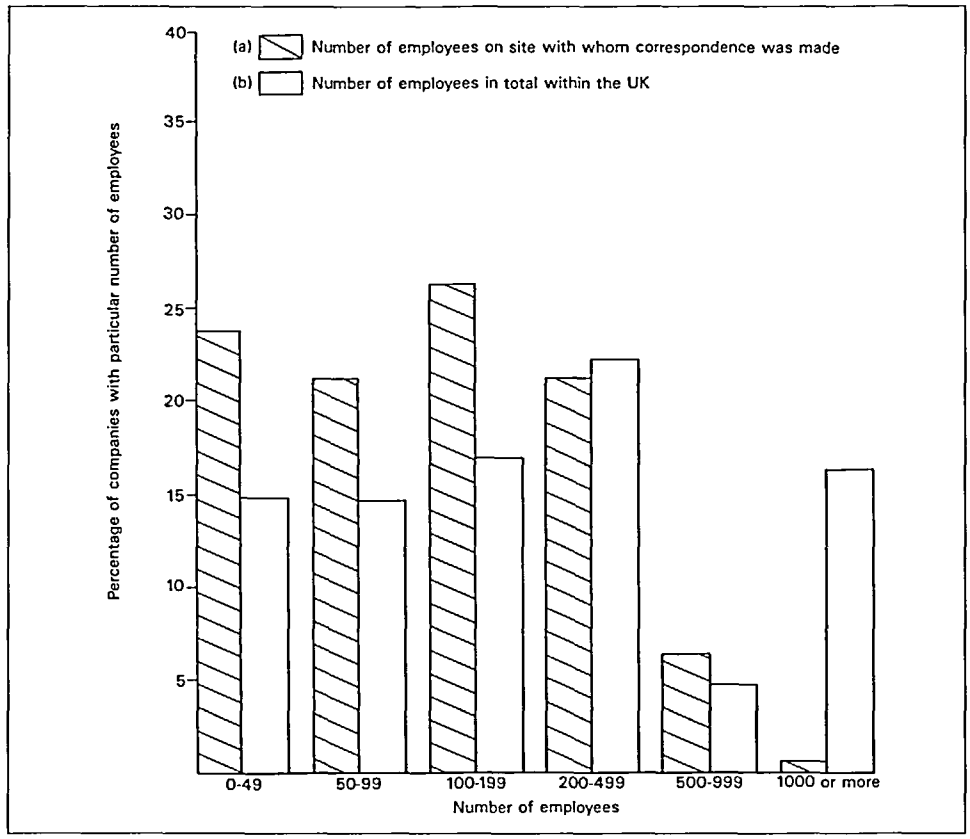



**Figure 2.**
Company Size Distribution

## Results and Analysis of the Survey

In all cases, tests for statistical significance of association have been carried out. The details are not given here, but are available from the authors.

It was found that there was no statistically significant relationship between the sector of the textile industry to which the companies belonged and the quality management practices that existed within them. In previous work, Lockyer *et al.*[5,6,7,8] had shown that foreign-owned companies make greater use of "good" quality control practice than British-owned companies. The results from this work provide very little opportunity to confirm this in the textile industry, since 93 per cent of the respondents were from British-owned companies. The relatively small number of foreign-owned firms in the sample means that only qualitative statements can be made about the relationships between nationality of ownership and quality management practices.

## The Organisation of Quality

The majority of respondents (88 per cent) claimed to have a management representative responsible for quality, but only 54 per cent indicated that their company possessed a separate quality control/assurance department. In 64 per cent

of the companies possessing such a department, the quality management representative reported outside the production function, either directly to the managing director or to a general manager. Less than one-quarter (24 per cent) reported to either the production director or production manager. Lockyer and Oakland[8] found that a similar situation existed in the chemical industry.

Of UK-owned companies, 89 per cent had a management representative responsible for the quality system. In the case of the foreign-owned firms (including American-owned) nine out of ten had such a management representative. All the American-owned companies had a separate quality control/assurance department, compared with only 54 per cent of the UK respondents.

There was a significant relationship between the size of the factory site and whether or not the company had appointed a management representative responsible for quality; the larger the factory site the more likely the existence of such a manager. Similarly, there are highly significant relationships between the existence of a separate quality control/assurance department and the size of the factory site, and the size of the company within the UK.

The existence or not of a specialist department in itself gives no indication of whether quality management is "good". It is possible that small companies have to combine quality into another function due to size and doubling up of staff roles.

## Quality Systems

### *Quality Manual and/or Documented Procedures*

Only 27 per cent of respondents claimed that a quality manual existed in the company. A further 30 per cent indicated that written quality control procedures existed on "separate sheets". This leaves 44 per cent claiming no formal written quality procedures. Lockyer *et al.*[8], in their study of the chemical industry, found that nearly 96 per cent of respondents had either a quality manual or procedures existing on separate sheets and under 5 per cent had nothing. Statistical analysis on these two sets of results has shown that a firm in the chemical industry is more likely to have documented quality management procedures than a firm in the textile industry.

Approximately 55 per cent of the UK respondents either had a quality manual (25 per cent) or quality control procedures on separate sheets (30 per cent). Both of the American-owned firms based in the UK owned quality manuals. Not surprisingly perhaps, the likelihood of a company possessing a quality manual, or written procedures, increases as the size of the factory or company site increases.

There is, of course, a great deal of difference between the general principles and organisation, documentation (manual) and procedures. Companies with procedures only may suffer from a lack of quality policy and initiation of quality action. It is important not to confuse bureaucratic "control" of quality with its being managed properly.

### *BS5750*

Of all the companies that replied to the questionnaire, 62 per cent had no knowledge of British Standard (BS) 5750. Moreover, only 2.5 per cent (five firms) of those

that indicated that they had heard of the standard claimed to be registered to it. After further consultation with the Certification bodies it was discovered at the time that only one textile firm had in fact been registered by BS5750. Forty-two per cent of the companies claimed to be assessed to other standards, the most popular of these being the Ministry of Defence Standard 05/21 series (15 per cent). This was followed by standards set up by various department stores, e.g. Marks and Spencer and British Home Stores (6 per cent). Forty-five per cent of respondents claimed to carry out reviews of their own quality systems.

Two-thirds of the UK companies had never heard of BS5750, whereas all the American-owned firms were aware of it. The American firms also carried out audits on their quality systems, whereas only 54 per cent of the UK-owned firms did so. A correlation exists between the company and unit size, and knowledge of BS5750, and the question asking whether the firm was assessed and registered to other standards similarly elicited more affirmative responses from the larger companies.

*Specifications*

Less than two-thirds (64 per cent) of companies that replied had specifications for all finished products, with a further 26 per cent having specifications for some finished products. In the survey of the UK Chemical Industry by Lockyer *et al.*[8], more than 99 per cent were found to have written specifications for at least some of their finished products, and 84 per cent had specifications for all products. In another survey of members of the Institute of Quality Assurance, Oakland and Duprey[6] showed that 94 per cent of the respondents' companies had written specifications for all products (Figure 3(a)).

Specifications were set down for all bought-in goods by 35 per cent of the textile companies and a further 52 per cent said they had specifications for some. This again compares unfavourably with the chemical industry survey, in which 56 per cent of firms had specifications for all bought-in materials, and 41 per cent for some (Figure 3(b)).

In the area of setting specifications there is a suggestion of better practices in US-owned firms. Both American firms had specifications for all products compared with less than two-thirds (63 per cent) of the UK-owned firms.

## Quality Control

Only 19 per cent of the respondents claimed to be using statistical quality control techniques (SQC) at goods inwards. The majority of firms (59 per cent) indicated that they were using "other types of sampling methods", while 100 per cent inspection was being used by 15 per cent. Nearly 5 per cent were using no quality control at all at goods inwards.

None of the American-owned firms practised 100 per cent inspection for bought-in materials. One had implemented SQC, the other indicated the use of "other sampling methods". Of the UK-owned firms, nearly 16 per cent used 100 per cent inspection, and only 18 per cent used SQC. The majority of them chose to use "other sampling methods". Some problems of interpretation occur here because the respondent was left to decide which sampling methods were regarded

as SQC and which were not. Process control charting methods and statistically based acceptance sampling techniques may both be regarded as "SQC".

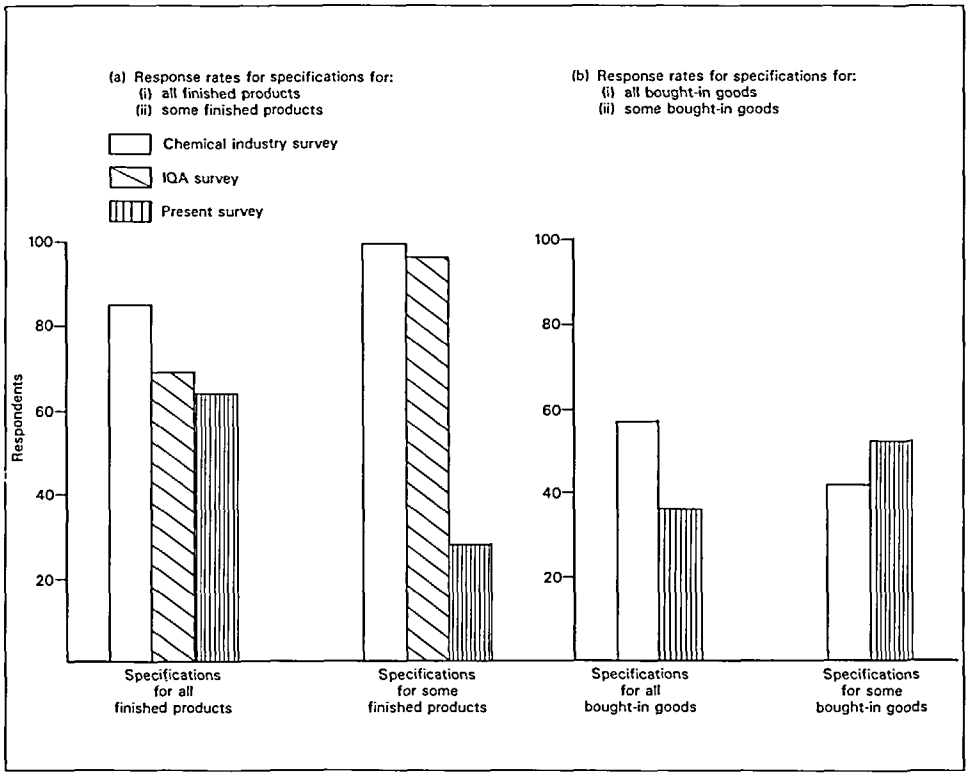



**Figure 3.** Percentage of Respondents having Specifications

Only one in six respondents (17 per cent) stated that they were using information from quality control procedures at goods inwards to generate vendor rating schemes. This compares with 51 per cent of respondents in the IQA survey carried out by Oakland and Duprey[6]. Of course, some upward bias in favour of good quality control/assurance methods would be expected from members of the IQA.

Nationality of ownership appears to affect whether or not a company uses a vendor rating scheme. It is more likely that a foreign-owned company within the UK will possess such a scheme.

The two most popular methods of controlling the quality of production processes were 100 per cent inspection (39 per cent) and "other types of sampling methods" (38 per cent). Eighteen per cent of firms claimed to use SQC techniques at this stage of manufacturing. Foreign-owned firms within the UK were more likely to use SQC techniques for process control.

The favoured methods employed for verifying the correctness to specification at final inspection were, once more, 100 per cent inspection (38 per cent) and "other types of sampling methods" (36 per cent). SQC was used by only 21 per cent of the respondents, with foreign-owned firms again more likely to use SQC techniques.

Figure 4 shows the usage of SQC at the various stages of manufacture for the DTI[5] survey and the present one. Lockyer *et al.*[8] found that in the chemical industry, foreign ownership favoured the use of SQC at goods receipt and during process control, and this also appears to be the case in the textile industry. There is evidence to suggest that the larger textile factory sites are more likely to use SQC than the smaller ones. This contrasts slightly with the findings of the chemical industry survey in which no effect of size on the usage of SQC was found.

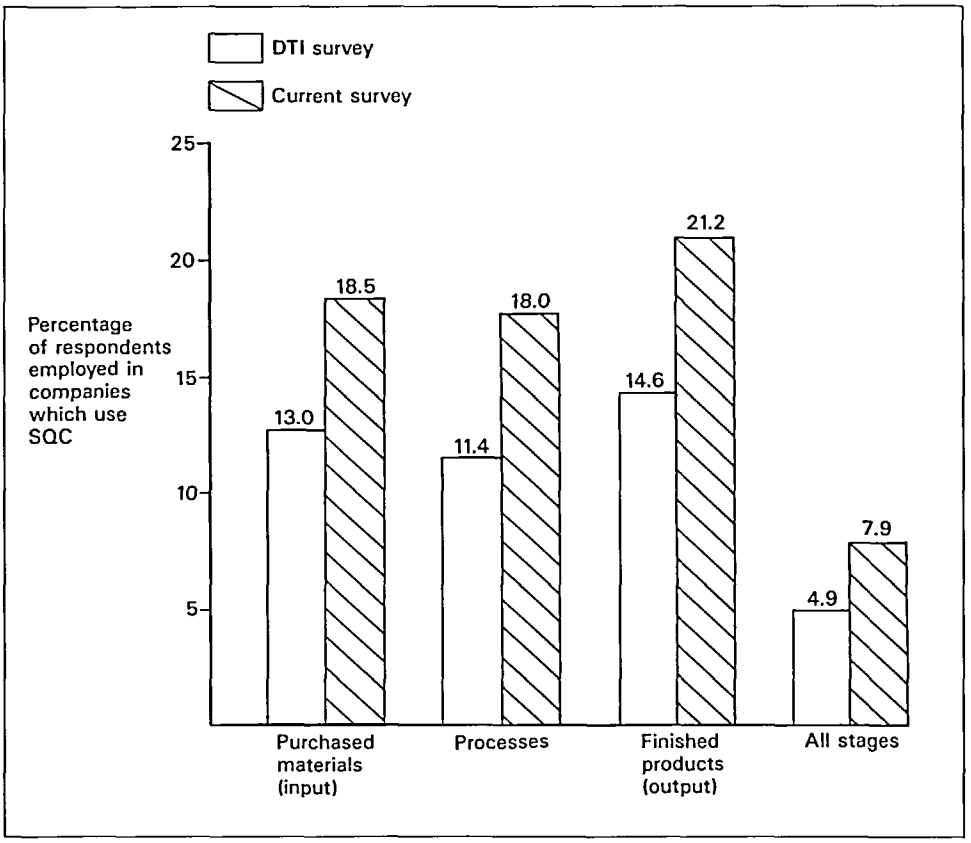



**Figure 4.**
Usage of SQC — DTI Survey and Present Questionnaire Survey

The general conclusion that can be drawn immediately from this comparison is that the usage of SQC in the UK textile industry is higher than that of British manufacturing industry in general, but care has to be taken in drawing such conclusions before in-company interviews have been carried out.

The reliability or durability of finished products was monitored by nearly two-thirds (64 per cent) of respondents. Of these, 70 per cent claimed to be using the information gathered to help modify/develop product designs, 85 per cent to help modify/develop process control, and 73 per cent to help modify/develop specifications for purchased materials.

## Quality Costs

Approximately half of the respondents (56 per cent) claimed to be recording quality costs in some form. Despite this, the number of firms that could give an actual value for quality costs, as a percentage of turnover, was only 27 per cent (Table I). This causes speculation that quality managers in the textile industry either do not understand what is meant by quality costs and how they are comprised, or are unwilling to release quality cost figures. The likelihood of attempts being made to record quality costs increases with the size of the factory site, or company within the UK.

| Quality Cost % of Turnover | Absolute Frequency % | Relative Frequency % |
|---|---|---|
| < 1 | 3 | 1.6 |
| 1 → 5 | 38 | 20.1 |
| 6 → 10 | 7 | 3.7 |
| > 10 | 3 | 1.6 |
| Total | 51 | 27.0 |

**Table I.** Respondents' Quality Costs. Shown as a Percentage of their Turnover

## The Inter-relationships between the Four Aspects of Quality Systems

*Quality Organisation versus Quality Systems*

Those companies which possessed a quality management representative were more likely to own either a quality manual or have written quality procedures. It was also revealed that if a company had such a representative, then it was more likely to carry out quality audits on a regular basis. Similar relationships were also apparent between the existence of a company quality department and the possession of a quality manual, knowledge of BS5750 and quality audits carried out on a regular basis.

*Quality Organisation versus Quality Control*

The only associations to show here are those between the existence of a quality department and the most frequently used method of controlling the quality of production processes, and verifying the correctness to specification of finished products. Interestingly, those companies that have set up separate quality control departments tend to prefer the usage of SQC techniques at these stages.

*Quality Organisation versus Quality Costs*

Generally, the existence of a separate quality control/assurance department within a firm enhances the possibility of that company attempting to record quality costs.

*Quality Systems versus Quality Control*

Those people who had compiled a quality manual, or had at least written quality procedures, were more likely to use SQC techniques at goods inwards. They were also more likely to formulate vendor rating schemes. In the area of process control, those firms which had quality manuals favoured the use of SQC techniques rather than 100 per cent inspection. The chances of a firm using SQC for finished goods was also increased if they had some form of quality manual in their possession. A similar relationship existed between the ownership of a quality manual and the monitoring of the reliability of a firm's products in the field. As expected, it would seem that the possession of a quality manual, or some form of formal written procedures, results in generally better quality control procedures.

Simply knowing of the existence of BS5750 seems to increase the chances of SQC being used at goods inwards, of vendor rating schemes being used, and of the reliability of products in the field being monitored.

Those firms using quality audits tend to prefer the use of SQC during process control and at final inspection. Perhaps not surprisingly, vendor rating schemes are more likely to be used by those firms that have laid down specifications for bought-in materials, and firms that have specifications for finished products tend to make greater use of SQC during process control.

*Quality Systems versus Quality Costs*

There is a strong positive relationship between the existence of a quality manual and the recording of quality costs, and knowledge of BS5750 or registration to other standards has a similar effect.

## Conclusions

*Company Background versus the Four Aspects of Quality Assurance Systems*

Table II provides an overview of these results and shows the positive relationships between the four aspects of the quality assurance system and the variables that provided the information on company background. The sector of the textile industry does not appear to influence any aspect of the quality assurance system, and the only areas in which company nationality has an effect is in the formulation of vendor rating schemes and use of SQC during process control.

As one might expect from previous work, the larger the factory site and the company within the UK, the better the quality assurance system. From government statistics[11], only 297 (15.5 per cent) textile firms, out of a total of 1,915, employ 200 or more people (a small firm has been defined[11] as one which employs up to 200 people) (Figure 5). Hence the relationship between factory size and quality management practices in the textile industry causes some concern as the industry is largely made up of small companies, which clearly have less well-managed quality systems. This could go some way to explaining the relative decline of the industry in the UK.

*The Inter-relationships between the Four Aspects of Quality Assurance Systems*

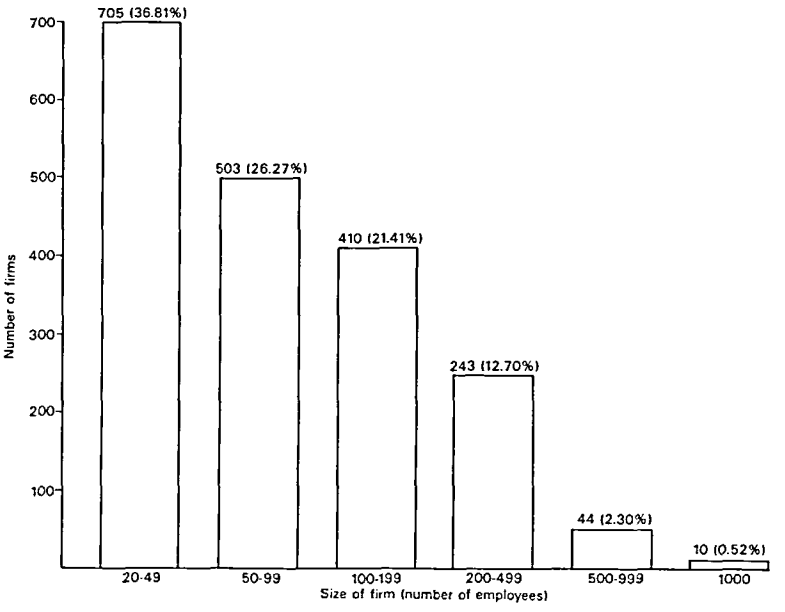
As shown in Figure 6, there are many relationships which emerge from the research reported here. The factors which appear to have the greatest influence on other

| QA System | Company Background: Sector of Textile Industry | Nationality of Company[a] | Size of Site | Size of Company within UK |
|---|---|---|---|---|
| Quality Organisation | X | X | √ | √ |
| Quality Systems | X | X | √ | √ |
| Quality Control | X | √ | √ | X |
| Quality Costs | X | X | √ | √ |

√ = relationship exists
X = no relationship exists

[a]Association confirmed by Fisher's exact test.

**Table II.**
Relationship between the Quality Assurance System and Company Background




Source: Annual Abstract of Statistics No 1211 1985 (Central Statistical Office)

**Figure 5.**
Graph Showing Distribution Size of Textile Firms 1983

quality aspects are the existence of a quality department and the presence of a quality management representative. There is a relationship between quality costs and six other quality factors, indicating perhaps that good quality management leads to the gathering of quality cost data. The use of quality audits is increased by the existence of a quality department and having a quality representative. The audits themselves appear to be associated with the use of SQC and knowledge of quality costs. Quality manuals appear more often in companies with a quality department and a quality management representative, and are themselves important in influencing the usage of SQC and the gathering of quality cost data.

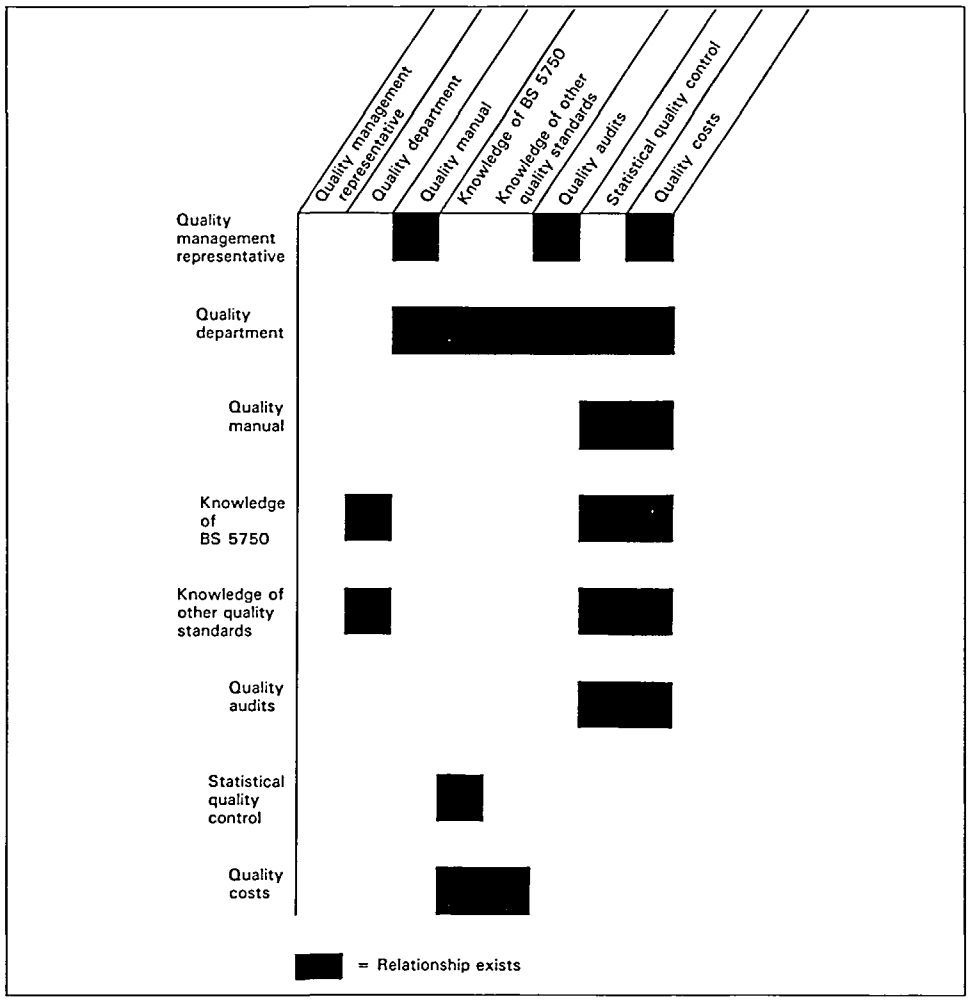



**Figure 6.**
Relationships between Various Aspects of Quality Assurance Systems

Many of the results of the research may well be predicted from common-sense expectations, but it is useful to confirm that the implementation of good quality systems acts as a spearhead to draw through an organisation many other quality

related improvements. In some cases, the situation in textiles appears to be worse than in other industries. Small companies are not practising quality assurance as well as the large ones, whether on one or several sites. There would seem to be a case for some co-operation between small firms to use consultants to install good quality systems, to train personnel and perhaps for the amalgamation of the quality organisation of adjacent small firms, which do not compete directly with each other.

*Further Work*

In previous research, firms have responded to questionnaires indicating they use SQC, yet on follow-up visits this was found not to be so. The accuracy of the data on quality systems presented in this paper similarly requires validation. To provide further detailed information, in-company interviews have been carried out in selected companies. The results of this work will published in Part II of this paper.

In-company work has also taken place in selected companies, which range from those with a less well-documented quality system to those that have been assessed and registered to BS5750. Quality audits based on BS5750 are being carried out in each firm, followed by analysis of each company's quality costs. It is hoped that this work will lead to a semi-quantitative method for quality management system assessment.

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