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TQM and labour productivity in Jordanian industrial companies

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Reports on research to determine the degree of application of total quality management (TQM) philosophy and practices in industrial corporations in Jordan. Uses primary and secondary empirical data to examine the link between TQM and labour productivity. Survey responses were classified into two groups: high-TQM implementation and low-TQM implementation. Found that mean labour productivity measurements for high-TQM companies were significantly higher than for low-TQM companies over the period 1993-1998. Also, mean growth rates of labour productivity measurements for companies with high-level TQM were higher than for those with low-level TQM during this period. Regression analysis demonstrated a statistically significant positive relationship between TQM and labour productivity.

TQM; ISO 9000; Labour; Productivity; Jordan.

Introduction

Total quality management (TQM) is a key strategy for maintaining competitive advantage and market leadership. In today's manufacturing environment, manufacturers use TQM as a powerful tool to continuously improve productivity and customer satisfaction (Mohanty and Yadav, 1994; Grant Thornton, 1996/1997). As the industrial sector is considered to be one of the major contributors to the Jordanian economy, the research has examined the degree of application of TQM principles, and then investigated the relationship between TQM implementation and labour productivity in industrial companies in Jordan.

Many aspects of TQM have been examined in previous studies, such as: employee participation; education and training; communication; customer focus; statistical quality control; continuous improvement; and teamwork (see, for example: Morris, 1993; Roth, 1993; Bovet, 1994; Gunasekaran *et al.*, 1994; Mohanty and Yadav, 1994; Rothman, 1994; *Canadian Manager*, 1995; Scheidt and Amsler, 1995; Chapman *et al.*, 1997; Hendrickson, 1997). Previous studies attempting to link TQM and productivity have been limited in scope and often suffered from methodological constraints or inaccuracies. Some of these linked only one or two elements of TQM with productivity. Most of the previous studies are theoretical studies and only a few provide empirical evidence to support their conclusions. Many of the previous empirical studies used descriptive statistics (frequencies) to analyse data (Morris, 1993; Roth, 1993; Chong and Kukalis, 1997), and a few used inferential statistics (correlations, *t*-test and χ^2) (Sluti *et al.*, 1995; Chapman *et al.*, 1997).

A clear need existed for analytical studies that link TQM and labour productivity using appropriate statistical methods. This research examined the link between all recognised elements of TQM and labour productivity. Eight core elements of TQM were identified from the literature and investigated in this research (see following section). Data analysis was

based on descriptive statistics (frequencies and means) and inferential statistics (*t*-test, factor analysis, and regression analysis).

Conceptual research framework

Based on an extensive study of previous research on TQM, eight elements of TQM have been identified as critical for successful TQM. These elements of TQM are: employee participation (EP); education and training (E&T); organisational communication (OC); customer focus (CF); scientific approaches to decision making (SATDM); statistical methods for quality control (SMFQC); organisational commitment to quality and continuous improvement (OCTQ&CI); and unity of purpose (UOP).

The elements of TQM listed above represent the best way to encourage the employees to be more skilled, committed and productive by giving them information, knowledge, power and rewards (Goetsch and Davis, 2000). So logically, one of the more significant expected relationships is the relationship between the application of TQM principles and labour productivity. Previous studies also point out that labour productivity is the measure most directly affected by the application of the TQM principles (Morris, 1993; *Quality*, 1994; Bovet, 1994; Mohanty and Yadav, 1994; Rothman, 1994; Sandelands, 1994; Chapman *et al.*, 1997). This means that the adoption of TQM concepts leads to inspiring employees to succeed and grow, improving their performance and productivity (Oakland, 1993; Omachonu and Ross, 1994; Raiborn and Payne, 1996; Weinstein, 1996a; Terziowski, 1997; Van Horn, 1997; Goetsch and Davis, 2000). Therefore, this research focused on TQM and the link between TQM and labour productivity.

TQM is a recent approach to doing business that attempts to maximise the competitiveness of an organisation through the continual improvement of the quality of its products, services, people, processes, and environments (Goetsch and Davis, 2000). Productivity may be simply defined as a ratio between the outputs generated from a system (goods or services) and the inputs provided to create those outputs (capital, labour, materials, energy and other inputs) (Mohanty and Yadav, 1994). Most definitions of productivity include profitability, efficiency, effectiveness, value, quality, innovation, and quality of work life (Smith, 1995). Labour productivity is a measure of how many products or services are produced relative to the amount of labour required (Gaither, 1992).

The main factors that effect labour productivity are education, training and experience of the workforce; quality of management; capital investment in equipment, technology and facilities; and social environment (Alby, 1994; Saha, 1994; Lysko, 1995; Francalanci and Galal, 1998). All of these factors appear in the eight elements of TQM investigated in this study, with the exception of capital investment in equipment, technology and facilities. Capital investment in equipment, technology and facilities (capital stock) is represented in the fixed assets that the company uses to facilitate its whole processes. Therefore, it was decided to use figures for capital stock (as measured by the net value of fixed assets) as a control variable for the relationship between TQM and labour productivity (see Figure 1). To remove the effect of company size, relative capital stock was used as a control variable rather than capital stock. Relative capital stock is the ratio of net value of fixed assets to market capitalisation. Market capitalisation was used as a measure for the size of the company. Nine hypotheses were developed and tested to investigate if there is a relationship between each of TQM, its elements, and relative capital stock (the independent variables) and labour productivity (the dependent variable).

Methodology

The population of the study

The population of the study consists of all Jordanian shareholding corporations listed in 1998 under the industrial category in Amman Financial Market, now called "Amman Stock Exchange". In late 1998, this consisted of a total of 90 companies. This study focused on Jordan because it is the home country of one of the authors and its small size provides an excellent study of the impact of TQM on the major industrial sector of a total national economy. This sector was chosen because there is a clear trend in the social and economic development plans of successive Jordanian governments to support the industrial sector. The companies in this sector provide significant local employment, and increasing national income. The contribution of the industrial sector to Gross Domestic Product (GDP) at constant factor cost reached 16.9 per cent in 1998, against 15.4 per cent in 1993. Industrial exports were Jordan Dinar (JD) 551,249,000 in 1993 and JD 881,345,000 in 1998 (1 JD=US\$1.40). Industrial exports constituted about 84.2 per cent of total domestic exports in 1998, against 79.7 per cent in 1993 (Central Bank of Jordan, 1999a,b).

Methods of data collection

Both quantitative and qualitative data were collected and analysed in order to investigate fully the relationship between TQM implementation and labour productivity. The elements of TQM identified for the study were measured through questionnaires and personal interviews. The questionnaire was developed, trialed, modified and then distributed to quality (production) managers (or managers who were responsible for quality) in all industrial corporations in Jordan. Five-point Likert scales (strongly agree, agree, neither agree nor disagree, disagree, and strongly disagree) were used in formatting the questionnaire. The external validity of the questionnaire was ensured through the pilot testing of the survey questionnaire. Ten copies of the questionnaire were distributed to quality experts in Quality Society of Australia and industrial corporations in Jordan. Nine copies were sent via fax to corporations selected randomly, and one copy was sent electronically to the Quality Society of Australia. All of the nine faxed copies were collected by mail, whereas the comments and suggestions from a membership manager in Quality Society of Australia were received electronically. The format of the questionnaire was modified according to their comments and suggestions. To ensure internal validity of the questionnaire, it included three internal check questions.

All quality (production) managers (or managers who were responsible for quality) in 88 industrial corporations listed in Jordan were initially phoned to seek their participation in the study. The other two companies had closed down prior to the time of contact. A total of 76 managers agreed to participate in the completion of the questionnaire, while four managers mentioned that their companies were still in the early establishment stage and did not consider themselves ready to participate. The remaining eight managers did not agree to participate in the completion of the questionnaire, primarily because they did not have the time to fill it out. A questionnaire was distributed to each company of the 76 participating companies. The questionnaires were delivered by hand, and left with the managers for a few days to enable them to fill them out. All of the distributed questionnaires were collected by hand (76 questionnaires).

The eight non-responding managers were phoned again to explain the importance and the objectives of the study. This was to encourage them to participate in the completion of a small subset of the full questionnaire. The small subset consisted of nine questions – one question asking about sales revenue and number of employees in 1998 and the other eight questions asking about the elements of TQM – one question for each element. The questions, which looked like general questions, were selected. These subsets of the questionnaire were distributed to the non-responding companies via fax. All the eight small subsets of the questionnaire, which were distributed to the non-responding companies, were collected. Sales revenue in three companies was zero because the production and marketing processes had been stopped before 1998. Therefore, data collected from the other five companies was analysed to investigate any non-response bias in the results.

Personal interviews were conducted to collect more information about the practical application of TQM principles from the same managers who filled out the questionnaire in ten industrial corporations in Jordan. To examine differences between companies with high and low levels of TQM, samples of five companies with high-level of each element of TQM, and five companies with low-levels of each element of TQM were selected. A qualified person assisted this process by recording answers to all questions during the interviews. The feedback from each interview was reviewed immediately on completion of each interview.

Like most variables in management science, productivity is not easy to measure, and can only be measured indirectly, that is, by measuring other variables and then calculating productivity from them (Alby, 1994). Productivity measurement is a required management tool in evaluating and monitoring the performance of a business operation. Productivity is, therefore, a major concern in today's business organisations that enable it to survive and be profitable. To become a more meaningful management tool, productivity measurement methodologies must show the linkage with profitability for which management is held accountable. Sales revenue, as an indicator of profitability, has been used in many cases to calculate labour productivity (Aboganda, 1994). Measures of value-added are commonly used for broad comparison of aggregate sector productivity (Jablonski, 1995; Van Ark, 1995), whereas the use of sales per employee has been used frequently to measure labour productivity for individual companies (*Quality*, 1994; Byrne, 1994; Ensley and Banks, 1994; Sandelands, 1994; Chapman *et al.*, 1997). Labour productivity can be measured in terms of either employee numbers or labour costs. Salaries and wages expenditures are unavailable in many of the annual reports for the industrial corporations in Jordan for the years 1993-1998. All of the employees in these corporations are full-time employees who work eight hours a day. Therefore, employee numbers were used to measure labour productivity rather than the cost component of labour. Labour productivity, sales revenue per employee for the 76 participating companies, were calculated from companies' annual reports for the years 1993-1998. Sales revenue was taken from the statement of income for the years 1993-1998. Number of employees was taken from companies' annual reports for the years 1993-1998. To remove the effect of inflation, labour productivity measurements for the years 1993-1998 were adjusted by the published Jordanian Cost of Living Index (1997 = 100) during this period. Cost of living index figures for the years 1993-1998 were taken from the 35th Annual Report (1998) of the Central Bank of Jordan (Central Bank of Jordan, 1999a). Labour productivity measurements for the non-responding companies were calculated for the year 1998 from their responses on the small subset of the questionnaire.

Relative capital stock was used as a control variable for the relationship between TQM and labour productivity. Relative capital stock is the ratio of net value of fixed assets to market

capitalisation. Market capitalisation was used as a measure for the size of the company. Relative capital stock figures for the 76 participating companies were measured from annual reports for the year ended 31 December 1998. Net values of fixed assets were taken from the balance sheet for the year ended 31 December 1998. Market capitalisation figures for these companies were taken from companies' reports issued by Amman Stock Exchange for the year 1998.

Methods of data analysis

The reliability of the questionnaire was tested according to Cronbach Alpha measurements. The reliability coefficient (Alpha) of each element of TQM was as follows: employee participation (88.50 per cent); education and training (82.31 per cent); organisational communication (83.23 per cent); customer focus (88.97 per cent); scientific approaches to decision making (87.05 per cent); statistical methods for quality control (67.76 per cent); organisational commitment to quality and continuous improvement (84.62 per cent); and unity of purpose (78.71 per cent). The reliability coefficients of six elements of TQM are good and of the other two elements are acceptable, which means the reliability of the questionnaire is high. Correlation of means ($R > 0.75$) and significance t -test checks showed no significant difference between responses for the internal check questions. Therefore, the internal validity of the questionnaire is high.

Through careful analysis of survey responses, the 76 participating companies were classified into two groups: high-level TQM implementation and low-level TQM implementation. For example, the companies were classified into high and low levels of employee participation (one of the eight elements of TQM investigated) as follows:

- Determine the median value from the eight questions related to employee participation across the whole database for 76 companies.
- For each company, determine whether the response of each question is above, equal, or below the median.

Then, for each company:

- If the number of the responses above the median ($>$ median) is larger than the number of the responses below the median ($<$ median), that company is considered "high employee participation".
- If the number of the responses above the median ($>$ median) is smaller than the number of the responses below the median ($<$ median), that company is considered "low employee participation".
- But if the number of the responses above the median ($>$ median) is equal to the number of the responses below the median ($<$ median), that company will be excluded.

In the same way, the companies were classified according to all other elements of TQM. Regarding the overall TQM, the classification was based on all the 48 questions excepting the three check questions. These three questions were excluded, because they are check questions just to ensure internal validity of the questionnaire.

Data analysis was based on descriptive statistics analysis (frequencies and means) and inferential statistics (t -test, factor analysis, and regression analysis). Hypotheses were tested using comparison of means, t -test, R^2 coefficients of regression, and the significance of the f

value. The relationship between TQM and labour productivity was tested by comparing the mean of labour productivity for high-level TQM companies (μ_{LPH}) with the mean of labour productivity for low-level TQM companies (μ_{LPL}). There is a relationship between TQM and labour productivity if $\mu_{LPH} \neq \mu_{LPL}$. The relationship is positive if $\mu_{LPH} > \mu_{LPL}$ or negative if $\mu_{LPH} < \mu_{LPL}$. The strength of the relationship was examined using *t*-tests. Hypotheses were also tested by R^2 coefficient of determination. The significance of the *f* value was used to determine the strength of the relationship between all elements of TQM and relative capital stock (independent variables) and labour productivity (dependent variable).

Using factor analysis, all of the eight elements of TQM were shown to be one factor in component matrix. This was to be expected as all these elements are related to people and interrelated in their nature. Therefore, multiple regression analyses were examined between the eight elements of TQM and relative capital stock (the independent variables), and labour productivity (the dependent variable). Each element of TQM was measured by adding the responses of all related questions. For example, employee participation was measured by adding the responses of the eight questions related to this element.

Regarding the non-responding companies, the group showed a similar distribution of high- and low-TQM companies to the main group of companies, and the mean of labour productivity for companies with high-level TQM (μ_{LPH}) was significantly higher than for those with low-level TQM (μ_{LPL}) (19691.5 > 5561). Therefore, there appears to be no significant non-response bias in the results.

Results

Analysing TQM

The distribution of the companies according to the classification of high and low level of each element of TQM is shown in Figure 2. About one-third of all companies showed a high level of each element of TQM, and 16 per cent of all companies showed a low level of each element of TQM. The majority of the high-level companies were larger companies (greater than 100 employees), and included many from the chemical, construction, food and drinks, paper and packaging industries. The majority of the low-level companies were smaller companies, and included many from the engineering, clothes and textile, and pharmaceutical industries.

Most of the managers, from the five high-TQM companies selected for detailed interviews, mentioned that top management encourages employees to be involved in decision making and empowers them through decentralisation of decision making:

There is a senior manager for each department and he can take any decision relating to the work in his department. For example, I approve most of the production issues ... Making decisions regarding these issues is based on the output of full discussion with the employees in my department. (Production Manager, high-TQM company).

Whereas those managers, from the five low-TQM companies, made no mention of employees being encouraged to be involved in decision making. In the high-TQM companies, quality teams and periodical work meetings have full support and facilitation from top management. But there are no permanent quality teams and fewer work meetings in the low-TQM

companies. The high-TQM companies emphasise employee learning through providing access to lectures, discussion circles, conference attendance, and visiting experts. Low-TQM companies rarely provided employees with such levels of continuous education and training:

We usually call international experts to provide us with some useful information, for example, about: globalisation, ISO 9000, etc ... We encourage our employees to contribute to and attend local and international conferences (Quality Manager, high-TQM company).

Communication is open and continuous between the different levels and departments in the high-TQM companies:

As our company applies open-door policy, any employee can meet the general manager without any problem (Quality Manager, high-TQM company).

Most managers from the low-TQM companies frequently mentioned barriers to effective communication within their companies rather than “open-door” policies or the like. Market analysis, customer satisfaction studies and market segmentation are used in the high-TQM companies. These companies are responsive to fixing and resolving customer problems and complaints:

Our company has a form for customer complaints and a special register for collating and resolving customer complaints, which then feeds into process improvement activities (Quality Manager, high-TQM company).

On the other hand, the low-TQM companies conduct very few market studies to understand and identify customer needs:

We just produce then we try to sell what have been produced (Assistant General Manager, low-TQM company).

In the high-TQM companies, decision making is generally based on facts and data.

We have a report to fill out by our employees once they expect or experience problems in production operations ... Then based on the causes mentioned in these reports; we discuss how to solve such problems (Production Manager, high-TQM company).

But in the low-TQM companies, decision making is frequently based on instinct and senior managers’ “best-estimates”. In high-TQM companies, in-process test and acceptance samples are used both during the production process and for final inspection. Where such inspection and test methods are used in the low-TQM companies, they are limited to final product testing. The high-TQM companies develop new products and improve their existing products. These companies always concentrate on improving their processes continuously:

We always try to improve our processes by removing unnecessary steps to reduce the time required to produce products or do things in general... Top management in our company has established a committee, which includes qualified employees from all departments, to provide it with valuable suggestions to improve all processes on an on-going basis (Quality Manager, high-TQM company).

On the other hand, there was little or no evidence for continuous improvement of products or processes in the low-TQM companies:

We still produce the same product from year-to-year without any drive for improvement (Production Manager, low-TQM company).

The managers interviewed from the high-TQM companies generally identified company cultures highlighted by a development of long-term relationships built on loyalty and trust with the employees. This was not evident in the low-TQM companies:

Our company usually awards the employees grant-shares. (Quality Manager, high-TQM company). There is a housing fund and a social occasions fund for the employees both financially supported by the company (Production Manager, high-TQM company).

Most of the managers, from both the high- and low-TQM companies selected for detailed interviews, mentioned that companies have generated or will potentially generate the following benefits from the adoption of TQM principles: improving productivity and increasing sales and profits, improving the performance and reducing costs. Generally, TQM is considered as a builder of competitive advantage. Managers from the high-TQM companies mentioned that the major difficulties faced by their companies in implementing TQM principles related to the financial cost and the time required for such implementation. Managers from the low-TQM companies mentioned that the reasons for avoiding TQM, or only limited or partial adoption of the TQM principles, also revolved around the financial and time requirements, but also included the need for qualified employees and new technology. Also, several low-TQM company managers mentioned that their top management did not perceive the benefits of TQM principles yet.

Analysing labour productivity

Adjusted mean labour productivity measurements for companies classified into the high- and low-TQM groups during the period (1993-1998) are shown in Figure 3. Adjusted mean labour productivity for all companies in the high-TQM group was significantly higher than for those in the low-TQM group during 1993 to 1998. Adjusted mean labour productivity had increased for companies with high levels of TQM, whereas it had decreased for those with low levels of TQM during this period. The difference in adjusted mean labour productivity between the high-TQM companies and the low-TQM companies had increased during this period.

Adjusted mean growth rate of labour productivity measurements for all companies with high and low levels of TQM during the period 1993-1998 is shown in Figure 4. Year-by-year adjusted growth rates are higher for high-TQM companies than for low-TQM companies. In general, adjusted growth rate of labour productivity for most of the companies with high level of TQM had a positive value over this period. Adjusted growth rate of labour productivity for about 40 per cent of the companies with low level of TQM had a negative value over this period. Adjusted mean growth rates of labour productivity for both high and low TQM companies dropped sharply in 1995-1996. This is primarily attributable to a widespread drop in the performance of the Jordanian economy generally in this year. For example, growth rate of GDP at constant market prices was 1 per cent in 1995-1996, against 3.9 per cent in 1994-1995 (Central Bank of Jordan, 1999a, p. 9).

A random sample of five high-TQM companies having a complete set of labour productivity figures for the years 1993-1998 was selected. Adjusted labour productivity measurements for this sample of high-TQM companies during the period (1993-1998) are shown in Figure 5. In general, adjusted labour productivity for all of these five companies had increased over the period (1993-1998).

A random sample of five low-TQM companies having a complete set of labour productivity figures for the years 1993-1998 was also selected. Adjusted labour productivity measurements for this sample of low-TQM companies during the period 1993-1998 is shown in Figure 6. In general, adjusted labour productivity for all of these five companies had either decreased or remained static over the period 1993-1998. This indicates that there appears to be a sort of association between the degree of the practical application of TQM principles and labour productivity measurements for these two samples of companies.

Analysing the relationship between TQM and labour productivity

Companies were classified into high and low groups for each individual element of TQM as well as for overall TQM. For each element of TQM and the overall TQM, the mean of labour productivity was calculated for high-level companies and for low-level companies in 1998. Mean labour productivity for companies with high and low-levels TQM (and its elements) in 1998 is shown in Figure 7. Mean labour productivity for companies with a high level of each element of TQM is significantly higher than for those with a low level of each element of TQM.

The difference of means between high- and low-TQM companies for all elements, plus the overall TQM measure, produce *t*-statistic values roughly four times the critical *t*-value, with *p*-values <0.001. This confirms that there is a statistically significant difference between the mean labour productivity for groups of companies classified as high and low for each element of TQM, plus for the overall TQM measure. Therefore, there is a positive relationship between all the examined elements of TQM and labour productivity.

A scatter diagram exploring the relationship between TQM and labour productivity is shown in Figure 8. The TQM scores were calculated by adding the Likert scale responses of all the 48 questions with the exception of the three check questions. There are two issues in this scatter diagram. The first issue relates to companies at the two extremities of the chart. On examining the background information on the seven largest labour productivity values (LP>100,000), it was found that these companies belong to numerous industrial sectors. Some of these companies are large companies and some are small companies. The same diversity was found in the nine companies showing the lowest TQM scores. No consistent factor could be identified to differentiate the companies in these two groups from the companies in the central body of the scatter diagram. Therefore, there is no reason to exclude these companies as outliers, particularly as they make up a significant percentage of the participating companies (21 per cent).

The second issue evident from Figure 8 relates to the nature of the relationship between TQM and labour productivity. It is a positive relationship with either an unusual curvilinear relationship, or a linear relationship with two separate regions, one with a low positive slope and one with a high positive slope. The relationship exhibits a low positive slope for companies with lower TQM scores. That is, a large change in TQM score comes only with a small change in labour productivity. Then, this relationship changes to one with a much

higher positive slope. That is, a small change in TQM score comes with a large change in labour productivity. This precipitated the question “Is there some factor which differentiates the two groups of companies?”

Attempts to classify companies according to industry sector or employee numbers or turnover did not separate the two types of the relationship. Following the lead of previous authors in the field of TQM (Prabhu *et al.*, 2000), companies were classified into two groups: companies with ISO 9000 certification and companies without ISO 9000 certification.

Scatter diagrams that explore the relationship between TQM and labour productivity according to quality system certification are shown in Figure 9. As shown in Figure 9, the trend line for the relationship between TQM and labour productivity in companies with ISO 9000 certification shows a high positive slope (slope coefficient = 2.6232). This trend line shows a low positive slope in companies without ISO 9000 certification (slope coefficient = 0.1732).

Multiple regression analysis was used to determine the nature and the strength of the relationship between the eight elements of TQM and relative capital stock (the independent variables) and labour productivity (the dependent variable). Due to multicollinearity between the various elements of TQM, simple regression analyses between each element and the labour productivity measures were examined. Simple regression is appropriate for this study because the aim was to investigate if there is a relationship (association) between TQM and labour productivity, not to develop/generate a statistical model to predict labour productivity using TQM data. It was found that there is no apparent violation in the assumptions of regression. It was also found that there is very little or no pattern in the relationship between the residuals and the value of each independent variable (the elements of TQM and relative capital stock), or the predicted value of the dependent variable. This means that the fitted regression model is appropriate for the set of data being studied.

Results of simple and multiple regression analysis for companies with and without ISO 9000 certification are shown in Table I. Both sets of results indicate that there is a statistically significant positive relationship between the elements of TQM and labour productivity. These results also indicate that there is no statistically significant relationship between relative capital stock and labour productivity.

Discussion of results

The results of data analysis indicate that there is a positive linear relationship between TQM (and each element of TQM) and labour productivity. This relationship has a high positive slope in companies with ISO 9000 certification, whereas it has a low positive slope in companies without ISO 9000 certification. The findings also indicate that there is no relationship between relative capital stock and labour productivity. This means that the changes in labour productivity were related to the changes in the degree of application of TQM philosophy and practices rather than the changes in relative capital stock. Therefore, the implementation of TQM principles is positively associated with labour productivity.

The ISO 9000 series of international quality system standards provides a framework for a basic quality assurance system and a good starting point for achieving total quality (Terziovski, 1997; Evans and Lindsay, 1999). Skrabec *et al.* (1997) identified the following reasons for pursuing ISO registration: improving quality, gaining customers, and improving

performance. They concluded that ISO 9000 is considered an elementary foundation for TQM systems. Quality system standards are considered as a necessary background or an appropriate base for the adoption of TQM principles. This is because these quality system standards provide employees with a good understanding of the quality concept. Thereby, this knowledge helps employees in understanding and applying the TQM principles. The process that a company goes through to achieve certification tends to improve the quality and uniformity of work while simultaneously improving productivity (Omachonu and Ross, 1994).

An outstanding characteristic of ISO 9000 for management is that it automatically provides both controls to ensure quality of production and delivery, and reduces waste, down time, and labour inefficiencies, thereby increasing productivity (Rothery, 1993). The ISO 9000 approach is completely compatible with the total quality philosophy (Goetsch and Davis, 2000). Companies using quality system standards as guidance tools are able to maximise the possible benefits of the practical application of TQM principles, such as improving productivity. The results suggest that ISO 9000 is an excellent, perhaps essential, foundation for TQM principles because it provides management and employees with the knowledge and expertise to build, improve and maintain the total quality approach. For these reasons, the relationship between the elements of TQM and labour productivity has a high positive slope in companies with ISO 9000 certification and a low positive slope in companies without ISO 9000 certification.

The elements of TQM investigated in this study represent the best way to provide the employees with information, knowledge, power and rewards to encourage them to be more skilled, committed and productive (Goetsch and Davis, 2000). This means that the adoption of TQM principles leads to inspiring employees to succeed and grow, which then improves their performance and productivity (Raiborn and Payne, 1996; Weinstein, 1996a; Terziowski, 1997; Van Horn, 1997). The practical application of the TQM principles is considered as an approach to maximise the competitiveness of an organisation through the continual improvement of the quality of its products, services, people and processes and increased productivity generated by increased production and decreased costs (Gitlow *et al.*, 1995). TQM enables the companies to produce a product with high quality and minimum cost, which results in savings to the company. Adoption of the TQM philosophy enables the companies to increase production using the same or a smaller amount of resources, or reduce the amount of resources used while keeping the same production or increasing it. Reducing inventories, lowering manufacturing costs and cycle times and eliminating wastes all generate higher productivity and better return on assets (Shores, 1990; Gaither, 1992; Kendrick, 1993; Omachonu and Ross, 1994). For the above reasons, the relationship between the overall TQM and labour productivity is a positive linear relationship.

While all elements of TQM are associated with labour productivity (Gitlow *et al.*, 1995; Goetsch and Davis, 2000), it might be expected that some of the elements would show a more direct association with labour productivity. Using the R^2 value as an indicator of the strength of relationship, it can be seen that for companies with ISO 9000, SMFQC, CF, E&T, OCTQ&CI and EP show a stronger relationship to labour productivity than the other three elements. It can be argued that these five elements of TQM focusing on: statistical methods for quality control (Rothman, 1994); a strong focus on customer satisfaction (Scheidt and Amsler, 1995; Wood, 1997; Quazi *et al.*, 1998); effective education and training (Nwabueze and Kanji, 1997 and Mandal *et al.*, 1998); organisational commitment to quality and continuous improvement (Chapman *et al.*, 1997; Hertz *et al.*, 1997); and widespread

employee participation (Oakland, 1993; Berman, 1993/1994; Van Horn, 1997) all are related directly to improvement in labour productivity. The other three elements of TQM, focusing on organisational communication, unity of purpose and scientific approaches to decision making all provide longer term, infrastructural benefits necessary for continued improvement over time, but with a less direct association with labour productivity. Similar results were found for the non-ISO 9000 companies, although the OC element surprisingly produced the largest R^2 value whereas the E&T element produces the smallest R^2 value for these companies.

Conclusion

Results of descriptive analysis indicate that there is a statistically significant difference between the mean labour productivity for groups of companies classified as high or low for each element of TQM plus the overall TQM measure. Results of regression analysis show that there is a positive linear relationship between TQM and labour productivity. This relationship showed a high positive slope in companies with ISO 9000 certification, and considerably lower (but still positive) slope in companies without ISO 9000 certification. Also, this reflects the importance of the ISO certification as an excellent foundation for achieving total quality (see for example: Rothery, 1993; Omachonu and Ross, 1994; Voehl *et al.*, 1994; Evans and Lindsay, 1999). As found by other authors (see, for example: Guzzetta, 1993; Weinstein, 1996b; Lackritz, 1997; Skrabec *et al.*, 1997; Goetsch and Davis, 2000), the results of this study suggest that ISO 9000 is completely compatible with the total quality philosophy.

Implications

The study has a significant implication for the development of a theoretical base for application of TQM in Jordanian industries. The findings are considered to make a significant contribution in terms of creating awareness and understanding of the TQM principles. One of the main implications of this research is summarised in identifying eight significant elements of TQM that are used to differentiate between high-TQM and low-TQM companies. These elements are: employee participation, education and training, organisational communication, customer focus, scientific approaches to decision making, statistical methods for quality control, organisational commitment to quality and continuous improvement, and unity of purpose.

Companies must be aware of the following requirements for successful TQM implementation:

- Encourage employees to be involved in decision making, empower them through decentralisation of decision making, and to support and facilitate quality teams and periodical work meetings.
- Emphasise employee learning through providing access to lectures, discussion circles, conference attendance, and visiting experts.
- Communication should be open and continuous between the different levels and departments.
- Use market analysis, customer satisfaction studies and market segmentation, and to be responsive to fixing and resolving customer problems and complaints.
- Decision-making should be based on facts and data.

- Use in-process test and acceptance samples during the production process and for final inspection.
- Develop new products and improve the existing products, and to concentrate on improving the processes continuously.
- Develop a long-term relationship of loyalty and trust with the employees.

Based on the empirical evidence linking the elements of TQM with labour productivity, the findings of this study have several important implications. The findings indicate that labour productivity measurements for all companies in the high-TQM group was significantly higher than for those in the low-TQM group during 1993 to 1998. There is a clear message for managers that the practical application of the TQM principles is associated with labour productivity over time. Results of regression analysis show that there is a positive linear relationship between the elements of TQM and labour productivity. This relationship has a high positive slope in companies with ISO 9000 certification and a low positive slope in companies without ISO 9000 certification. Results suggest that ISO 9000 is an excellent, perhaps essential, foundation for TQM principles because it provides management and employees with the knowledge and expertise to build, improve and maintain the total quality approach. The implication is that ideally quality system standards should be used by companies as guidance tools to maximise the possible benefits that are associated with the practical application of TQM principles, such as improving productivity. The study has useful implications for Jordanian government to encourage corporations to adopt TQM principles and improve their labour productivity, which in turn, support the Jordanian economy. Also, these implications might be useful for the governments of other developing economies.

Commentary

The people power in delivering quality.

Table I Simple and multiple regression analyses using labour productivity as the dependent variable

Independent variable(s)	Companies with ISO 9000			Companies without ISO 9000		
	R	R ²	Signif. of F value	R	R ²	Signif. of F value
Overall TQM and RCS*	0.838	0.703	0.000	0.905	0.819	0.000
EP	0.634	0.401	0.000	0.831	0.691	0.000
E&T	0.675	0.455	0.000	0.720	0.518	0.000
OC	0.368	0.136	0.009	0.858	0.737	0.000
CF	0.676	0.457	0.000	0.821	0.674	0.000
SATDM	0.472	0.223	0.001	0.775	0.601	0.000
SMFQC	0.714	0.510	0.000	0.802	0.643	0.000
OCTQ&CI	0.668	0.446	0.000	0.792	0.628	0.000
UOP	0.558	0.311	0.000	0.736	0.542	0.000
RCS	0.142	0.020	0.331	0.089	0.008	0.660

Note: * Results for multiple regression in this row, all others are simple regression

Table I Simple and multiple regression analyses using labour productivity as the dependent variable

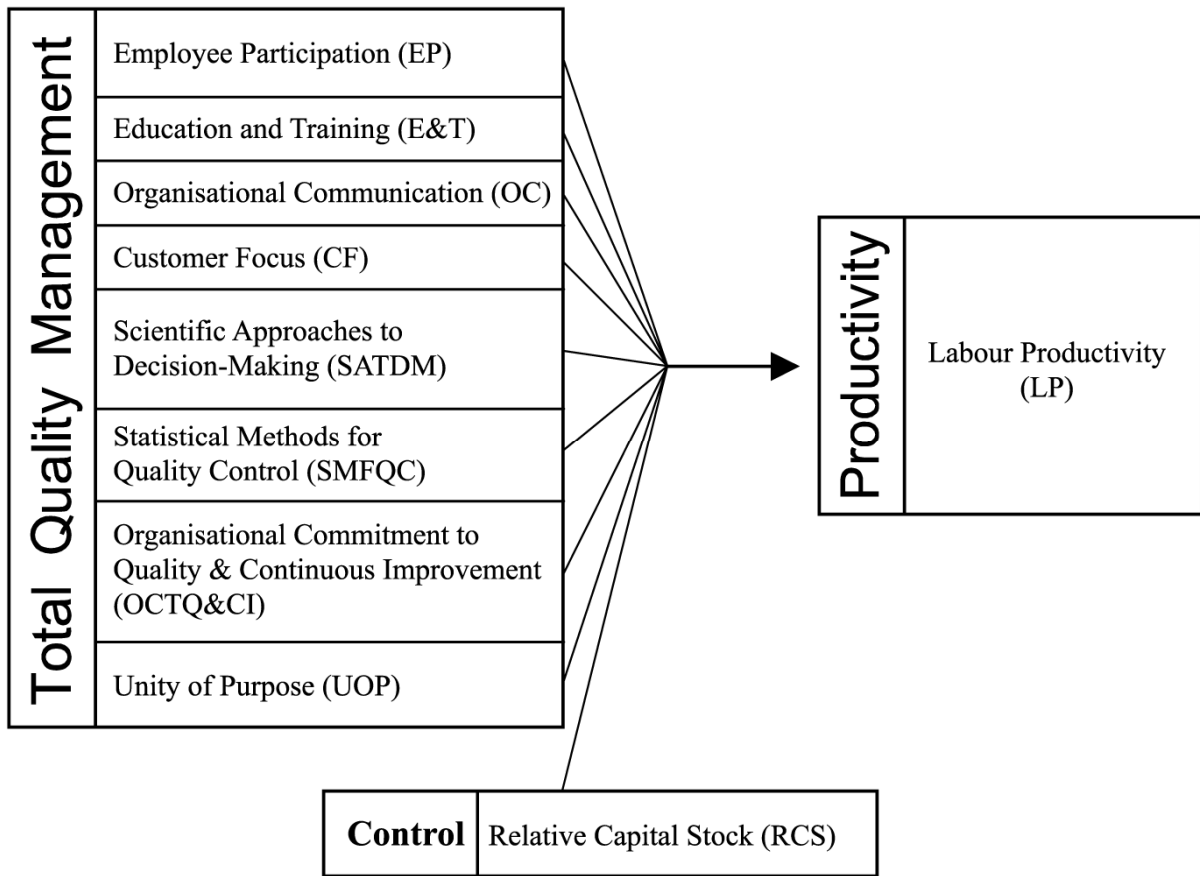


Figure 1 The research framework

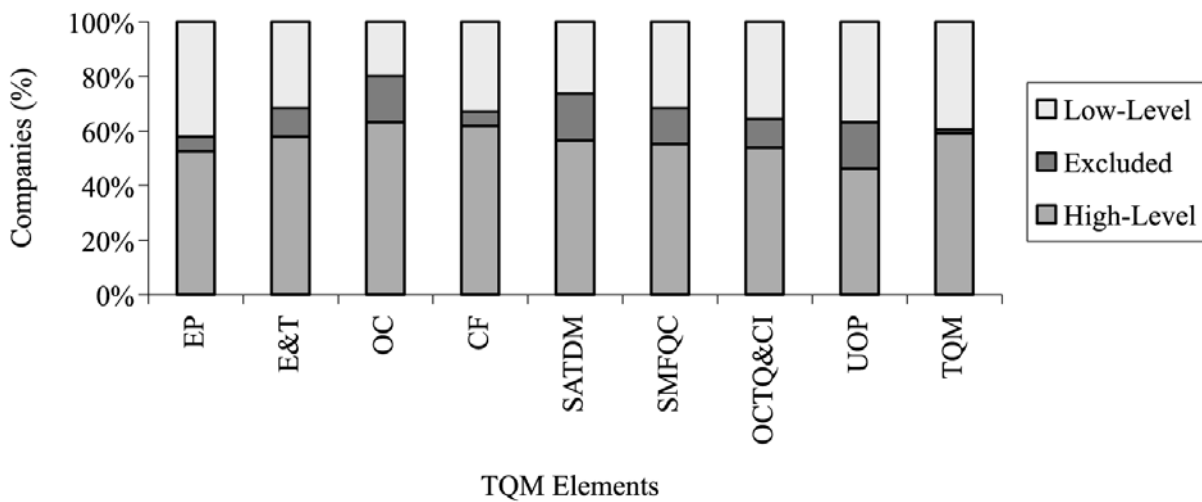


Figure 2 Distribution of the companies (%) according to the classification of high and low level of each element of TQM

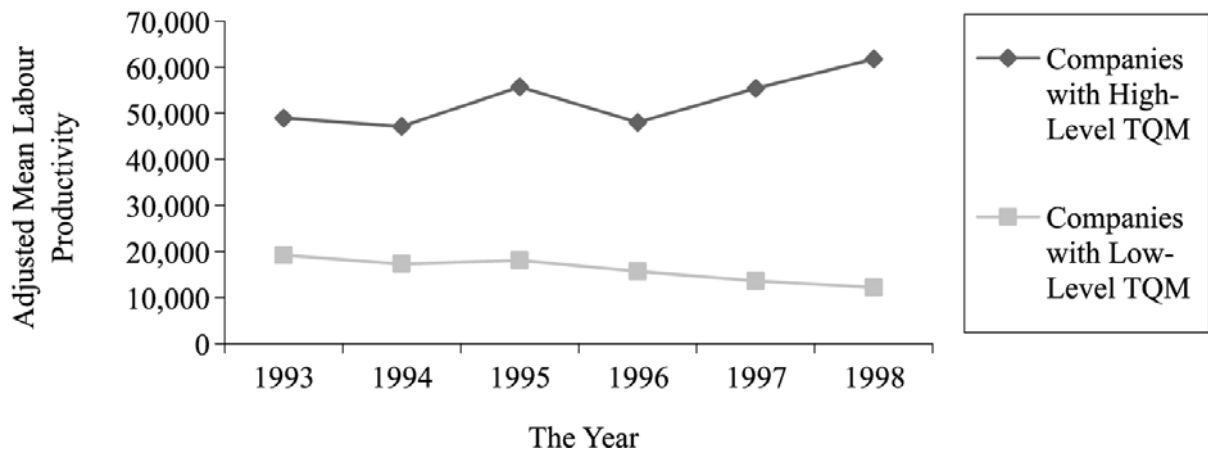


Figure 3 Adjusted mean labour productivity for companies with high and low levels of TQM during the period 1993-1998

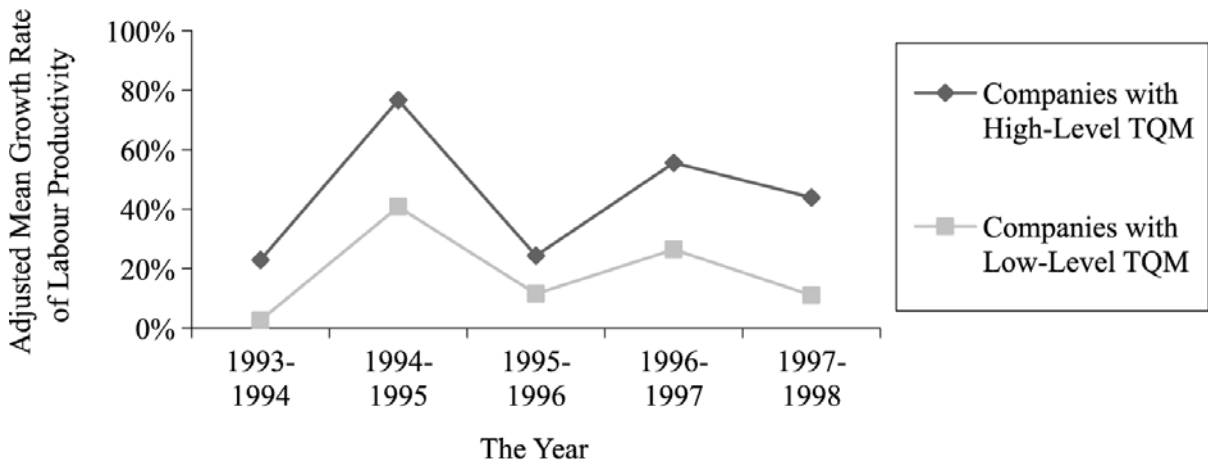


Figure 4 Adjusted mean growth rate of labour productivity for all companies with high and low levels of TQM during the period 1993-1998

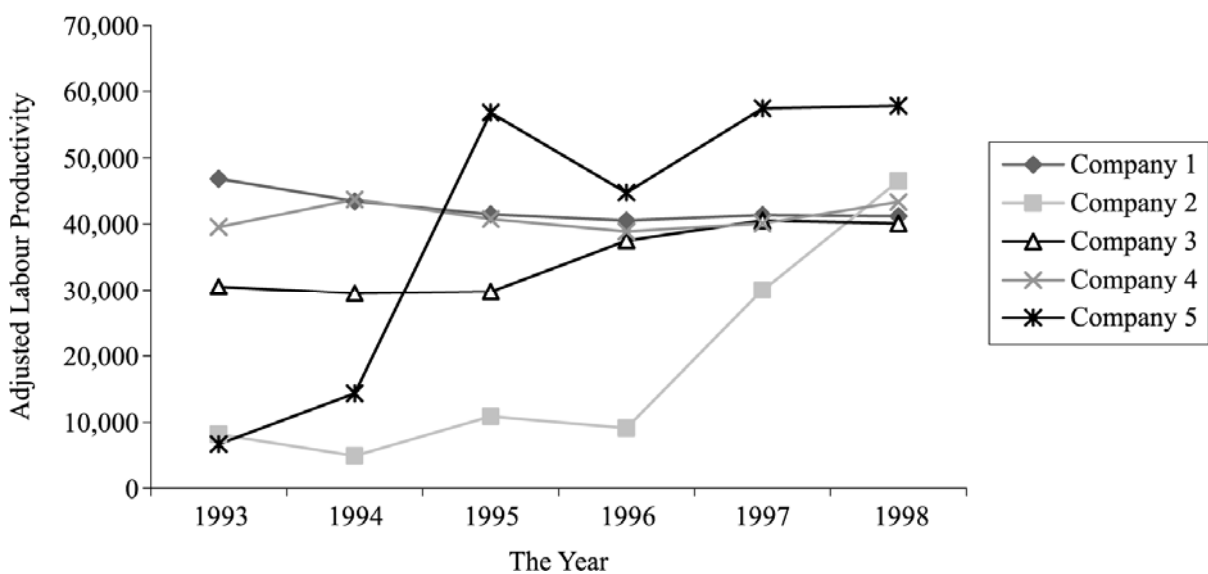


Figure 5 Adjusted labour productivity measurements for sample high-TQM companies during the period 1993-1998

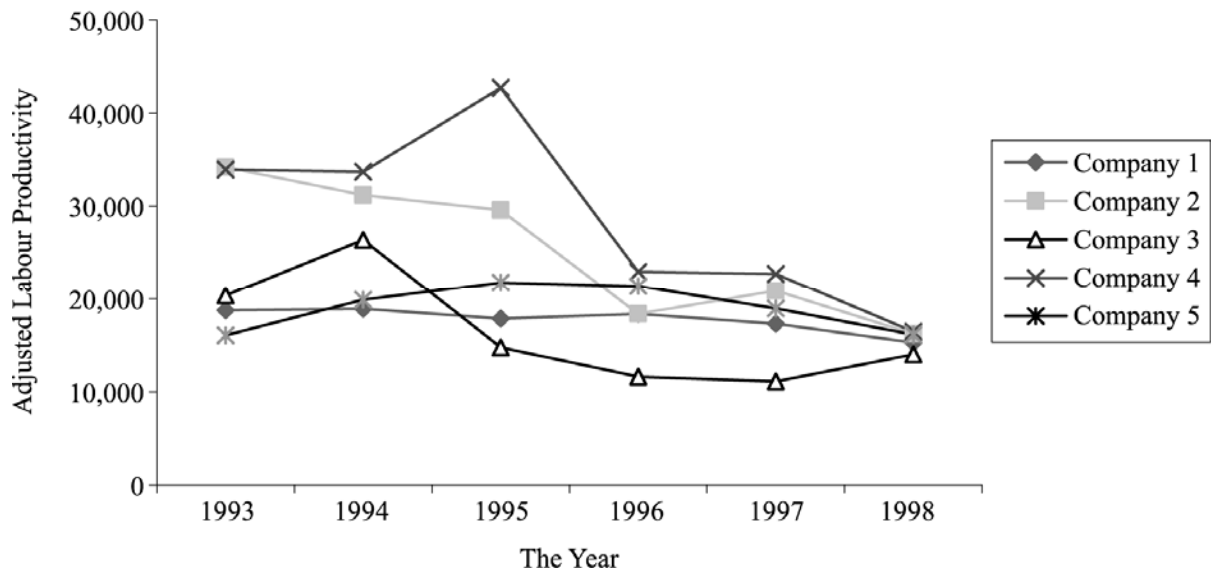


Figure 6 Adjusted labour productivity measurements for sample low-TQM companies during the period 1993-1998

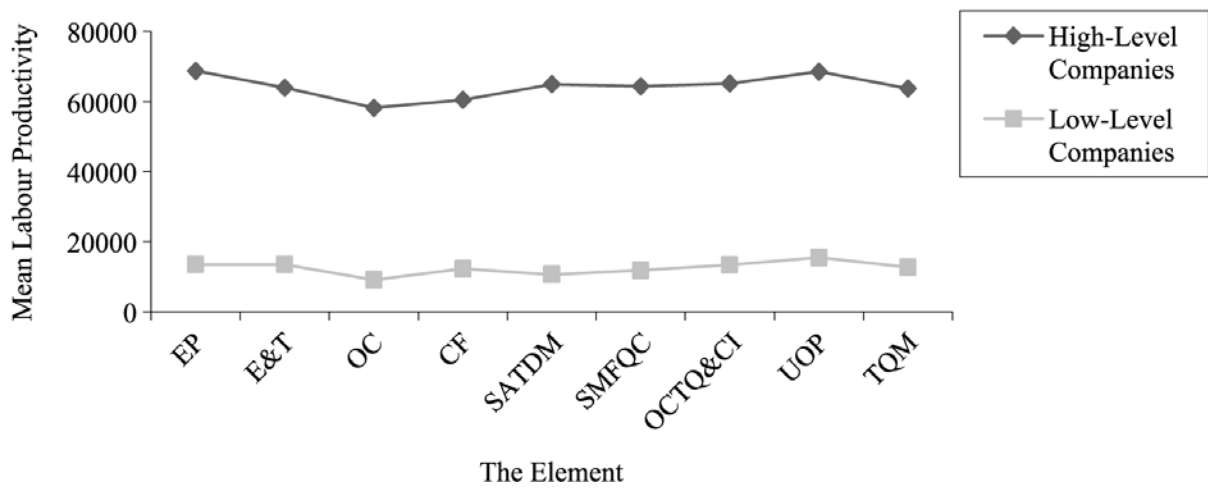


Figure 7 Mean labour productivity for companies with high and low levels of TQM in 1998

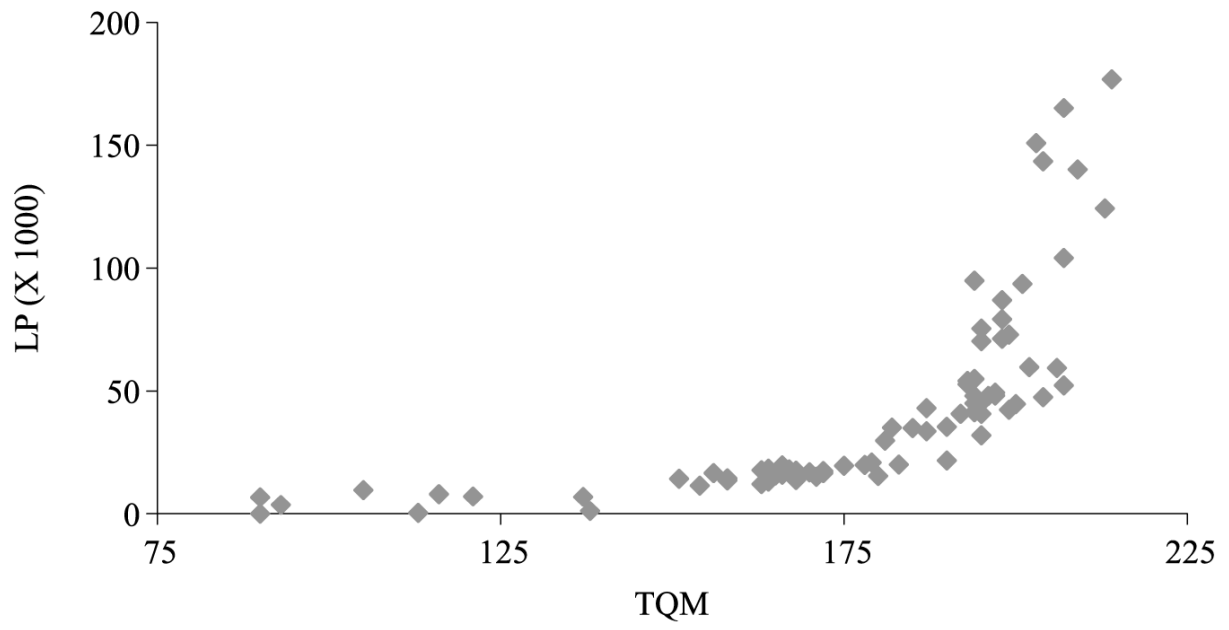


Figure 8 Scatter diagram for the relationship between TQM and labour productivity

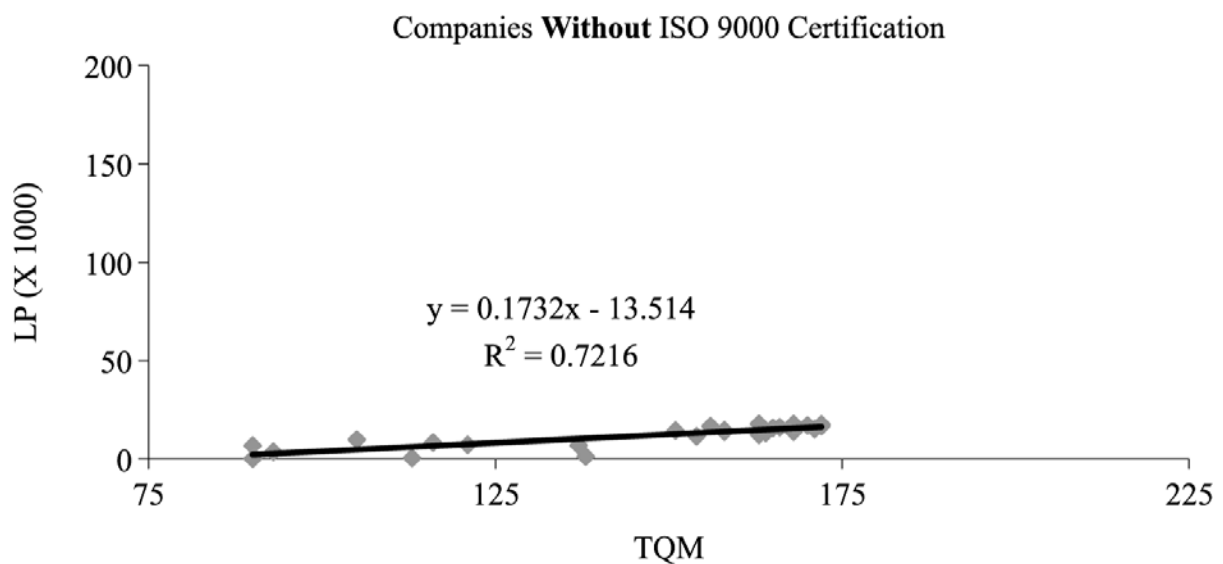
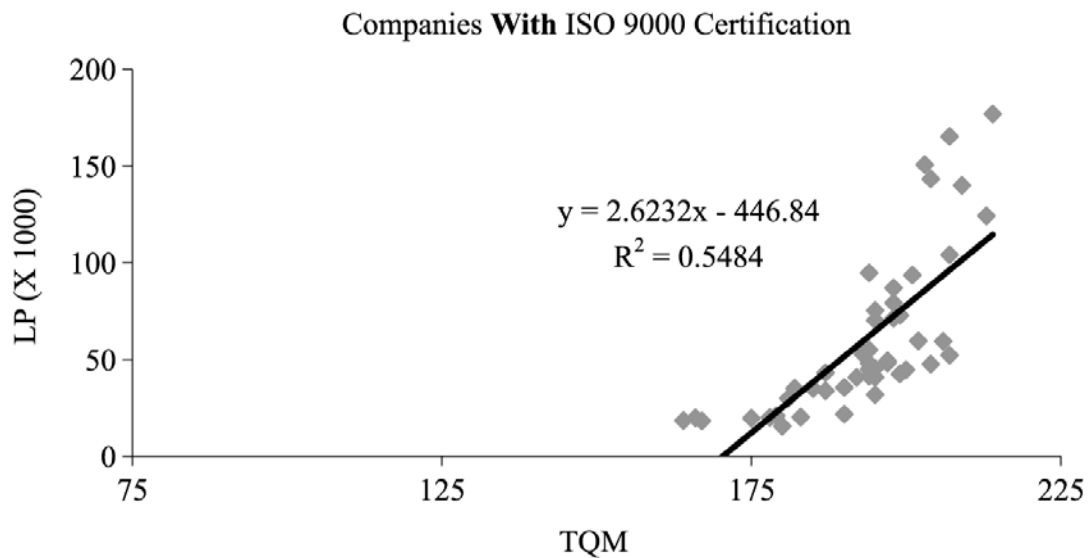


Figure 9 Scatter diagrams for the relationship between TQM and labour productivity according to quality system certification

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