

# **QUALITY PRACTICES, QUALITY PERFORMANCE AND BUSINESS PERFORMANCE: A TEST OF THE "TRADE-OFF" AND "MULTIPLE CAPABILITY" THEORIES**

*Brian Fynes, Seán de Búrca, Teresa Brannick and William J. Glynn\**

## **Introduction**

The aim of this research is to develop and test an integrated model of quality practices, quality performance, manufacturing performance and business performance. In doing so, it seeks to address the broad operations management question: *does the concept of trade-offs (the traditional paradigm) or the concept of world class manufacturing (multiple capabilities) apply in the manufacturing industry?*

This paper is structured as follows. Firstly, we review the literature on quality management in the context of manufacturing. We then review the literature on manufacturing strategy. This is incorporated into our research model, which we analyse using path analysis. We conclude with a discussion of the findings with respect to their implications for management and theory.

## **Synthesis of the Quality Management Literature**

Theory development and rigorous empirical research in this area is a relatively recent phenomenon. Prior to the early 1990s, much of the literature is anecdotal, prescriptive and questionable with respect to statistical reliability and validity. In addition, methodological issues frequently received insufficient treatment while statistical analysis, if at all present, was of a descriptive nature. The shortcomings evident in much of this work include an emphasis on merely describing the

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\* Centre for Quality and Services Management, Business Research Programme, Graduate School of Business, University College Dublin.

level of adoption of quality tools and techniques (rather than the impact on quality performance); a focus on implementation or "how-to" issues (rather than "why" issues); a tendency to focus on the role of the so-called quality "gurus"; and a failure to distinguish between quality practices and quality performance. Thus, while the area provides a potentially rich field for scholarly advancement, the available literature is of limited usefulness. It is probably not surprising then that many managers, employees and academics displayed considerable scepticism with respect to the claimed benefits of quality management.

Defining the term "quality" has very much been an inexact science. The range of definitions suggested in the literature poses problems with respect to precisely measuring the construct. In addition, it poses problems with respect to distinguishing between independent and dependent variables. However, the identification of quality practices as a set of independent variables and quality performance as a dependent variable have considerably advanced the scope for theoretical development.

Empirical studies of quality practices initially focused on the identification of core quality practices. The series of studies conducted by Schroeder's research team (Saraph et al., 1989; Benson et al., 1991; Flynn et al., 1994; Flynn et al., 1995) have provided valuable contributions in terms of operationalising quality practices and the development and testing of associated measurement scales. Additional empirical studies from the organisational behaviour, human resource management and marketing disciplines provide further evidence of the predictive power of specific quality practices (Huselid, 1995; Forker et al., 1997; Choi et al., 1998).

Differentiating between the internal and external dimensions of quality performance has proved to be another significant step in theory development. Internal quality performance incorporates both design quality and conformance quality while external quality performance incorporates quality-in-use and customer value and satisfaction (Fujimoto, 1989; Voss et al., 1994). Although the causal relationships *between* these dimensions of quality performance has received some attention in the literature (Voss et al., 1993; Flynn et al., 1995), there is little evidence of posited relationships with other dimensions of manufacturing performance such as unit production cost and time-to-market, except in longitudinal studies such as the "sandcone" model of cumulative manufacturing capabilities (Ferdows et al., 1990).

The omission of design quality as an operationalised construct is a particularly significant gap in the quality management literature. Em-

pirical evidence from the product development and innovation literatures emphasise the potentially strong predictive power of design quality with respect to other dimensions of quality performance, unit production cost and time-to-market (Fleischer et al., 1992; Youssef, 1994; Hanson et al., 1996). The need to address this gap and to conceptualise these relationships is thus a key issue.

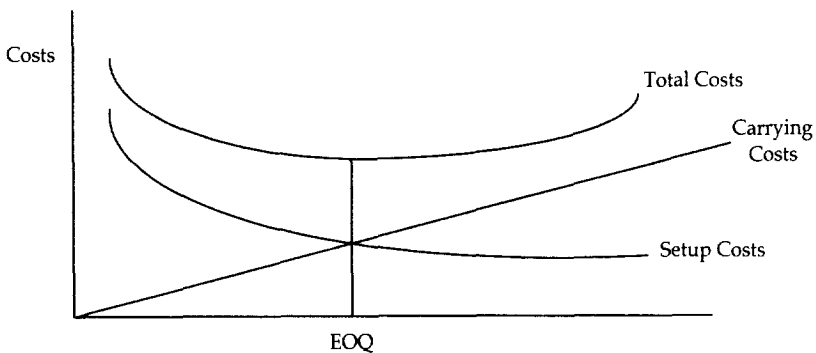
In conclusion, notwithstanding the cumulative shortcomings associated with much of the initial literature that emerged in this area, recent empirical research has extended theory development and testing in the field of quality management, particularly in the context of contingency perspectives. Such contributions reflect the fact that research in the area, from an evolutionary perspective, is still very much at a preliminary stage of development and does not match the level of sophistication apparent in other management disciplines such as strategy or organisational behaviour.

### **Manufacturing Strategy: Trade-offs or Multiple Capabilities**

Advances in our understanding of manufacturing management are of relatively recent vintage. The central theory which has underpinned traditional mass production is the Economic Order Quantity (EOQ) Model (Figure 1).

In a manufacturing context, the basis of this theory is that there is an optimum production batch size, which minimises total costs. This batch size is based on achieving an equitable *trade-off* between production set-up costs and inventory carrying costs. This concept of *trade-offs* subsequently became a central assumption of both manufacturing and logistics management.

FIGURE 1: THE ECONOMIC ORDER QUANTITY (EOQ) MODEL



In the early part of the twentieth century, the application of a more scientific approach to manufacturing quickly led to the emergence of *mass production* as the dominant way of producing goods. Mass production was based on three basic principles: specialisation of labour, standardisation of parts and ownership of the entire supply chain. Mass production was characterised essentially by economies of scale: by producing in large batches, manufacturing costs were spread over a greater number of units in a marketplace dominated by considerations of price. Competition was primarily cost-focused. At the same time, product variety fell to just a few dozen offerings — “you can have any colour as long as it’s black”. However, while this approach was acceptable in the less consumer-oriented markets of the first half of the century, it is not likely to satisfy the fashion-conscious user of colour co-ordinated mobile phones at the turn of the millennium.

As the century progressed, there was a gradual movement away from standardisation and towards customisation, which was to culminate with the emergence of the Japanese manufacturing industry and their *lean production* or world class manufacturing strategies. Such strategies were based on the notion of using fewer resources to offer far greater choice. Based on an international research project in the automobile industry (Womack et al., 1990), the term “lean”, although often used loosely in management jargon, was defined in terms of a two-to-one performance gap. The lean organisation is twice as efficient and as effective as its more traditional competitor: it uses less of everything. It takes half the time and effort to design its products, half the human effort and tooling to make it with half the level of inventories and level of defects. As a result, the customer can be offered twice the number of products (product range flexibility) that can be built in half the normal volume (volume flexibility). Thus, economies of scope with both volume and variety advantages had come to replace economies of scale as the basis of competition.

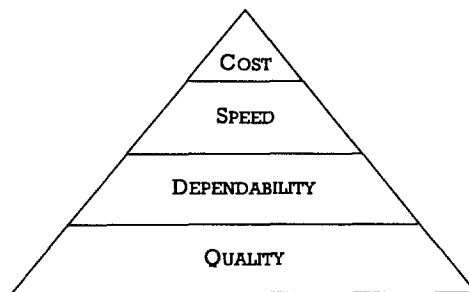
What does the future hold with respect to the evolution of manufacturing? Product diversity has increased as products have grown more complex and differentiated while simultaneously product life cycles have shortened dramatically. At the same time, national markets have become increasingly similar, particularly for intermediate goods. Accordingly, companies have been able to extend their global market presence as a result of more flexible manufacturing and distribution methods and better communications and logistics technologies. Some commentators have suggested that in many industries this represents the era of *mass customisation* (Westbrook and Williamson, 1993). Using flexible manufacturing systems (FMS), companies

adopting this approach allow the customer to design and configure his/her product order to a personalised specification. For example, the US shoe retailer Custom Foot does not carry any inventory in its stores; instead it stocks examples of styles, accessories, leathers and colours. Customers effectively *design* their own product from amongst the available options and have their foot dimensions accurately scanned, recorded and an order dispatched to the Italian manufacturer, which is filled within three weeks at a highly competitive price (Christopher, 1998).

The competitive advantage in terms of quality, cost, flexibility and speed-to-market accruing to such lean or world class organisations is crystal clear. They can compete on not just one, but on *all* the order-winning criteria in both global and local marketplaces. This ability to compete across a number of competitive fronts represents a fundamental shift in the trade-off assumption which traditionally has underpinned both manufacturing theory and practice. As already noted in the case of the EOQ model, this assumption is based on the proposition that trade-offs between measures of manufacturing performance occur because factories are technology-based systems which are limited in what they can do by their equipment, materials, information systems and management systems (Skinner, 1992). As a result, trade-offs must and will occur.

However, competing on multiple fronts represents an entirely different approach to manufacturing. This competing explanation has been labelled the "sandcone" theory by Ferdows and De Meyer (1990) and is based on the proposition that competencies are *cumulative* rather than *mutually exclusive*. They suggest that lasting improvements in performance always involve the same sequence of quality improvement, followed by dependability, speed and finally cost efficiency (see Figure 2).

FIGURE 2: THE SANDCONE THEORY OF MANUFACTURING



Source: Adapted from Ferdows and De Meyer (1990)

Furthermore, in addition to describing a specific sequence of manufacturing improvements, the "sandcone" structure represents diminishing returns on efforts to improve manufacturing performance. Thus, while the quality "platform" which forms the foundation of manufacturing is relatively straightforward to establish, improving performance in dependability, speed and cost requires increasing effort if one is to get to the top of the sandcone, because diminishing returns apply.

Whether or not Skinner's (1969) traditional trade-off theory or the lean production/WCM/multiple capabilities (Ferdows et al., 1990; Womack et al., 1990; Voss et al., 1995) theory provides the conceptual underpinnings of manufacturing at the close of the century is thus our core research question.

### **Research Model**

In positing our research model, we initially focus on the role of quality management in manufacturing strategy. We have already argued in our synthesis of the existing literature on quality management for the need to distinguish between quality practices and quality performance. Previous empirical studies all supported the relationship between quality practices and quality performance (Adam, 1994; Flynn et al., 1994). Accordingly we now hypothesise that:

***H1:** Quality practices have a positive effect on quality performance*

The relationships between quality and product cost have received considerable attention in the cost of quality literature. Juran (1986) and Crosby (1979) have consistently argued that better quality practices can reduce the cost associated with quality prevention, inspection, appraisal and warranty returns. In addition, the adoption of techniques such as value engineering, design for ease of manufacturing (DFM) and quality function deployment (QFD), and the fact that the majority of costs are committed at the design stage (Fleischer et al., 1992), suggest the following hypothesis:

***H2:** Quality practices have a negative effect on product cost*

The impact of quality practices can also significantly impact on time-to-market (De Meyer et al., 1990b; Youssef, 1994). Accordingly, we hypothesise that:

***H3:** Quality practices have a positive effect on time-to-market*

Much of the literature on quality management exhorts managers and researchers to adopt customer-driven definitions of quality perform-

ance (Gale, 1994). We further argue that quality performance from a customer value and satisfaction perspective is inversely related to product cost (or price from the customer's perspective), because measures of value and satisfaction can incorporate both quality and cost dimensions (Choi et al., 1998). Formally, this gives:

**H4:** *Product cost has a negative effect on customer satisfaction*

In addition, business performance and customer satisfaction may be enhanced through improved availability because the product is more quickly available in the marketplace (De Meyer et al., 1990a). This gives:

**H5:** *Time-to-market has a positive impact on business performance*

Studies in both the operations management literature and the marketing literature have addressed the impact of quality performance on overall business performance (Maani et al., 1990; Day, 1994; Gale, 1994; Powell, 1995; Voss et al., 1995). While there is mixed empirical support for this hypothesis, it is of particular significance to management given the effort and resources dedicated to quality improvement programmes. Therefore, we hypothesise that:

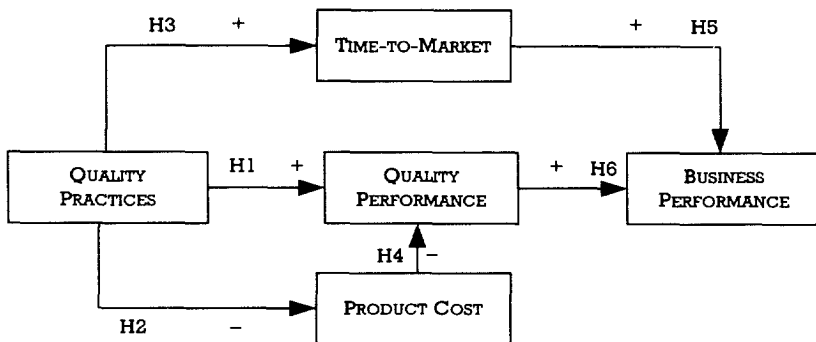
**H6:** *Quality performance has a positive effect on business performance*

Table 1 summarises these hypotheses while Figure 3 combines the hypotheses in an integrated theoretical model.

TABLE 1: SUMMARY OF HYPOTHESES

| Hypothesis | Path                                       | Direction |
|------------|--|-----------|
| H1         | Quality Practices → Quality Performance    | +         |
| H2         | Quality Practices → Product Cost           | -         |
| H3         | Quality Practices → Time-to-Market         | +         |
| H4         | Product Cost → Quality Performance         | -         |
| H5         | Time-to-market → Business Performance      | +         |
| H6         | Quality Performance → Business Performance | +         |

FIGURE 3: INTEGRATED THEORETICAL MODEL: HYPOTHESISED PATH RELATIONSHIPS



**Research Design**

Research design is the approach adopted to obtain answers to the research questions. The design constitutes the blueprint for the measurement, collection and analysis of the data (Kerlinger, 1986). The study draws on the data collected in the Survey of National Management Practices (for a detailed overview, see De Búrca et al., 1997). The sampling method used was a disproportionate stratified design. The sample was stratified by size and represented the population. The Economic and Social Research Institute provided the sample list of 1,003 companies in Ireland, which included company name, address, telephone and fax numbers, sector, industrial grouping and company size. The overall response rate was 35 per cent. All sectors of industry were included in the research, as well as companies with 20 employees or more. This diversity increased the representativeness and overall generalisability of the study’s findings and analysis.

*Construct Measurement*

This section details the manner in which our research constructs are measured. Each measure is described in more detail in Table 2.

TABLE 2: CONSTRUCT MEASUREMENT

| Construct                               | Indicator   | Source  |
|---|---|---|
| Quality Practices<br>(48 scale items)   | <i>Top Management Support</i><br>♦ Quality Leadership<br>♦ Quality Improvement Rewards<br><i>Quality Information</i><br>♦ Process Control<br>♦ Feedback<br><i>Process Management</i><br><i>Product Design</i><br>♦ New Product Quality<br>♦ Interfunctional Design Process<br><i>Workforce Management</i><br>♦ Selection for Teamwork Potential<br>♦ Teamwork<br><i>Supplier Involvement</i><br><i>Customer Involvement</i> | Flynn,<br>Schroeder and<br>Sakakibara<br>(1994) |
| Quality Performance<br>(6 scale items)  | <i>Product failure rates</i><br><i>Frequency of product recalls</i><br><i>Product failure rates</i><br><i>Frequency of product recalls</i><br><i>Frequency of customer complaints</i><br><i>Adequacy of customer tracking systems</i>   | Voss and<br>Blackmon<br>(1994)                  |
| Cost<br>(1 scale item)                  | <i>Unit Cost of Product</i>   | Pre-test<br>interviews                          |
| Time-to-Market<br>(2 scale items)       | <i>Speed of New Product Development</i>   | Pre-test<br>interviews                          |
| Business Performance<br>(4 scale items) | <i>Growth in ROI</i><br><i>Growth in Sales</i><br><i>Growth in EBT</i><br><i>Growth in Market Share</i>   | Maani, Putterill<br>and Sluti (1994)            |

In using these measures, the following issues were considered:

1. Where possible, existing measures from the literature are used. This is to facilitate comparison with past findings and promote an integrated approach to quality management research.
2. In line with good measurement practice, multiple measures for most variables have been used (Churchill, 1979). These are either *reflective* (all items measure different aspects of the same variable), or *formative* (the linear combination of the indicators actu-

ally form the variable, as in the case of an index) (Bagozzi et al., 1982).

3. Items are measured on five-point Likert scales to facilitate analysis. Most scales are anchored by strongly agree/strongly disagree. However, items relating to quality performance are anchored by the respondents' own evaluation of their perception of their focal customer's evaluation of relative inferiority/relative superiority. Business performance is anchored by poorer/superior to historical performance.
4. Objective measures are used where possible to reduce perceptual bias and to improve the validity of the responses.
5. Reverse scales were used to enhance validity.

### *Unit of Analysis*

The selection of an appropriate unit of analysis frequently causes confusion and controversy in management research (Klein et al., 1994). Quality practices and performance can be studied using different units of analysis, including country, industry and plant level. Given the operations management perspective of this research, the key focus is on quality practices and performance at the *plant level*. Thus, the unit of analysis for this study will be the manufacturing plant. The rationale for this selection is that quality practices are carried out on the factory floor at plant level. Furthermore, most major empirical studies of operations and quality practices have also adopted the plant as the appropriate unit of analysis (see Adam, 1994; Flynn et al., 1994; Voss et al., 1995).

### *Key Informant*

Identifying the individual who is most knowledgeable and most willing to communicate about quality practices and manufacturing strategy is also a central issue for this research. The key informant in most operations practices studies is typically the manufacturing/production/operations manager because of his/her knowledge of the plant, operational practices and the business environment (see Ferdows et al., 1990; Voss et al., 1995; Collins et al., 1997; Flynn et al., 1997).

For the purposes of this study, the key informant was initially identified by making telephone contact with each plant in the sampling frame and enquiring as to which single individual was responsible and capable of responding to questions on quality practices, quality

performance and performance and manufacturing strategy. Typically this individual was the operations or plant manager. This step was taken in order to improve the quality and quantity of responses as well as to reduce the impact of potential inaccurate recall, hindsight bias and subconscious attempts to maintain self-esteem that can occur from using a single informant (Kumar et al., 1993).

### **Analytical Procedure**

The analytical procedure used in this study included reliability analysis, factor analysis and path analysis.

The reliability analysis of a measurement instrument determines its ability to yield consistent measures. Reliability was operationalised as internal consistency, which is the degree of inter-correlation among the items that comprise a scale (Nunally, 1978). Cronbach's alpha was then calculated for each scale (Cronbach, 1951). After this step, three possibilities existed. First, as all scales had been previously used in the literature, the scale was accepted if it had a strong alpha value (at least 0.70). Second, scales with alpha values near 0.70 were further analysed to determine whether alpha could be improved by the removal of some items. Thirdly, if the scale still failed to provide an alpha of 0.70, the entire scale was discarded.

Construct validity measures the extent to which the items in a scale all measure the same construct. This was addressed through the use of factor analysis, with each scale factor analysed separately. The objective of factor analysis is to determine the underlying dimensions of the data, and in doing that, it summarises a large number of original variables into a small number of factors (or constructs). For the purposes of this study, a principal component factor analysis followed by a varimax rotation (if necessary) was used, with an eigenvalue of 1.0 as the criterion.

Hypothesis testing was accomplished using path analysis. Path analysis is a multivariate analytical methodology for empirically examining sets of relationships represented in the form of linear causal models (Li, 1975). Examples of path analysis can be found in many disciplines including operations management (Swarnidass et al., 1987) and, more recently, quality management (Anderson et al., 1995).

Path analysis gives insights into the causal ordering of variables in a system of relationships. The first step in path analysis is to specify a path diagram as supported by theory. In the path diagram, the theorised causal relationships are represented by uni-directional arrows linking two variables together.

Mathematically, path analysis decomposes the empirical correlations or covariances among the measured variables to estimate the path coefficients in the path diagram. Most applications of this approach have employed multiple regression analysis, as it can be shown that the path coefficients are equivalent to the standardised regression coefficients (Li, 1975).

Path analysis is preferred to conventional regression analysis in this research for four reasons. Firstly, in decomposing statistical relationships between variables in a structural equation model, path analysis allows the researcher to distinguish between direct, indirect and spurious or irrelevant effects. Secondly, by specifying a model of inter-relationships between variables, path analysis makes use of their inter-correlations to obtain better estimates of the effects of these variables on the dependent variable. Thirdly, the procedure allows the researcher to assess which variables in the model have the strongest effect on the dependent variable. Finally, for any intervening variable, it is possible to measure the magnitude of its effects (Land, 1969).

In this study, path analysis using multiple regression was carried out using the AMOS 3.61 software package.

### **Results of Path Analysis**

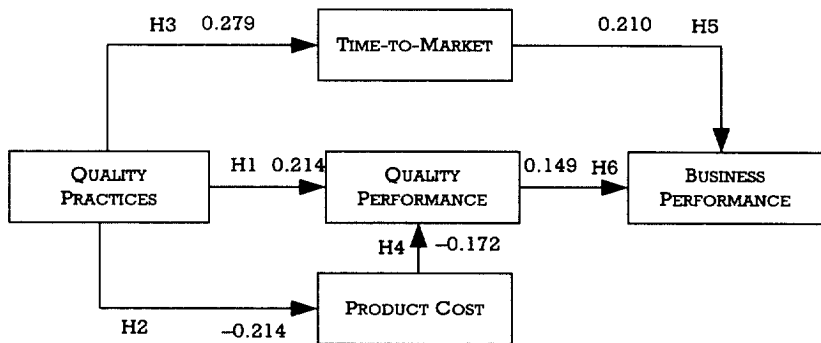
We do not report on descriptive statistics, reliability analysis or factor analysis because of space constraints. The output from path analysis is summarised in the following figures and tables. Figure 3 shows the coefficients (unstandardised betas) for our path model while Table 3 summarises the output from the regression analysis (unstandardised betas and t-tests). The analysis reveals that all six hypotheses are supported at the 5 per cent level ( $t > 1.96$ ). The data thus provides broad support for the overall model.

Model evaluation and fit is a significant issue. The most widely used measure of fit is the minimum discrepancy function divided by the degrees of freedom (CMIN/DF). Various rules of thumb have been suggested for an acceptable CMIN/DF. Wheaton et al. (1977) suggest a ratio of 5 or less as being reasonable while Marsh and Hocevar (1985) recommend using ratios as low as 2 or as high as 7. The CMIN/DF for our model was calculated at 7.38, indicating a reasonable fit.

TABLE 3: PATH MODEL COEFFICIENTS

| Hypothesis | Path                                       | Estimate | t-value | Direction | Result |
|------------|--|----------|---------|-----------|--------|
| H1         | Quality Practices → Quality Performance    | 0.214    | 2.80    | +         | +      |
| H2         | Quality Practices → Product Cost           | -0.214   | 2.79    | -         | -      |
| H3         | Quality Practices → Time-to-Market         | 0.279    | 3.69    | +         | +      |
| H4         | Product Cost → Quality Performance         | -0.172   | 2.23    | -         | -      |
| H5         | Time-to-Market → Business Performance      | 0.210    | 2.76    | +         | +      |
| H6         | Quality Performance → Business Performance | 0.149    | 1.96    | +         | +      |

FIGURE 3: PATH MODEL COEFFICIENTS



#### *Path Decomposition: Direct, Indirect and Unexplained Effects*

As already noted, the main advantage of path analysis over conventional regression is the ability to extend "the single-multiple regression equation treatment to a network of equations involving more than one equation" (Li, 1975: 135). The estimation of path coefficients also makes it possible to decompose the observed empirical correlation or covariance between any two variables into three components: direct, indirect and unexplained effects (Land, 1969).

A direct effect between two variables is indicated by an arrow joining them in the path model while an indirect effect is indicated by a pair or series of forward-pointing arrows. For example, in our path model, quality practices have a direct effect on quality performance and product cost, but an indirect effect on business performance.

The total indirect effect, which can be traced along all possible compound paths connecting two variables, is calculated by summing the values of all possible compound paths, where a compound path value is the product of the path coefficients constituting the compound path (Anderson et al., 1995). In our model, for example, the total indirect effect of quality practices on business performance is computed as follows:

$$I_{QP \rightarrow BP} = (\beta_{QP \rightarrow TM} \cdot \beta_{TM \rightarrow BP}) + (\beta_{QP \rightarrow QPe} \cdot \beta_{QPe \rightarrow BP}) + (\beta_{QP \rightarrow PC} \cdot \beta_{PC \rightarrow QPe} \cdot \beta_{QPe \rightarrow BP})$$

where:

$I_{QP \rightarrow BP}$  = indirect effect of quality practices on business performance;

$\beta_{QP \rightarrow TM}$  = path coefficient for quality practices  $\rightarrow$  time-to-market;

$\beta_{TM \rightarrow BP}$  = path coefficient for time-to-market  $\rightarrow$  business performance;

$\beta_{QP \rightarrow QPe}$  = path coefficient for quality practices  $\rightarrow$  quality performance;

$\beta_{QPe \rightarrow BP}$  = path coefficient for quality performance  $\rightarrow$  business performance;

$\beta_{QP \rightarrow PC}$  = path coefficient for quality practices  $\rightarrow$  product cost;

$\beta_{PC \rightarrow QPe}$  = path coefficient for product cost  $\rightarrow$  quality performance;

$\beta_{QPe \rightarrow BP}$  = path coefficient for quality performance  $\rightarrow$  business performance.

The sum of the direct and indirect effects represents the total meaningful effect of one variable on another (Asher, 1983).

An unexplained effect between two variables is the residual portion of the empirical correlation between the two variables not accounted for by the total (sum of direct and indirect effects). Thus if the total effect equals the observed empirical correlation, then the path diagram as drawn is deemed to be consistent with empirical reality (Anderson et al., 1995).

Computationally, the unexplained effect is calculated as follows:

$$U_{ji} = r_{ji} - (\beta_{ji} + I_{ji})$$

where

$U_{ji}$  = portion of the empirical correlation between variables  $i$  and  $j$  not accounted for by the sum of the indirect effects of  $i$  on  $j$ ;

$r_{ji}$  = empirical correlation between variables  $i$  and  $j$ ;

$\beta_{ji}$  = direct effect of variable  $i$  on variable  $j$ ;

$I_{ji}$  = total indirect effect of variable  $i$  on variable  $j$ .

Examining Table 4 reveals that the unexplained effects are quite low with the exception of product quality on business performance. This would seem to suggest that the path model could be revised to incorporate the direct effects of cost competitiveness on business performance. Overall, however, the model is quite well specified.

TABLE 4: DECOMPOSED PATH MODEL: DIRECT (D), INDIRECT (I) AND UNEXPLAINED (U) EFFECTS

| Construct           |   | Quality Performance | Cost  | Time-to-market | Business Performance |
|---------------------|---|---------------------|-------|----------------|----------------------|
| Quality Practices   | D | 0.21                | -0.21 | 0.28           | 0.00                 |
|                     | I | 0.03                | 0.00  | 0.00           | 0.10                 |
|                     | U | 0.00                | 0.00  | 0.00           | 0.13                 |
| Quality Performance | D |                     |       |                | 0.15                 |
|                     | I |                     |       |                | 0.00                 |
|                     | U |                     |       |                | 0.04                 |
| Cost                | D |                     |       |                | 0.00                 |
|                     | I |                     |       |                | 0.02                 |
|                     | U |                     |       |                | 0.19                 |
| Time-to-market      | D |                     |       |                | 0.21                 |
|                     | I |                     |       |                | 0.00                 |
|                     | U |                     |       |                | 0.03                 |

### Discussion: Implications for Theory and Practice

The model developed and tested in this paper represents an extension of theory development in the area of quality and operations management. Although similar models have been posited in the literature (Maani et al., 1990), the relationships tested in our model extend the traditional quality management literature into the realm of overall manufacturing performance. In addition, because we have used a population-based sample of Irish industry, our results are more generalisable than in those of other studies, which are sector-specific.

What then are the implications for operations management (OM) theory? Up to recent times, it has been suggested that research in OM has failed to be integrative, is less sophisticated in its research methodologies than the other functional areas of business and is not very useful to operations managers and practitioners (Meredith et al., 1989). However, the 1990s witnessed significant development in this regard as the academic community strove to build new theories and use more sophisticated research approaches.

As already noted, the nature of the relationship between measures of operations performance has been addressed by two dominant theories in OM: the cumulative or "sandcone" theory and the "trade-

off" theory. The "sandcone" theory, as developed by Ferdows and De Meyer (1990) is based on the proposition that competencies are cumulative rather than mutually exclusive. They suggest that lasting improvements in performance always involve the same sequence of first quality improvement, followed by dependability, speed and finally cost efficiency. While our study neither addresses dependability nor is longitudinal in design, it does support the argument that improvements in quality performance can have a significant impact on both cost efficiency and time-to-market (which is a component of what Ferdows and De Meyer (1990) label "speed"). This is in contrast with Schroeder et al. (1996) who found that high levels of conformance quality and short cycle times are associated with short lead times, but *not* low cost.

The development of a unified theory of OM thus continues. Our findings, in providing support for the sandcone theory, represents a contribution to the debate. In taking this debate further, Amundson (1998) notes that OM has suffered from a dearth of theories within the discipline and suggests drawing on other management theories such as transaction cost economics. Likewise Voss (1995) proposes that the discipline is broadening beyond its traditional functional remit to include concepts such as buyer-seller relationships and that such interfaces with other disciplines provide ripe scope to further contribute to knowledge. Drawing on theoretical contributions from other management disciplines as a "lens" for exploring OM (and indeed quality management theory) is thus a potentially rich and rewarding avenue for future research.

Turning now to the implications for management practice, the practitioner literature over the last 15 years is replete with exhortations to the business community to adopt total quality management. While many firms have invested substantial resources in adopting and implementing TQM programmes, the results have been mixed with as many as 80 per cent of firms reporting little or no performance improvement (*The Economist*, 1992). This lack of success has generated much cynicism regarding the rhetoric of TQM and undermined its potential role within organisations. In this context, this study has clear implications for the management of quality at the level of the firm.

From management's perspective, the first implication is the need to recognise the central role quality practices play in the overall spectrum of business performance. Not only is it necessary to focus on quality practices which have a direct impact on quality performance; in addition, companies must recognise the influential role of quality practices on other measures of manufacturing performance such as

cost and time-to-market. Quality may no longer be an "order-winner" but it is still an "order-qualifier".

A second implication of this study for companies points to the need to consider all measures of manufacturing performance if overall business performance is to improve. The results of this and other studies have indicated that quality performance alone does not explain business performance. Indeed, other disciplines such as marketing and human resource management suggest the potential effects of a wide range of possible intervening variables on business performance (see Day, 1994; Huselid, 1995). However, from a manufacturing perspective, firms must also consider other measures of manufacturing and operational performance such as flexibility, dependability and customer service. Thus, by focusing on improvements across a selection of measures of manufacturing performance, firms could possibly see improvements in "bottom-line" results.

Another significant implication of this study relates to the "cost of quality" argument that appears in the quality literature. The basis of this argument is that higher levels of product quality can reduce unit manufacturing costs. Although Maani, Puterill and Sluti (1994) found empirical support for this argument, this study contributed to theory refinement in its finding that low levels of product cost, coupled with higher levels of quality performance, leads to higher levels of business performance. This extends the traditional "improved conformance quality — lower manufacturing cost" argument to include customer-based measures of quality performance such as value, which incorporates *both* price (which is based on manufacturing cost) and quality.

From an Irish perspective, the impact of country effects on quality practices/quality performance has been the focus of a number of studies (see Hayward et al., 1984; Dahlgaard, 1987; Vargas et al., 1992; Adam et al., 1994). In addition, government agencies responsible for the formulation of industrial policy and the attraction of inward foreign direct investment (FDI) are particularly aware of the impact of quality products/services on national competitiveness. Empirical evidence confirms that there is a significant association between perceived competitiveness of manufactured products and the stated extent of quality management adoption across different countries (World Economic Forum, 1993). Given that national competitiveness with respect to quality derives from quality competitiveness at firm and industry level, our findings provide considerable support for the proposition that Irish industry (both multinational and indigenous) is competitive from a manufacturing perspective.

## Conclusion

This study makes a number of important contributions to the development of theory in the field of quality management. The research thus adds to theoretical development in both the quality management and manufacturing strategy literatures and suggests that the notion of world class manufacturing, often described as a utopian state, may in fact be attainable.

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