

**SWP 9/00 LINKING COMPETITIVE AND GENERIC
MANUFACTURING STRATEGIES**

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Linking competitive and generic manufacturing strategies

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Abstract

The search for generic manufacturing strategies has been attempted previously by analysing the American and the European Manufacturing Futures survey data. This paper details the results of a similar study using manufacturing strategy management information submitted by over 300 plants for the 1993 to 1996 UK Best Factory Awards.

The research method used was the same as that applied by the previous researchers of this subject. This was to carry out a cluster analysis of the rankings given to the need to improve six competitive capabilities within a two- year period that followed the completion of the questionnaire.

The study findings are similar to those of the previous American study but add to them. Four distinct clusters of different competitive capabilities were

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observed. The distinguishing competitive capability of each of the four clusters was found to be consistent with those detailed in a previously published theoretical framework that had been developed to link competitive capabilities with generic manufacturing strategies.

Keywords: Competitive strategy; Generic manufacturing strategy; Taxonomies; Typologies; Configuration theory.

Linking competitive and generic manufacturing strategies

Introduction

In Skinner's (1996) review of the status of manufacturing strategy theory and practice, the Author attempted to scale the complexity of designing a production system for a specific manufacturing purpose. Bozarth and McDermott (1998) summarised Skinner's (1996) estimation of the magnitude of this design task as follows:

“Conceptually, the problem is to design a system to do a job, that job being defined by trade-off choices. There are about fifty design variables and perhaps a menu of choices of about sixty. But there is no handbook.”

Skinner's suggestion for dealing with such a wide range of design decisions was to reduce them by “boil(ing) the manufacturing tasks list down to about a dozen ‘generic’ tasks” and then addressing major decisions or choices within each type (Skinner, 1996).

To adopt this approach to strategic manufacturing management will require the selection of the best procedure to use to reduce this complex decision-making process down into its constituent “generic” tasks. There are two methods of organisational analysis that are used to gain a better understanding of how to design complex organisational systems, these are the contingency and the configuration research methodologies. Meyer, Tsui and Hinings (1993) define the contingency research method as follows:

“Contingency research invokes reductionism as its dominant mode of enquiry, an approach whereby researchers seek to understand the behaviour of a social entity by separately analysing its constituent parts. Accordingly, contingency theorists implicitly treat organisations as loosely coupled aggregates whose separate components may be adjusted or fine-tuned incrementally once weak constraints have been overcome (Meyer, Goes and Brooks, 1993).

A critical weakness of this research method is that quite simple causal assumptions are often deduced, with external contingencies and internal system attributes often seen as linked by linear relationships involving unidirectional causation. To statistically isolate the effects of each contingent variable will probably require minimising the effects of complex forms of interaction and the existence of non-linear relationships, if the modelling process is to remain manageable.

The alternative to this mode of enquiry is the configuration research method.

“Organisational configuration” is defined by Meyer, Tsui and Hinings (1993) as follows:

“We use the term “organisational configuration” to denote any multidimensional constellation of conceptually distinct characteristics that commonly occur together.... Configurations may be represented in typologies developed conceptually or captured in taxonomies derived empirically. They can be situated at multiple levels of analysis, depicting patterns common across individuals, groups, departments, organisations or networks of organisations”.

Configuration research considers organisations or parts of organisations as complex amalgams of multiple attributes and thus adopts the holistic approach for the choice of the unit of analysis. Configuration researchers (Miller and Friesen, 1984; Miller, 1986) have concluded from their studies that the attributes of configurations tend to fall into a limited number of coherent patterns. The explanation for this pattern of organisational behaviour is “because attributes are in fact interdependent and often can change only discretely or intermittently. The upshot is that just a fraction of the theoretically conceivable configurations are viable and apt to be observed empirically” (Meyer, Tsui and Hinings, 1993).

A weakness with this approach is that classification may not amount to an understanding of what is discovered. It may therefore be necessary to

undertake further research to explain how the different amalgams of multiple attributes observed were created originally and how they are now being maintained. As the mathematician Charles Dodgson, writing as Lewis Carroll, explained so succinctly:

“Naming something,” said Alice to the Red Queen, “isn’t the same as explaining it.”

Lewis Carroll, *Alice’s Adventures in Wonderland*

However, such a research methodology fits well with current thinking about how a manufacturing strategy should be planned and implemented. A manufacturing strategy is a plan prepared for the building of a range of manufacturing capabilities that enable the competitive provision of both tangible and intangible customer benefits. Previous research has suggested that two procedures have been used for determining the development of the configuration of the manufacturing capabilities needed for such a performance objective to be achieved.

The first is to adopt the concept of strategic manufacturing management developed by Skinner (1969; 1974). Skinner advocates that the selection of the manufacturing capabilities to develop should be determined by their fit with how the company plans to compete in its chosen markets, that is there should be an environmental fit between the structures and the processes of organisations and their external settings (Miller, 1992). Hill (1993) also recommends that the customer requirements need to be analysed and classified

and through such an analysis the priorities for improving the manufacturing competitiveness of the firm can be set to ensure an environmental fit.

His approach, like that of Skinner, is also to seek to establish an internal fit between the product sets, processes and infrastructures within the firm. Hill uses five types of production process as a precursor to linking process design with the market characteristics, product volumes and the how to achieve the internal fit of organisation structure and infrastructure. He specifies twenty-five types of decision that need to be made (level of capital investment, type of technology, etc.) in order to establish a manufacturing strategy with both an environmental fit and an internal fit.

The alternative approach for determining a manufacturing strategy for a business is the cumulative or 'sand cone' model. Ferdows and De Meyer (1990) have reported that some companies design their manufacturing strategies to enable them to progressively build a multiple of manufacturing capabilities or a configuration of capabilities. Their hypothesis is that there is an order and manner in which manufacturing capabilities should be built which is similar to that proposed by Hall (1987). The procedure recommended by Ferdows and De Meyer is that quality improvement should be the foundation upon which a manufacturing strategy is built followed by dependability, flexibility and then cost-efficiency. Hall and Nakane (1990) then added two more capabilities to the preceding four; a company-developed culture (to be considered the first priority) and innovation.

Noble's (1995) research findings concurred with those of Roth and Miller (1990, 1992) which also showed that the better performing firms compete on the basis of a multiple or a configuration of manufacturing capabilities. Their research findings differ from those of Ferdows and De Meyer and seem to support the concept of equifinality, that is that there are many routes to operational effectiveness, one of them being through the development of different combinations of manufacturing capability.

In this paper, research findings are presented on a study of strategic manufacturing management in United Kingdom. An empirical research methodology was used and the objective of the study was to search for a range of manufacturing strategy types that are distinguishable by the combinations of customer service capabilities that are planned for development. The research data were analysed by following the same research methodology employed by Miller and Roth (1994).

De Meyer (1992) has also carried out a study similar to this one. His objective was to compare findings on the types of manufacturing strategies planned by European companies with those found by Miller and Roth using the United States manufacturing futures survey data. However, his research results were both consistent with those of Miller and Roth and significantly different. The purpose of this study was to investigate whether the different findings from the two previous studies could be explained and to carry out another test of the general applicability of the Miller and Roth taxonomy of manufacturing strategies. A supplementary aim was also to test the convergence theory for

manufacturing strategy development, that is that similar or “generic” manufacturing strategy types will be developed when similar competitive conditions prevail.

Background

The Collins English Dictionary definition of “generic” is:

“applicable or referring to a whole class or group”

To use the term “generic” to describe a type of manufacturing strategy will imply that it is employed by a substantial number of manufacturing businesses. This may, at first, seem improbable given the considerable diversity of manufacturing companies and the variety of products that they produce.

The possibility that only a small number of generic manufacturing strategies are used can be better assessed by examining how a manufacturing strategy is designed and implemented. The process recommended by both Skinner (1969) and Hill (1993), and that has been explained in the previous section of this paper, is the one that many accept as best practice. An alternative process is the cumulative building of manufacturing capabilities, as prescribed by the “sand cone” model. There are differences of opinion about the order or sequence for the development of these capabilities (Hall and Nikane (1990)) and so it may be premature to describe this approach to strategic

manufacturing management as best practice. Perhaps further research is required to prove that this process is better than that recommended by Skinner and Hill.

One reason why it is conceivable that only a limited number of manufacturing strategies have been developed is that the manufacturing strategy planning process could be significantly constrained by the application of two management concepts that were designed for this purpose. The first concept is the Hill model of strategic manufacturing management, which links the customer service criteria to a definition of the manufacturing task; the second is Porter's (1980) claim that organisations implement three distinct types of generic competitive strategy, that is least cost, differentiation and focus. If manufacturing companies do try to develop strategies to establish both environmental and internal fits then the limited number of options for competitive strategy may limit the range of options for manufacturing strategy design.

The concept of generic manufacturing strategies fulfilling an ideological fit with generic competitive strategies could facilitate the creation of a vision of the bundle of manufacturing capabilities that a firm should develop to achieve environmental fit. A framework that links generic competitive strategies with generic manufacturing strategies could therefore provide an aid to the manufacturing manager when planning the longer-term development of the manufacturing capabilities of a business.

However, such a framework would need to recognise and incorporate the new forms of competitive strategy that many companies recently have been observed to take. Hayes and Pisano (1994) have provided a summary of these changes and their view is that increased competition has driven many companies to intensify their searches for new ways of offering perceived customer value. Their conclusion on the evolutionary changes that are being made to competitive strategy is as follows:

“ The terms of competition (have) shifted from low cost to high quality to flexibility to innovation”

McDermott, Greis and Fischer (1997), in their study of the US power tool industry between 1970 and the 1990s, have provided an insight into how managers in this industry have interpreted the changes that have been taking place in their competitive environment. They reported that the industry managers considered that competition was originally based on price and low cost but during the 1970s many firms made the investments needed to change their inflexible but highly efficient production systems into more flexible processes.

The 1980s were another period of major change. The focus for improvement for manufacturing companies during this decade was reported to be quality. Firms in this industry were moving away from 100 per cent inspection and changing their quality strategy to defect prevention. The 1990s have been a period when the concentration of the ownership of retail outlets for power

tools, which had stated earlier, enabled the owners to exploit their increased buyer power. They are now applying downward pressure on prices and upward pressure on the responsiveness.

The 1990s have also been a period when the rate of product innovation has been used as a competitive weapon. The conclusion of McDermott, Greis and Fischer on this subject was:

“By all accounts, the rate of new product introduction and innovation is accelerating. Customisation requests from mass merchants have severely altered the means of competition...”

These developments have also been observed in Europe. The environmental forces that have stimulated such changes are not only the increase in buying power of large retailing organisations but also the reduction of trade barriers that are a consequence of the creation of the single European market. As a consequence, in most mature markets the capacity to supply exceeds the aggregate level of demand. These changes in the competitive environment with the required changes in manufacturing capability are shown in a simplified form in Figure 1.

Figure 1: The Changing Scope of Competitive and Manufacturing Strategies

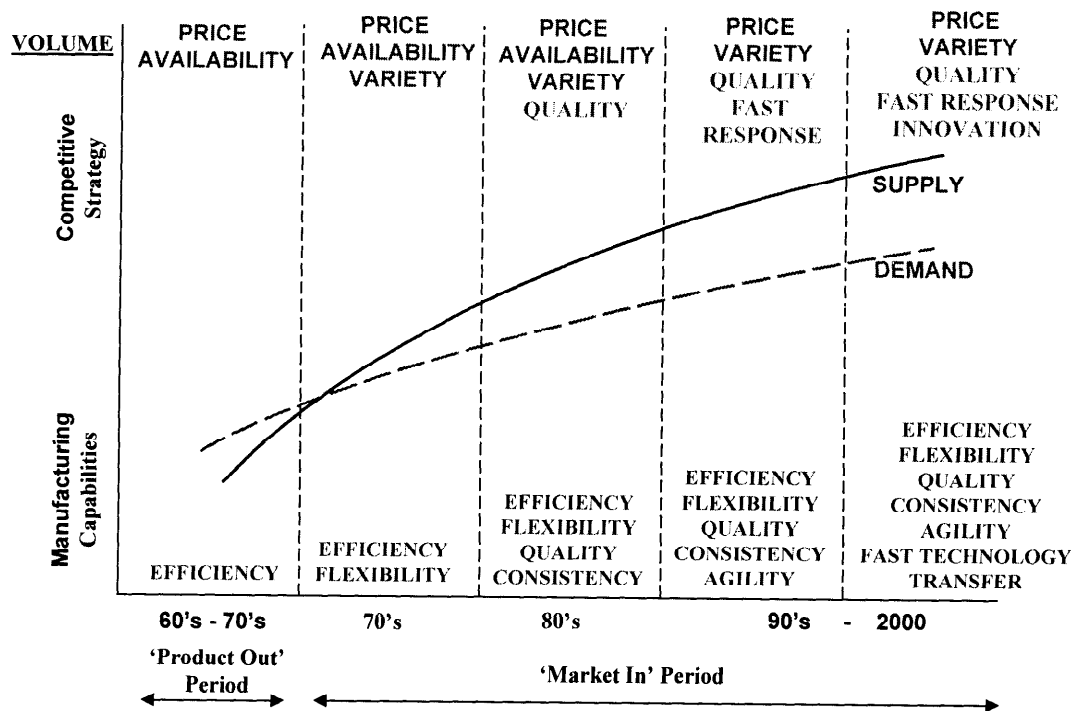


Figure 1 shows how the types of customer service benefits expected in the US power industry have changed over time. This is similar to the changes that have taken place in the mature markets for manufactured goods in Europe. However, all competitors in these markets will not be able to offer all of these benefits if one accepts Porter's theory (1980) of generic competitive strategies. If trade-off decisions are necessary to develop a least cost production capability then some companies may have selected this strategic option for their game plan to cope with the changes in the competitive environment shown in Figure 1. In a similar manner, some companies may have elected to prioritise some of the range of customer benefits that their customers were seeking and in this way sought to offer a distinct form of differentiation strategy. These conclusions about how companies are striving to cope with

this rapidly changing competitive environment form the basis for the following hypotheses:

Inertia or barriers to change require manufacturing companies to prioritise the customer requirements that they choose to develop for their differentiation strategy.

As a consequence, within an industry, a range of manufacturing strategies will be used and each will be designed to fulfil the requirements for environmental and internal fit with a specific segment of the targeted market.

Combination theory suggests that only a number of these manufacturing strategy types will be considered as viable and these could therefore be considered as generic manufacturing strategies.

If a set of generic manufacturing strategies are identified, then evidence of the desire to satisfy the complete range customer service benefits shown for the 1990s in Figure 1 should also be evident since these have been reported as expected by customers at this time. However, it may be that most companies within a particular industry will not be able to become world class in all of the manufacturing capabilities needed to satisfy the customer expectations shown in Figure 1. Therefore, management in such firms may be forced to prioritise those manufacturing capabilities that they choose to develop, and perhaps this

at the expense of others because the barriers to change for the latter may be deemed to be uneconomic.

Research objectives

The principal objective of this study was to test whether the taxonomy of manufacturing strategies, originally proposed by Miller and Roth (1994), could be deemed to be appropriate descriptors of the manufacturing strategies currently being implemented by United Kingdom manufacturing businesses. The study included strategic manufacturing management information obtained from three industrial sectors in the United Kingdom, these being the engineering, electronic and processing industries.

Bozarth and McDermott (1998) have reported that very little general testing of the existing manufacturing strategy taxonomies and typologies had been carried out. Table 1 shows a list of the names of the originators of the more recently published manufacturing strategy taxonomies and typologies; it also details those that have been empirically tested and those that remain to be tested.

Table 1: Current status of empirical testing of manufacturing strategy
typologies and taxonomies

	Untested	Tested
Typologies	Hill (1993) Kotha & Orne (1989)	Richardson et al (1985) Hayes & Wheelwright (1979)*
Taxonomies	Stobaugh & Telesio (1983) Wheelwright & Hayes (1985)	Miller & Roth (1994) De Meyer (1992) Sweeney & Szwejczewski (1996)

* Partially tested by Safizadeh et al. (1996), and McDermott et al (1997)

This research project was designed to replicate a previous test of the general applicability of the taxonomies of manufacturing strategies proposed by Miller and Roth (1994) and De Meyer (1992). This test was carried out in 1996. The Miller and Roth and De Meyer taxonomies of manufacturing strategies were derived from empirical analyses of United States and European manufacturing futures survey data. Sweeney and Szwejczewski (1996) found from their initial study that the types of manufacturing strategy being implemented in the United Kingdom Engineering industry were similar to all of those found in the Miller and Roth and De Meyer studies. One of the findings of the Sweeney and Szwejczewski study was that evidence was found that supported the inclusion of the type of manufacturing strategy that was unique to De Meyer's study in combination with those discovered by Miller and Roth. The findings of this study reinforced the need for further research to confirm or challenge the general applicability of Sweeney and Szwejczewski (1996) taxonomy of manufacturing strategies.

Research methodology

The source of the information used for this research is questionnaire data completed by manufacturing managers in those British companies who have chosen to enter their factory for the Management Today-Cranfield School of Management Best Factory Award scheme. To determine which manufacturing plant qualifies for the award of "United Kingdom Best Factory" requires a comprehensive understanding of the production methods and the

manufacturing performance of each applicant for the award. This information is gathered, in the first instance, by the use of a questionnaire. The aggregation of this survey data, which is carried out to protect the confidentiality of individual company information, constitutes a unique set of facts that has proved to be beneficial for the empirical research of both manufacturing strategy and manufacturing performance.

The uniqueness of this database is the strategic and operational information that it holds. The strategic management information collected is the type of customer service that each company strives to deliver to gain a competitive advantage. The operational data gathered are the measurements of current performance for both manufacturing and customer service. The range of manufacturing performance information sought includes data on both the key performance indicators and their principle drivers.

This database is a valuable source of information for another reason. A review of empirical studies of manufacturing strategy, carried out by Minor et al. (1994), concluded that even the most carefully planned surveys can be adversely affected by a lack of response and by a lack of standards in reporting financial and manufacturing data. They emphasised that the development of databases for empirical analysis would be a definite contribution to the discipline and for this to happen manufacturing managers must have an interest in the research, or something to gain by making the effort to respond. The data supplied for this empirical research meet this condition for improved data integrity. It is in the interest of those who enter the Best Factory Award

competition to complete the questionnaire as accurately as possible because all factories short-listed as potential award winners are visited to audit the accuracy of the information that they have provided to enter the competition.

The research method used consisted of searching this database in an attempt to find groups of competitive capabilities that were ranked in a similar order of priority for improvement to increase the competitiveness of the responding firm. This research design is essentially the same as that adopted by Miller and Roth and De Meyer. However, a critical research design problem was how to reconcile the approaches taken by Miller and Roth and De Meyer because they used dissimilar sets of competitive capabilities for their research. These competitive capabilities differed in both type and number. The competitive capabilities chosen for their research and for this study are detailed in Table 2.

Table 2: Competitive capability variables used to define the manufacturing task

Competitive Capability	Miller and Roth	De Meyer	Sweeney and Szejczewski
1. Low Price	x	x	x
2. Design Flexibility - ability to (a) Make Rapid Design Changes (b) Introduce New Products Quickly	x	x	x
3. Conformance - consistent quality	x	x	x
4. Performance - provide high performance products	x	x	x
5. Speed - quick delivery	x	x	x
6. Dependability - reliable delivery	x	x	x
7. Volume flexibility - capability to respond to swings in volume	x	x	
8. After Sales Service	x		
9. Advertising	x		
10. Broad Distribution	x		
11. Broad Line - to deliver a broad product line	x	x	
12. Speed to production changes		x	

The decision to use only six competitive capabilities to define the manufacturing task instead of the greater number used by the other researchers was made for the following reasons:

1. Volume flexibility was excluded as a separate competitive capability because it is considered a prerequisite for dependable delivery. To achieve dependable delivery will require many companies to cope with both product volume and mix variabilities.
2. In the Miller and Roth and De Meyer studies an enquiry was made about the capability to offer a broad product line. It was decided to exclude this competitive capability from the list for this research because of the problem with the interpretation of the term “broad”. A question that is asked in this study’s questionnaire is “how many product types are sold to the customer?” Reference has been made to the answer to this question when investigating the companies that have been grouped together in each of the four types of manufacturing strategy identified.
3. The remaining four competitive capabilities shown in table 2 were excluded from the set of competitive capability variables used for this study because they were either not directly related to manufacturing strategy design or because the capability was unique to one of the studies.

The manufacturing strategy data used for this research were obtained from questionnaires completed by contestants for the 1993 to 1996 Best Factory Award schemes. The data set consists of completed questionnaires received

from 120 engineering factories, 121 electronic engineering factories and 113 processing industry plants.

The specific data used for this research were the responses given to the request to rank the relative emphasis to be given, in their strategic plans for the next two years, to the six competitive capabilities shown in table 2. The method of ranking used was 1 represents of greatest importance and 6 the least important. The definitions given in the questionnaire to the capabilities listed in Table 2 were as shown in Table 3.

Table 3 Best factory award competitive capabilities

1. Manufacturing cost reduction
2. Rapid product design change
3. Consistent quality
4. Improved product performance
5. Short delivery lead times
6. Dependable delivery dates

The identification of the use of a range of manufacturing strategy types was accomplished by using the K-means cluster analysis procedure for grouping the respondents' rankings of the competitive capabilities listed in Table 3. Final clusters were determined by nearest centroid sorting, which is by assigning each case, or the individual rankings for competitive capabilities of each firm, to the cluster with the smallest distance between the case and the centroid of a cluster. This was the same statistical method as that used by both Miller and Roth (1994) and De Meyer (1992).

The process used to determine the optimal number of clusters was also the same as that followed by Miller and Roth and De Meyer but with one additional criterion. This was that the selection of the number of clusters would be made in accordance with all the options suggested by Lehmann (1979). The original set of criteria used for the statistical analyses of the survey data by all the previously referenced researchers in this field were as follows:

1. Accept Lehmann's (1979) suggestion that the number of clusters should be limited to between $n/30$ and $n/60$ where n is the sample size. Thus the results obtained for two, three and four clusters were analysed.
2. The tightness of the clusters of the competitive capability variables was measured by the F-ratio.
3. An analysis of variance was measured by calculating the level of significance of the probability that the cluster mean values differed for each competitive capability.

Research results

The most interesting findings of this study were those that resulted from three and four cluster analyses. The results obtained from the three cluster analysis using only engineering industry data are shown in Table 4.

Table 4: Comparison of clusters of competitive capabilities

Three cluster analysis

<u>Miller and Roth (1994)</u>	<u>Sweeney and Szwejczewski (1996)</u>
<p><u>Caretakers</u></p> <ol style="list-style-type: none"> 1. Low price (cost) 2. Dependability (delivery) 3. Conformance (consistency) 4. Speed (delivery) 	<p><u>Caretakers</u> N = 27</p> <ol style="list-style-type: none"> 1. Cost reduction (1.4) 2. Short Delivery Lead Times (3.1) 3. Consistent quality (3.8) 4. Dependable delivery (4.0)
<p><u>Marketeers</u></p> <ol style="list-style-type: none"> 1. Conformance 2. Dependability 3. Performance 4. Low price 	<p><u>Marketeers</u> N = 69</p> <ol style="list-style-type: none"> 1. Consistent quality (1.8) 2. Dependable delivery (2.58) 3. Cost reduction (2.6) 4. Short delivery lead times (3.9)
<p><u>Innovators</u></p> <ol style="list-style-type: none"> 1. Conformance 2. Performance 3. Dependability 4. Design flexibility 	<p><u>Innovators</u> N = 24</p> <ol style="list-style-type: none"> 1. Consistent quality (2.4) 2. Rapid product design change (2.9) 3. Dependable delivery (3.2) 4. Improved product performance (3.3)

Table 4 note:

The analysis of variance carried out by Sweeney and Szwejczewski were the measurements of tightness of the clusters (the F-ratio) and the degree that the mean value of each variable cluster differed. These were all within the 5% level of significance.

The most significant result obtained from this analysis of the UK survey data is the indistinguishable results obtained for the groups labelled as caretakers and marketeers in Table 4. The Miller and Roth results show a difference between the competitive capabilities of caretakers and marketeers, namely caretakers include delivery speed in their competitive capabilities set and marketeers include product performance. No differences were found in the competitive capabilities sets generated from a similar analysis of UK companies' data.

The results of the four cluster analysis of the data obtained from factories in the UK engineering industry sector are shown in Table 5.

Table 5: Four cluster analysis of UK Engineering industry data

Competitive Capabilities	Caretakers N=56	Marketeers N=25	Mass Customizers N=20	Innovators N=19	F-Value p=Probability
Manufacturing Cost Reduction	1.64 <i>1</i>	2.96 <i>3</i>	4.6 <i>5</i>	4.78 <i>6</i>	61.91 p=0.000
Rapid Product Design Changes	5.09 <i>5</i>	5.44 <i>6</i>	5.25 <i>6</i>	2.1 <i>2</i>	47.81 p=0.000
Consistent Quality	2.57 <i>2</i>	1.8 <i>1</i>	2.8 <i>3</i>	1.94 <i>1</i>	3.09 p=0.030
Improved Product Performance	5.23 <i>6</i>	2.4 <i>2</i>	4.4 <i>4</i>	3.84 <i>3</i>	43.45 p=0.000
Short Delivery Lead Times	3.53 <i>4</i>	4.88 <i>5</i>	2.05 <i>2</i>	4.47 <i>5</i>	32.83 p0.000
Dependable Delivery Dates	2.92 <i>3</i>	3.52 <i>4</i>	1.90 <i>1</i>	3.84 <i>3</i>	8.13 p=0.000

Table 5 note:

This table shows the mean value of each of the six competitive capabilities listed and these values have been linked with the four named competitive capabilities clusters produced by this analysis. The table also shows the ranking of their relative importance (1= highest and 6= lowest).

The analyses of variance carried out were the measurement of the tightness of the clusters (the F-value) and the degree that the mean value for each variable cluster differed. These are all shown to be within the 5% level of significance (the P-value).

A comparison of these results with those obtained by Miller and Roth and De Meyer is shown in Table 6.

Table 6: Comparison of clusters of competitive capabilities

Four cluster analysis of the UK Engineering industry data

Miller and Roth (1994)

Caretakers

1. Low price (cost)
2. Dependability (delivery)
- * 3. Conformance (consistency)
4. Speed (delivery)

Marketeers

- * 1. Conformance (consistency)
2. Dependability
- * 3. Performance (product)
4. Low price (cost)

Innovators

- * 1. Conformance (consistency)
- * 2. Performance (product)
3. Dependability
- * 4. Design flexibility (speed)

De Meyer (1992)

High Performance Products

(using 1988 data)

1. Conformance
- * 2. Delivery dependability
- * 3. Performance (product)
- * 4. Delivery speed

Sweeney and Szwejczewski (1996)

Caretakers

1. Cost reduction
2. Consistent quality
3. Dependable delivery
4. Short delivery lead time

Marketeers

1. Consistent quality
2. Improved product performance
3. Cost reduction
4. Dependable delivery

Innovators

1. Consistent quality
2. Rapid product design change
3. Improved product performance
4. Dependable delivery

Mass Customizers

1. Dependable delivery
2. Short delivery lead time
3. Consistent quality
4. Product performance

* This indicates those variable clusters that differed from the others at the 0.05 level of significance or less.

All the six variable clusters differed from each other at the 0.05 level of significance or less.

The four cluster analysis of the competitive capabilities needed by companies in the UK Engineering industry now appear to be totally consistent with the findings of Miller and Roth in type but not in rank order. The four cluster analysis also produced a set of competitive capabilities that are consistent in type with a group discovered by De Meyer but not included in the findings of Miller and Roth. All the cluster analysis data were statistically tested to determine whether they were from significantly different groups of competitive capabilities and this was confirmed, at the 5% level of significance, as shown in Table 5.

Because the four cluster analysis produced some consistency between the findings of Miller and Roth, De Meyer and the analysis of UK Engineering industry data, further statistical analyses were carried out on data obtained from the UK Electronics and Processing industries. The results of these analyses are shown in Tables 7 and 8.

Table 7: Comparison of clusters of competitive capabilities

Four cluster analysis of the UK Electronics industry data

Competitive Capabilities	Caretakers N=29	Marketeers N=20	Mass Customizers N=47	Innovators N=25	F-Value p=Probability
Manufacturing Cost Reduction	1.45 <i>1</i>	2.80 <i>3</i>	4.38 <i>4</i>	3.44 <i>4</i>	37.07 p=0.00
Rapid Product Design Changes	5.07 <i>5</i>	5.40 <i>6</i>	4.89 <i>5</i>	1.72 <i>1</i>	70.30 p=0.00
Consistent Quality	2.45 <i>2</i>	2.45 <i>2</i>	1.48 <i>1</i>	3.24 <i>3</i>	12.57 p=0.00
Improved Product Performance	5.45 <i>6</i>	2.30 <i>1</i>	5.04 <i>6</i>	2.80 <i>2</i>	65.29 p=0.00
Short Delivery Lead Times	3.00 <i>3</i>	5.20 <i>5</i>	3.15 <i>3</i>	5.08 <i>6</i>	27.31 p=0.00
Dependable Delivery Dates	3.59 <i>4</i>	2.85 <i>4</i>	2.04 <i>2</i>	4.72 <i>5</i>	48.98 p=0.00

Table 8: Comparison of clusters of competitive capabilities

Four cluster analysis of the UK Processing industry data

Competitive Capabilities	Caretakers N=36	Marketeers N=31	Mass Customizers N=26	Innovators N=20	F-Value p=Probability
Manufacturing Cost Reduction	1.81 <i>1</i>	2.26 <i>2</i>	3.61 <i>3</i>	3.00 <i>3</i>	11.74 p=0.00
Rapid Product Design Changes	5.47 <i>6</i>	5.74 <i>6</i>	4.65 <i>5</i>	1.95 <i>1</i>	93.99 p=0.00
Consistent Quality	3.36 <i>4</i>	1.84 <i>1</i>	1.46 <i>1</i>	2.85 <i>2</i>	19.32 p=0.00
Improved Product Performance	5.42 <i>5</i>	2.77 <i>3</i>	5.31 <i>6</i>	4.00 <i>4</i>	52.38 p=0.00
Short Delivery Lead Times	2.53 <i>3</i>	4.77 <i>5</i>	3.85 <i>4</i>	4.60 <i>5</i>	20.68 p0.000
Dependable Delivery Dates	2.42 <i>2</i>	3.61 <i>4</i>	2.12 <i>2</i>	4.60 <i>5</i>	30.94 p=0.00

A comparison can be made between the three sets of results by reference to Table 9. The results obtained from the three statistical analyses of UK Best Factory Award questionnaire data provide evidence of distinguishable differences in the types of prioritised competitive capabilities included in the four clusters of capability types. This is an interesting research finding because to determine if a range of different types of competitive strategies were used by businesses within an individual industry was one of the research objectives of this study. However, no consistency has been found in the rankings of the priorities for competitive capability improvement.

The data presented in Table 9 also shows differences between the top four priorities for the innovator and mass customizer competitive capability clusters and these can be identified by a * in the table. However, three of the four competitive capabilities listed in these clusters are the same and perhaps these are the competitive capabilities that should be used to distinguish these clusters from the other clusters of competitive capabilities.

The types competitive capabilities included in the four clusters derived from the statistical analyses of both the electronics and the processing industries data (excluding one from the innovator and mass customizer sets) are very similar to those derived from the analysis of engineering industry data. In addition, the constituents of the clusters derived from the analysis of engineering industry data are consistent with the findings of the Miller and Roth and De Meyer studies.

Table 9: Comparison of research results – 4 cluster analyses
of competitive capabilities by type of industry

Sweeney and Szwejczewski Engineering Industry (1996)	Sweeney and Szwejczewski Electronics Industry (1999)	Sweeney and Szwejczewski Processing Industries (2000)
<u>Mass Producers (Caretakers)</u> 1. Cost Reduction 2. Consistent Quality 3. Dependable Delivery 4. Short Delivery Lead Time	<u>Mass Producers (Caretakers)</u> 1. Cost Reduction 2. Consistent Quality 3. Short Delivery Lead Times 4. Dependable Delivery	<u>Mass Producers (Caretakers)</u> 1. Cost Reduction 2. Dependable Delivery 3. Short Delivery Lead Time 4. Consistent Quality
<u>Variant Producers (Marketeers)</u> 1. Consistent Quality 2. Improved Product Performance 3. Cost Reduction 4. Dependable Delivery	<u>Variant Producers (Marketeers)</u> 1. Improved Product Performance 2. Consistent Quality 3. Cost Reduction 4. Dependable Delivery	<u>Variant Producers (Marketeers)</u> 1. Consistent Quality 2. Cost Reduction 3. Improved Product Performance 4. Dependable Delivery
<u>Innovators</u> 1. Consistent Quality 2. Rapid Product Design Change 3. Improved Product Performance *4. Dependable Delivery	<u>Innovators</u> 1. Rapid Product Design Change 2. Improved Product Performance 3. Consistent Quality *4. Cost Reduction	<u>Innovators</u> 1. Rapid Product Design Change 2. Consistent Quality *3. Cost Reduction 4. Improved Product Performance
<u>Mass Customizers</u> 1. Dependable Delivery 2. Short Delivery Lead Time 3. Consistent Quality *4. Improved Product Performance	<u>Mass Customizers</u> 1. Consistent Quality 2. Dependable Delivery 3. Short Delivery Lead Time *4. Cost Reduction	<u>Mass Customizers</u> 1. Consistent Quality 2. Dependable Delivery *3. Cost Reduction 4. Short Delivery Lead Time

Conclusions

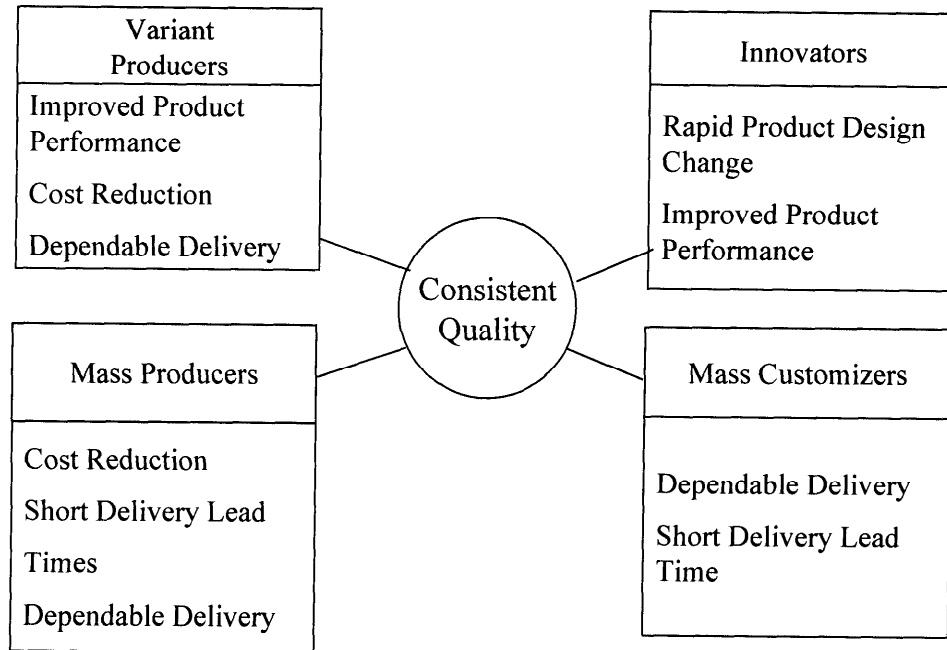
The objective of this research was to search for generic types of manufacturing strategy that would enable manufacturing managers to link the competitive strategy of their company with the most appropriate set of priorities for the development of their manufacturing capabilities. The four cluster analysis of the UK questionnaire data show that the results obtained from this study are consistent with those produced by previous studies of this type. In addition, an analysis of variance of the results produced an improved set of statistical significance test results.

The tentative conclusions drawn from these findings are that there is a limited number of configurations of competitive capabilities that companies have set as priorities for improvement. These would seem to be represented by the four clusters of competitive capabilities generated by the statistical analyses carried out on the UK industry data. Therefore, if environmental fit is accepted as a general goal for the designers of manufacturing strategy, there would seem to be a limited number of types of manufacturing strategy that can be used to achieve the environmental fit [that is necessary for the synergy with corporate activities]. A number of common sets of competitive capabilities have been identified and these can only be created or improved by the manufacturing function. These groups of competitive capabilities could be considered to be definitions of generic manufacturing tasks and the goal of manufacturing management would be to design generic manufacturing strategies that will accomplish those tasks.

The range of competitive capabilities, in total, also match the current set of customer service criteria that managers have emphasised are expected by customer at this time. These have been listed in Figure 1.

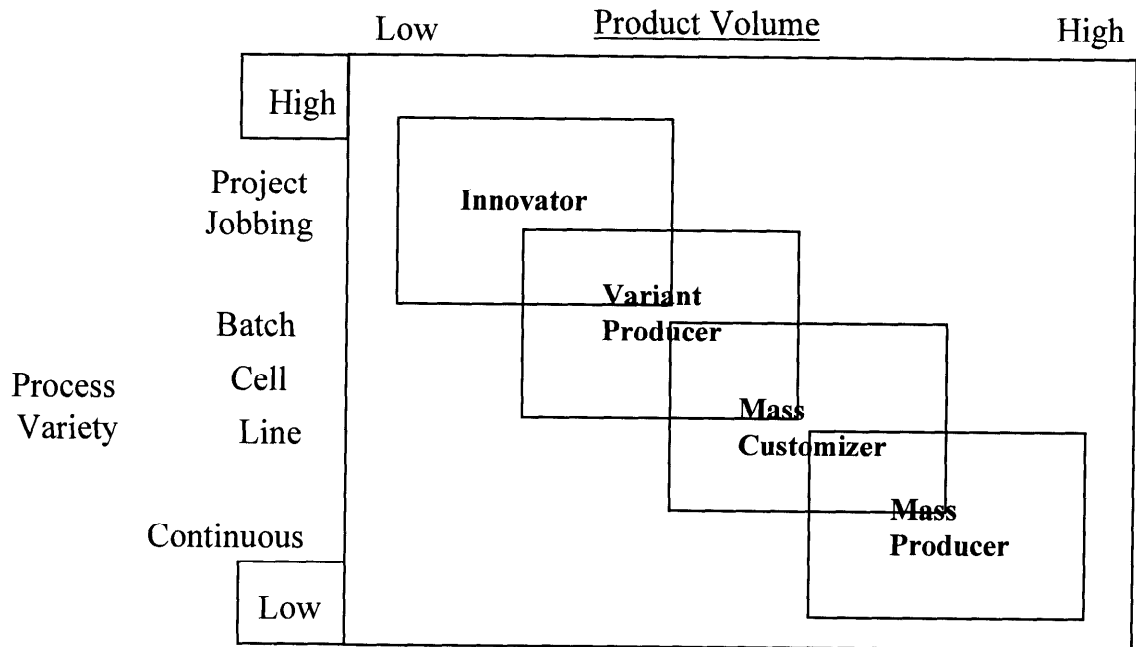
An analysis of Table 9 shows that the competitive capability common to all four configurations of competitive capabilities is consistent quality. For this reason we believe this capability to be an order qualifier and the remainder to be order winners. How these differ for the four generic manufacturing strategy types is shown on Figure 2.

Figure 2: A taxonomy of generic manufacturing strategies and their constituent manufacturing capabilities



We have also proposed a revised taxonomy of manufacturing strategies in an attempt to link the name of the generic manufacturing strategy with the type of operation and the process design used by the firms that were grouped in each of the four clusters of competitive capabilities. How we think these generic types of manufacturing fit on the product-process matrix is shown in Figure 3.

Figure 3: The total volume-process variety matrix



The reasons for showing each of the generic manufacturing strategies as they are on Figure 3 is because the innovators in the UK industry data are businesses that are frequently either adapting established product designs or creating new product designs quickly. The mass customizers are the higher volume producers of products with a range of feature options that are made to order using flexible manufacturing systems that are capable of the high volume production of a broad range of products. The mass producers (caretakers) and the variant producers (marketeers) are the same as that Miller and Roth (1994) have described in their paper.

The results of this research may be explained by convergence theory. The creation of the single market in Europe has established competitive conditions in Europe that are similar to those in America. As a consequence, perhaps

similar manufacturing strategies are being devised to cope with the similar competitive conditions.

It was proposed previously in this paper that configuration theory would be a more effective concept than contingency theory for designing a manufacturing strategy.

The results of this research may prove useful as a means of applying configuration theory for this purpose

Future research

It is planned to use data from other manufacturing sectors in the UK and to continue to test the general applicability of the taxonomy of generic manufacturing strategies proposed in this paper. Also to combine all the UK industry data used to date in order to increase the number of clusters that can be used for their analysis, as Lehmann (1979) has recommended.

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