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IMPLEMENTATION OF TECHNOLOGY AND MANAGEMENT INITIATIVES TO ELIMINATE COMPETITIVE PRIORITIES TRADE-OFFS

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ABSTRAKSI

Penelitian ini mengidentifikasi apakah implementasi teknologi dan praktek manajemen berperan dalam meminimalkan trade-off diantara competitive priorities. Pengujian dilakukan dengan menggunakan paradigma matrik produk-proses (Hayes dan Wheelwright 1979) yang mensyaratkan adanya kesesuaian antara struktur produk dan struktur proses produksi. Variabel yang digunakan untuk meminimalkan trade-off adalah teknologi pemrosesan, teknologi pendesainan produk, program kualitas dan JIT. Competitive priorities dibentuk dengan analisis faktor (factor analysis) sedangkan untuk menyusun kategori process choice diterapkan non-hierarchical clustering.

Hasil analisa menunjukkan process choice berkaitan erat dengan competitive priorities yang diterapkan dalam persaingan, kecuali untuk competitive priorities pengiriman. Hal ini mengindikasikan bahwa perusahaan manufaktur belum mempertimbangkan pengiriman sebagai variabel yang penting untuk memberikan keunggulan kompetitif. Sebagian besar plant yang dijadikan sampel juga masih mengikuti paradigma matrik produk-proses dengan memposisikan dirinya berada pada diagonal matrik. Namun demikian, terdapat beberapa plant yang memposisikan diri berada di luar diagonal matrik untuk memperjelas posisinya dengan pesaing. Plant pada kelompok ini berhasil menghilangkan beberapa trade-off dengan menerapkan teknologi dan praktek manajemen meskipun masih terdapat dua trade-off yang belum berhasil untuk dihilangkan, yaitu biaya-kustomisasi dan biaya-kualitas.

Keywords: *competitive priorities, process choice, processing and designing technology, JIT, quality program.*

INTRODUCTION

Competitive priorities have shown to be a major determinant of manufacturing performance as well as to the overall business performance (Vickery et al. 1993). In order to create competitive advantages, the manufacturers should utilize some competitive priorities, such as competing based on cost, quality, time and customization simultaneously (Noble 1995). Previous studies of manufacturing companies indicated that competing on flexibility and on quality may lead trade-offs with competing on cost since the utilization of both competing priorities leads to higher cost and higher price (Wood 1991). In this context, the prerequisite for the manufacturing is that how to minimize that trade-offs.

Trade-off concept is based on focused factory proposed by Skinner (1974) explained that the manufacturers are unable to perform well in all competitive priorities equally at the same time. He further explains that one area creates a competitive advantage, but at the same time it raises expenses of others. According to Hayes and Schmenner (1978), it is potentially dangerous for a company to compete by offering superior performance along with several competitive priorities. The company must select definitely one of competitive priorities to avoid the trade-offs among them. Through product-process matrix concept, Hayes and Wheelwright (1979a) suggest that a process selection should be compatible well with one of the competitive priorities. By utilizing two competitive priorities in a process selection, it will lead trade-off each other. For example, the selection of the job shop process will utilize quality and customization as competitive priorities, but it will be sacrifice delivery and cost.

In contrast, the sandcone model of Ferdows and De Meyer (1990) argues that manufacturing should follow a certain pattern in applying several competitive priorities simultaneously. These include several competitive priorities, such as: competing on quality, dependability, flexibility (speed), and cost efficiency. According to Noble (1995), one or more competitive priorities can be applied in the same time if another has previously achieved a minimum level of manufacturing capability that will be able to eliminate the nature of manufacturing trade-offs. In his study at tool industry in USA, McDermott et al. (1997) found that competitive priorities trade-off decreased gradually along with implementing process technology, such as: cellular manufacturing technology, just-in-time (JIT), continuous improvement, and manufacturing information systems like flexible manufacturing system (FMS) and computer integrated manufacturing (CIM). By implementing new manufacturing technologies and methods, manufacturers are able to reduce the gap of ability between rigid flexibility and mass customization as well as eliminate the trade-offs. Through employing cluster analysis, Ahmad and Schroeder (2002) examined several variables implemented to minimize the trade-offs. The variables consist of process design, product design technology, Just-In-Time (JIT) and quality programs. Some of these variables are apparently useful to minimize contradiction between cycle time and inventory turnover.

Previous researches regarding the effort of minimizing competitive priorities trade-off have been undertaken mostly in the USA and other West Countries, which their manufacturing industries are in an advance phase (Safizadeh et al. 2000; Silveira and Slack 2001; Boyer and Lewis 2002; Flynn and Flynn 2000). Researchers have paid little attention to conduct the same research topic in developing countries, which most their manufacturing industry are still in the growth phase, like in Indonesia. Therefore, a similar study on this topic in Indonesia will make a significant contribution of theoretical and practical interest.

RESEARCH QUESTIONS

This study investigates the relationship of process choice with the implementation of manufacturing technologies and management initiatives to overcome the trade-off of competitive priorities in the Indonesian manufacturing industry. The propositions related the trade-off focus on three research questions as the following:

1. Is there compatibility between the process choice and selected competitive priorities?
2. Are the trade-offs resulted from competitive priorities requiring similar facilities easier to be eliminated?
3. Is the implementation of technology and management initiatives able to eliminate the trade-off of the selected competitive priorities?

RESEARCH FRAMEWORK

The result of previous research of Safizadeh al et. (1996) which then be renewed by Safizadeh al et. (2001) found that process choice determines type of trade-off among competitive priorities. Plants have to consider process choice to be applied because there should be compatibility between choice process with competitive priorities. Process-oriented plants are more appropiate to implement quality and customization, while product-oriented one should provide more emphasis on cost and delivery. Incompatibility between product structure and process structure will have negative impact to plant performance. The idea of Safizadeh al et. (2001) can be depicted graphically as Figure 1 below.

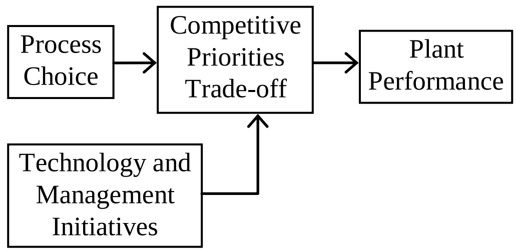
Figure 1. Framework of Previous Research

Source: Developed from Safizadeh et al. (1996) and Safizadeh et al. (2001).

Safizadeh al et. (1996) found evidence that the selection of product structure which do not appropriate with process structure can be overcome with certain technology such as modular design. Unfortunately, Safizadeh al et. (1996) did not formulate these variables into their research hypothesis. The next research conducted by Ahmad and Schroeder (2002) identified some variables can be used to overcome incompatibility between product structure and structure process and at the same time these technologies also facilitate plants to minimize trade-off. If plants were successful to minimize trade-off, plants can apply several competitive priorities simultaneously and lead to better performance. Conversely, the failure to minimize trade-offs deteriorates performance. The study of Noble (1995) found that plant will reach optimum performance using 4 competitive priorities simultaneously.

Technology and management initiatives influence do not effect process choice but they influece competitive priorities trade-offs resulted from process choice. By implementing them, a process choice has more similiraties than the difference. For example, product oriented process choice would be capable of producing a large number product with lower cost. Conversely, a process oriented one increase the degree of customization without sacrificing its low cost. The model of this research is described graphically as Figure 2 below.

Figure 2. Research Framework



LITERATURE REVIEW

A product-focused plant deploys automated and special-purpose equipment produced in very large volume. This kind of plants tends to be capital intensive with specialized labor skill. This production system bears high fixed cost but low variable cost. Production capacity in large volume enables plants to achieve economies of scale result in low product price. Heavy equipment, automated production system, and standardized product enable product-oriented plant to produce product in low cost and fast (Hayes and Wheelwright !978a).

In contrast, a process-focused plant is characterized with job shops producing low volume and customized product. Process-oriented plants employ multipurpose equipment, multi skilled labors, and jumbled-flow of production systems are able to produce various product characteristics come from different customers. Order variability inhibit process-oriented plant to produce as fast as process oriented plant since each order require different raw material, flow of production, type of and labor skill. But the positive side of this system is its ability to produce customized products that meet customers' order high degree of design quality. Based on explanation above, the following hypothesis are offered:

H1a: The higher plants emphasize on process, the higher the plants emphasize on quality.

H1b: The higher plants emphasize on process, the higher the plants emphasize on customization

H1c: The higher plants emphasize on product, the higher the plants emphasize on delivery.

H1d: The higher plants emphasize on product, the higher the plants emphasize on cost.

Trade-offs among competitive priorities requiring similar production facilities are easier to be minimized. For example, trade-off between quality and customization is much easier to be minimized than that between quality and cost. Both quality and customization are appropriate to be developed in proces-product oriented plant using multi-skill labor and multi-purpose equipment thus the plants suffer high unit product cost. This system has low utilization of facilities and extremely high variable cost (Heizer and Render 2001).

Oppositely, cost is appropriate to be developed in process oriented plant using automated production system operated by labors with a specific skill. An automated production system operates efficiently with high utililizatoin of facilities result in low product price and fast product delivery. A similar case occurs in product-focused plant where cost and delivery contradiction will be easier to be improved since both of them requiring process-oriented plant. The research expect trade-off requiring similar production facilities will no longer exist because of improvement efforts.

However, it is not impossible to eliminate trade-off requiring different production system. Safizadeh et al. (2000) found cost and quality trade-off is minimized despite they require different process choice to implement. This trade-off disappears because of improvement effort through quality program (Noble 1995). From the argument above, we propose hypothesis as follow:

H2a: There is a trade-off between cost and quality

H2b: There is a trade-off between cost and customization

H2c: There is a trade-off between cost and delivery

H2d: There is not a trade-off between quality and customization

H2e: There is not a trade-off between quality and delivery

H2f: There is not a trade-off between delivery and customization

Position outside diagonal reflects incompatibility between product structure and process structure. According to product-process matrix framework, product oriented production system, such as job shop and disconnected line flow, should produce in low volume with low standardization. By using multi purpose equipment and multi-skilled labor, this system capable of producing high quality and customized product. Conversely, continous flow is a very efficient process choice which can produce high volume product but it ignores customization. Incompatibility between product and process structure result in poor performance since they do not have competitive advantage (Hayes and Wheelwright 1979a). Recent research suggests that to be competitive plants do not have to be positioned inside or near the diagonal. Manufacturers' decision to be outside diagonal is a strategic choice to differentiate them from the other players in the industry (De Meyer and Vereecke 1996). This position can be successful, but success requires technology and management initiatives to overcome the incompatibility between product structure and process structure and minimize trade-offs.

Quality programs eliminate trade-off between quality and cost through reducing rework, scrap and process variance. Quality from the source principle of this program ensures to minimize process variance and product failure (Heizer and Render 2001). JIT principles such as waste elimination through the simplification of manufacturing process are able to minimize trade-off between delivery and cost (Flynn et al., 1995). CAD enables manufacturers to share database for all related function results in dramatic cost reduction. Computerize design allows designer to analyze various product without producing the prototype. This technology facilitates manufacturers to reduce trade-off between cost and customization (Heizer and Render 2001). We expect plants positioned off-diagonal product-process matrix implement these practice more intensively than those positioned on diagonal. Hence, we propose hypothesis as follow:

H3a: Plants positioned on upper product-process matrix diagonal implement technology and management initiatives more intensively than those positioned inside the diagonal.

H3b: Plants positioned on lower product-process matrix diagonal implement technology and management initiatives more intensively than those positioned inside the diagonal.

RESEARCH METHOD

Sample

Samples consist of plants from medium and large sized companies listed on Standard Trade & Industry Directory of Indonesia 2003 that were selected randomly as samples. These plants are categorized medium and big sized company with respect to asset capitalization. These companies have more financial resource to implement technology and management initiatives than those of the smaller one. The most dominant plant has greatest probability to contribute to overall business performance. In spite of strategic business unit, we select plant level as our unit of analysis.

A total of 217 questionnaires were sent to plant manager through mail survey followed by telephone interview. Of the total questionnaires, the response rate is 40.01 percent from 21 various industries at two-digit standard industry. Only two industry categories are not represented from a total of 25 industry categories. Statistical comparison using t-test to check non-response bias did not show any differences with respect to plant performance.

Variables

Corbett and Van Wassenhove (1993) argued that the use of several kinds management and technological initiatives could eliminate or at least minimize trade-off among competitive priorities. Ahmad and Schroeder (2002) classified these management and technological initiatives into four categories: processing technology, product design, management initiatives included JIT and quality program, and process choices. The definition of the variables is shown in Table 1 above.

To classify process choice from product oriented to process oriented, we employed non-hierarchical cluster analysis using two variables including orientation toward process (PROCESS) and orientation toward product (PRODUCT). PROCESS is measured with fixed sum scale with a total value of 100 classified into the following categories (in percentages with a total value of 100): highly customized, somewhat customized, standard with custom options, somewhat standardized and highly standardized. Similarly, respondents were asked to classify their PRODUCT into these categories (in percentages): one of a kind, small batch, large batch, repetitive/line flow, and continuous flow.

Table 1. Technology and Managerial Initiatives Operationanalization

Processing Technology	
VENDOR IN_HOUSE	We have a strong influence over the design of our process equipment Percentage of equipment purchased from vendor which was then modified for our use is ………%.
Product Design	
CUST_INV CON_ENG CAD COM_PART	Our customers are actively involved in the product design process. The tooling of new products is not started until the final design is completed. Years of use computer aided design (CAD) technology…..years. Percentage of common parts among all products……...%
Managerial Practice	
CONT_IMP QUAL_SUP QUAL_CUST JIT JIT_SUPP CUST_JIT	Continuous improvement of quality is stressed in all work processes throughout our plant. Quality is the number one criterion in selecting supplier. Quality is the number one criterion used by our customer in selecting us as supplier. We use JIT for daily control of operations. Our suppliers deliver to us on a just-in-time basis. Our customers receive just-in-time deliveries from us.

Note: Respondents were asked to respond the question using 5 points Likert Scale. Strongly Agree: 5, Agree: 4, Neutral: 3, Disagree: 2, and Strongly Disagree: 1.

ANALYSIS

Table 2. Factor Analysis

Factor	Cronbach α
Biaya	0.7358
Kualitas	0.8570
Pengiriman	0.7526
Kustomisasi	0.8660

As shown at Table 2 above, Confirmatory factor analysis with a Varimax rotation identified four competitive priorities with Cronbach α above the acceptance level of 0.70 (Cooper dan Schindler 2001). These four factors explain 76.675 percent of the overall variance while theother 23.235 percent are explained by unidentified factors.

We employed several criteria as suggested by Miller and Roth (1994) to analyze the feasibility of cluster analysis. The t-value of 0.000 suggests that both clustering variables contribute significantly to clustering process. The overall R^2 of 0.729 (above 0.50) is quite large suggesting that the four formed clusters are heterogeneous. Relative value of standard deviation within cluster to total standard deviation (15.677/110.410) is 0.142. The ralative value of standard deviation indicates the degree of homogenity of the member within the clusters. The lower the value, the higher the homogenity and the relative value of 0.142 suggesting that the member of the clusters are highly homogenous. Both of the clustering variables have R^2 value of 0.763 and 0.789 for PRODUCT and PROCESS respectively indicate that the clusters are well separated with respect to these variables.

Table 3. Cluster Analysis

Statistics	Value
t-value	0.000
Overall R^2	0.279
R^2 PRODUCT	0.763
R^2 PROCESS	0.789

Process Choice and Competitive Priorities

This study employed Spearman Correlation. Classification of process choice through cluster analysis results in four clusters varied from product oriented to process oriented. We label the most process oriented cluster as customized and the most product oriented one as standardized. To test hypothesis 1c and 1d, we assign score for each of process choice according to their sequence from process-oriented up to product-oriented one, e.g. standardized=1 and customized=4. We reserve the values of these scores as we test hypothesis 1c and 1d., e.g. standardized=4 and custom-mized=1. The correlation of the four factors and process choice are shown it Table 4.

Examining the correlation between quality and process choice (H1a), we found significant correlation as our expectation. This finding is similar to previous study of Miller and Roth (1994) which found that quality is the second highest rank competitive priorities after flexibility for job shop. Moreover, they also found that quality is the top competitive priorities for all other priorities. Unfortunately, this study does not examine the importance of quality across four process choices therefore we can not compare our result with theirs.

Consistent with the observation of Miller and Roth (1994) and Safizadeh et al. (2000), customization in our samples achieved through employing process-oriented plant. Customization loses its importance as process choice moves away from process-oriented toward product-oriented. This finding also confirms previous study of Safizadeh et al. (1996) who proved that product flexibility is the most important for job shops. Ward et al. (1998) also found that the importance of flexibility as competitive weapon increase when the process moves from continous flow to job shop. Even though customization and flexibility are two different constructs but they have strong relationship. A production system must be flexible enough to produce customized product (Corbett and Van Wassenhove 1993).

The ability to deliver product in timely manner is not considered important regardless of process choice (H1c). Theoretically, we expect delivery is important for product-oriented plants, which can produce a large number of products very quickly through heavy equipment and automation. One explanation of this phenomenon is fast delivery ignored because it is not considered as a good competitive weapon in product-oriented manufacturers. Delivery will be more important in process focused where customized products are produced based on order from customers so that on-time delivery is critical factor in this situation. In spite of the fact that the relationship is not significant, the direction of the correlation behaves as our expectation.

Highest correlation between cost and process choice indicates that minimizing product cost is the first criterion for manufacturers during process selection and product planning. This finding consistent with prior study (Ward et al. 1998; Safizadeh et al. 1996; Safizadeh et al. 2000) which found line flow is strongly linked to cost efficiency. Compared with sandcone model which suggests quality should has strongest correlation with process choice because it played as foundation for improving other capabilities, this finding seems contradictory.

Table 4. Correlation between Process Choice and Competitive Priorities

		Cost	Customization	Delivery	Quality
Process Choice	Corr. Coeff.	0.289	0.258	0.007	0.226
	Sig. (2-tailed)	0.010*	0.023*	0.950	0.047*

* Significant at 5% (2-tailed).

** Significant at 1% (2-tailed).

The direction and significance of the correlation between process choice and competitive priorities meet product-process matrix prescription. It also confirms previous study shows that plants need to develop very different infrastructures in order to excel on different dimensions of competitive performance (Flynn and Flynn 2000). Delivery is the only priority that does not has significant correlation with process choice (H1c) therefore Hayes and Wheelwright (1979a, 1979b) idea that process choice selection and product planning are linked together still has great relevance although it is not fully supported.

Competitive Priorities Trade-offs

To test hypothesis 2a until 2e, we employed Spearman Correlation then examined the correlation coefficients among capabilities to see whether they are traded-off or jointly emphasized. A positive correlation means parallel development of two capabilities while a negative correlation implies trading-off one capability for another. Table 5 below presents the correlation between capabilities.

As already noted at Table 4 above, among all competitive priorities cost has the highest correlation with process choice therefore it is not surprising to find cost contradict with both quality (H2a) and customization (H2b). This finding agrees with previous empirical study which found cost contradicts to others (Boyer and Lewis 2002). Flynn and Flynn (2000) also found cost still correlate negatively with quality and customization (flexibility) among World Class Manufacturing samples eventhough they applied quality program already. Quality construct we embrace in this study is only design quality, hence customer is paying higher prices for higher design quality. This trade-off is inherent when manufacturers decide to select product focused or process focused plant as their process choice (Safizadeh et al. 2000).

This positive correlation between quality and customization suggests that improving quality is accompanied with improving customization capability. This evidence agrees with previous study of Ferdows and De Meyer (1990) who found that quality which provides the foundation for other competitive priorities correlate positively with customization.

There is interesting evidence when examining delivery with other three capabilities. Why do the trade-offs of cost-delivery (H2c), quality-delivery (H2e), and customization-delivery (H2f) are not proved? From empirical evidence above, we found that delivery is ignored when choosing process choice. As a result, delivery does not have impact over other competitive priorities embedded in process choice. For instance, when selecting competitive priorities cost, quality, or customization, manufacturers do not evaluate whether their decision will have negative effect on delivery.

Table 5. Correlation among Competitive Priorities

		Cost	Delivery	Quality
Delivery	Corr.	-0.030		
	Sig.	0.793		
Quality	Corr.	-0.318	0.115	
	Sig.	0.004**	0.316	
Customization	Corr.	-0.298	-0.131	0.269
	Sig.	0.008**	0.252	0.017*

* Significant at 5% (2-tailed).

** Significant at 1% (2-tailed).

This evidence does not in line with previous research of Boyer and Lewis (2002) which shows that plants emphasize on delivery place a much lower emphasize on quality and customization. The similar case also occurs to delivery and flexibility.

The Implementation of Technology and Management Initiatives to Eliminate Trade-offs

The purpose of these hypothesis testing is to identify which of the technology and management initiatives may allow manufacturers to minimize trade-offs. We expect off-diagonal plants implement these variable higher than plants near or inside the diagonal matrix.

This research identify 32 plants select position near the diagonal, 24 plants far above the diagonal and 22 plants far below the diagonal. A plant is categorized as outside the diagonal if its distance is more than 50.[1] We compare the entire characteristics of the three groups plant to examine their effort to minimize trade-offs. The separation of plants positioned far above and far below diagonal brings us to special consequences. Plants below the diagonal tend to compete relatively more on consistent quality, leads time and responsiveness, and slightly more on price and technical performance. Conversely, plants above the diagonal focus more on market related advantages, such as product image, service, and also apparently innovativeness (De Meyer and Vereecke 1996). From these characteristics we find that plants above the diagonal are very similar with process-oriented plant while those below the diagonal are very close to product-oriented plant.

Table 6. Implementation of Technology and Management Initiatives Based on Position

Variables	Near Diagonal far below Diagonal		Near Diagonal far above Diagonal	
	T	Sig.(2-tailed)	T	Sig.(2-tailed)
VENDOR	-2.206	0.033*	-2.839	0.007**
IN_HOUSE	-1.372	0.177	-2.279	0.027*
CUST_INV	0.140	0.890	-2.321	0.024*
CON_ENG	-4.917	0.000**	-4.528	0.000**
CAD	-0.971	0.337	-1.447	0.154
COM_PART	-0.716	0.478	-1.635	0.108
CONT_IMP	-1.932	0.060	-1.423	0.161
SUPP_INV	-2.607	0.012*	-1.476	0.146
QUAL_SUP	-2.355	0.023*	-2.079	0.015*
JIT	-2.293	0.027*	-2.277	0.027*
JIT_SUPP	-4.093	0.000**	-2.417	0.019*
CUST_JIT	-1.537	0.131	-2.422	0.019*
PERFORMANCE	-1.779	0.082	-1.672	0.100

* Significant at 5% (2-tailed)
** Significant at 5% (2-tailed)

[1] This cut-off value for the bandwidth outside the diagonal was set based on the minimum value of variable PRODUCT and PROCESS. Both PRODUCT and PROCESS has minimum value of 100. Because the distance above and below the diagonal are equally important, the value of 50 represents the distance of a plant located on either side from the diagonal.

The vendors design processing equipment tend to be general and frequently do not fully meet the specific requirement of the manufacturers. To address this problem, off-diagonal plants customize the process through close relationship with vendor (VENDOR) or modify the equipment by them alone (IN_HOUSE). During modification, manufacturers can integrate two dissimilar functions, add new function, attach or eliminate unused part. In some cases, specialized equipment is a source of order winning criteria (Heizer and Render 2002; p. 251). Plants below the diagonal can not do this modification IN_HOUSE. It is not surprising since their equipment tend to be specific and vendors feel hesitate to share their knowledge. Quite often the vendors require manufacturers to sign a contract for continuity of equipment services so that manufacturers depend on the vendor for a long period of time.

This study includes customer involvement to ensure that product design process does not sacrifice customer specification (CUST_INV). The earlier customer involvement during product design, the higher the level of product customization (McCutcheon et al. 1994). We do not find CUST_INV in product design process for plants below diagonal because they rely on VENDOR only. Customer specification can be accommodated if VENDOR is combined with IN_HOUSE modification so that the equipment becomes more flexible. Another technique to accommodate customer specification is the use of modular design (MODULAR). MODULAR allows part of product to be made in high volume to reduce fixed cost by achieving economies of scale. MODULAR allows customizaton in lower cost by means of modifying the modules or adding features in the final stage of production (Duray 2002). Unfortunately, plants below diagonal do not implement this method either.

High significance values of simultaneous development process (CON_ENG) shows that the variable is important for all plants deviate from the diagonal to overcome misalignment between product design and process design function. This technique assists to reduce trade-offs related to delivery because it allows plants to produce in shorter time, reduce lead-time and response to customer faster by conducting several activities simultaneously (Herrmann and Chincholkar 2001/2002). Moreover, the advantages of this technique are higher for plants above the diagonal since their core competencies are responsiveness and lead-time (De Meyer and Vereecke 1996).

Theother method to cope with trade-off between cost and customization is the use of CAD which enables designer to investigates more potential problems, shortens product design phase, reduces cost, and allows a more rapid response to market. Centralized database allows related departments using the same information results in dramatic cost reductions (Heizer and Render 2002; p. 284). Unfortunately, this technology is not applied by all plant categories deviate from the diagonal.

Involvement of other parties such as supplier (JIT_SUPP, SUPP_INV) and customer (CUST_JIT, JIT_SUPP) is required to ensure that both quality program and JIT methods are applied holistically to gain optimal result (Vuppalapati et al. 1995; Sripavastu and Gupta 1997). Implementation of QUAL_SUP, JIT and JIT_SUP for all plants far from the diagonal indicates that these variables are appropriate under all plant categories. Implementing quality management practices through QUAL_SUP increase the predictability of process, while employing JIT internally and JIT_SUPP can streamline a production process under pull system (Flynn et al. 1995). All of these practices either applied individually or simultaneously assist the manufacturers to reduce cost, response customer more quickly and increase product quality. In short, these practices minimize trade-offs among cost, quality and delivery.

To accommodate the uncertainty in customers' order and fluctuation of production schedule, plants above the diagonal involve customer in JIT practice (CUST_JIT). Inventory can be reduced significantly through the use of linked data that enable production system connected to customer purchasing department (Chase et al. 2001; p. 407-408). Plants below the diagonal do not involve their customer in JIT practice because they are facing problem from various customer taste in low volume.

Plants below the diagonal involve supplier in production activity (SUPP_INV) to ensure the continuity of their production. A little suspension in these system causes manufacturers suffered huge loss because of high fixed cost of the system. The manufacturers need to guarantee that the materials are supplied as expected to ensure production activity run normally. Conversely, plants above the diagonal do not cooperate with supplier because of production schedule fluctuation. High degree of product variation and quick new product introduction foster this plant category to look for new alternative of raw materials. This group of plants assumes applying this variable is extravagance because of their difficulties to forecast their requirement accurately.

CONT_IMP and JIT result in synergies if applied together and therefore, applying both these two management initiatives minimize trade-off more effectively instead of implementing either one (Vuppalapati et al. 1995; Sripavastu and Gupta 1997). Despite our samples still implement them partially, they are able to minimize trade-off included quality-customization and quality-delivery, but trade-off between quality and cost remain exist. From this statistical result we can not refute the hypothesis that quality program facilitates the manufacturers to cope with trade-off between quality and cost. Most probably, manufacturers are still focusing on building capabilities other than cost, because cost should be built after all other capabilities attain a certain acceptable level (Ferdows and De Meyer 1990).

In general, our finding consistent with proposed hypothesis hence accept both H3a and H3b. Plants occupying off-diagonal positions implement technology and managerial initiatives higher than those on-diagonal to overcome trade-offs. These two groups apply slightly different approach to overcome trade-offs because the two groups emphasize different competitive priorities. Emphasizing different competitive priorities result in different types of trade-off they are facing.

CONCLUSION AND IMPLICATION

The findings of this study provide interesting answers to research questions mentioned in the beginning of this article. Manufacturers do not necessarily align their process choice with competitive priorities as suggested by Hayes and Whelwright (1979a). Recent emerging managerial practices and technology are useful to solve the problem concerning competitive priorities contradiction facing by the manufacturers. Technology indeed improves the performance of competitive priorities, but the manufacturers still have to make choice which one is the most important. However, Indonesian manufacturers are still implement these technologies partially so that they do not produce optimum result. Perhaps, most Indonesian manufacturers think the techologies are still too expensive to adopt.

Trade-offs resulted from competitive priorities requiring similar facilities easier to be eliminated. However, two type of trade-offs are remain exist involving cost-customization and cost-quality. These two types of trade-offs involves cost since cost is least important competitive priorities among manufacturers. This does not mean that technology and management initiatives are not succesful in improving cost performance. Trade-offs related to cost becauses manufacturers do not consider cost reduction is as important as other competitive priorities improvement. Perhaps this is one reason why Indonesian manufacturers' product found difficulities when compete with foreign product in international market.

The main limitation of this research is that we use cross sectional data. Cross sectional data only give us portrait at a particular point of time. We can not examine the dynamic nature of trade-off which is changing over time (Silveira and Slack 2001). Next research should be conducted longitudinally to observe the progress of improvement efforts. There is a probability that plants lack of strategic consensus between policy maker (manager) and the operator. To address this problem, next research should not rely on a single respondent only.

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