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Manufacturing Practices and Performances: A Malaysian Study

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The purpose of this study is to identify the most common manufacturing practices adopted by the Malaysian manufacturers, company performance factors and relationship between practices and performances. To fulfil the study objectives, 400 manufacturers were surveyed by a standard 400 questionnaire. Three research methodologies such as descriptive analysis, ANOVA and regression analysis have been employed in this study. The analysis revealed that Malaysian manufacturers focus on optimizing three critical performance factors: product development, less customer return rate and on time delivery (OTD). The most important competitive factor was found to be company reputation and design and manufacturing capacity is the least important factor. The findings also proved that manufacturing practices significantly influence company performances

Field of Research: Economics

1. Introduction

The tremendous technological change and the accelerating globalization of business have forced companies to look beyond cost and to emphasis speed, quality, agility and flexibility of their manufacturing facilities. Competitive advantage for many manufacturing companies now lies in their ability to effectively implement on-going product and process innovation, superior manufacturing, continuous improvement of quality and reliability (Q & R) of existing products and developing a continuous stream of new quality products (Yusuf, Gunasekaran, Adeleye, and Sivayoganathan, 2004).

The manufacturing sector plays an important role in the economy in many countries. For example, in Malaysia it is the single largest contributor to the economy (32%) and directly employs more than 29% of the total employment in the country and contributes 79% to the total exports (DOS, 1976-1995; MIDA 2005). Presently, the manufacturing

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sectors face heightened levels of competition in both the domestic and international markets.

Despite its spectacular achievements in the manufacturing sector, Malaysian manufacturers face several challenges. The main challenges are to improve competitiveness, quality and on time delivery (OTD) to global markets, while competing against imports from cheaper sources in the domestic market (Mahmood 2000). Malaysia has performed well on some of these measures of competitiveness, but there is certainly a lot more room for improvement.

The 1990s have seen the quality revolution spreading beyond manufacturing and many organisations are forced to change their old strategies and management styles and develop better ways to allocate available resources in order to remain competitive. Identifying manufacturers' competitive priorities and manufacturing practices is considered a key element in manufacturing strategy research (Ward, McCreery, Ritzman, and Sharma 1998). In this view, the authors have been motivated to conduct a study to identify the manufacturing practices/strategies considered important by Malaysian manufacturers in the changing circumstances and the impacts of these practices on the manufacturing performances.

The rest of the paper is organized as follows: the next section highlights the review of literature and an overview of the theoretical framework of this study and proposed hypotheses followed by the research methodology and the data analysis techniques adopted for this study. Section 4 presents the overall results of the study. Finally conclusions are drawn.

2. Literature Review

Competitive objectives are the goals sought by a manufacturing plant in terms of the set of values delivered to customers. Manufacturers usually focus on certain broad categories of competitive factors, namely: on-time delivery; product quality; customer satisfaction; employee morale; efficiency; cost; and product development (CIMA 1996; Ittner and Larcker 1998). Six competitive objectives that are more commonly discussed were compiled from the literature (Fliedner and Vokurka 1997; Yusuf, Gunasekaran, Adeleye, and Sivayoganathan, 2004; Kim, 1996). They are low cost, quality & reliability, on-time delivery, product customization (design and manufacturing capability), company reputation and marketing. This study expects that simultaneous attention to a wide range of competitive objectives will enhance the ability to attain in agile product development practices whilst also boosting manufacturing performance.

Incoming supply quality and long-term supplier management policies reflect a firm’s level of commitment to improve manufacturing quality (Leenders and Fearon, 1997). Early inclusion of suppliers in design teams is frequently cited as a key to success. Qualified suppliers must then be monitored periodically to ensure that they are keeping up with their quality assurance (Giunipero and Brewer, 1993). Long-term partnerships and technical assistance for supplier development should also be encouraged. Firms

with effective supply chain processes are more market sensitive, better capable of synchronizing supply with demand, and able to achieve shorter cycle times (Peitrucha, 1993).

Quality practices have a significant impact on manufacturing performance (Lai, 2003). However, the various dimensions of quality practices and their relationship with manufacturing performance have received less attention from the research community (Gupta, 2001). Several key techniques are common to this approach: (1) focusing on achieving robust, producible designs before production begins by requiring communication between key players; (2) using process controls to design products and control the production process as it occurs; and (3) establishing programs with key suppliers to ensure the quality of incoming material.

In principle any information required throughout a product's life can be managed by a PDM system, making correct data accessible to all people and systems that have a need to use them (Liu and Xu 2001). The benefits of this technology extend well beyond engineering design to include cost savings in manufacturing, reduced time to market and increased product quality, in addition to the benefits of reducing engineering design time (Philpotts, 1996). This is the path to better products, reduced costs, saved time, less scrap and less wasteful re-work.

Among all manufacturing strategies, continuous quality improvement comes to the forefront. Phillips, Chang, and Buzzell (1983) found that higher relative product quality has a direct positive influence on return on investment. Rho et al's survey (Rho, Corbett, and Adam 1994) showed that most respondent manufacturers considered product/service quality improvement as the first ranked strategy.

The major manufacturing goals are quality improvement, productivity enhancement, time management and cost reduction (Murugesh, Devadasan, Aravindan, and Natarajan 1997). For this reason, the general hypothesis being tested in this paper is that product quality and manufacturing performances of the companies are influenced by manufacturing practices like competitive factors, quality initiatives, supplier relationship, quality & reliability practices/techniques and product and field data management. The schematic diagram of relationship is presented in Fig. 1.

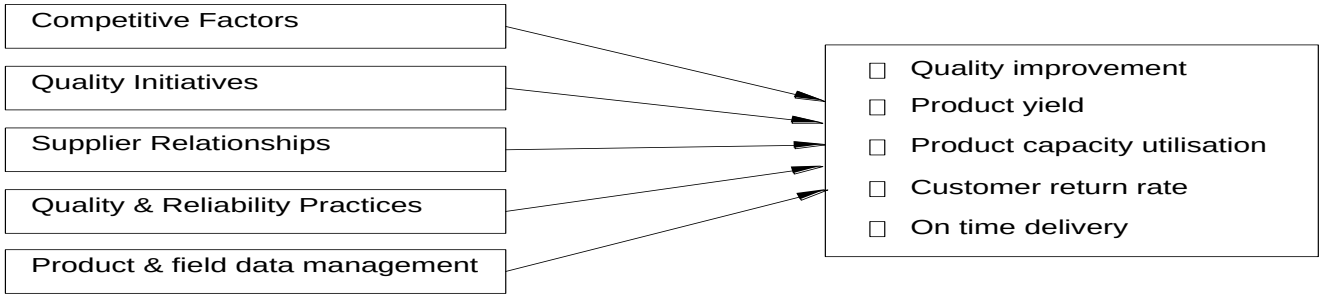

Figure 1: Theoretical framework

3. Methodology and Research Design

A questionnaire was designed with a view to collect data on the quality and reliability improvement model designed in the manufacturing industries. The questionnaire was based on the literature review and reviewed by two experts (one academics and a quality expert practitioner) asking about Q & R related activities, supplier relationship, product and field data management. The responses scale varied; most of the items were in likert scales (1-5 point scales), others were rankings, and some were requests for percentage estimates or counts. For items measured on 1-5 Likert scales, 5 represents strongly disagree, least important or strongly deteriorated whereas 1 implies strongly agree, most important or strong improvement. A 3 is represented as modest or neutral. Usage of the Likert scale facilitates the transformation of qualitative values into quantitative values. Quantifying the information-using mean weighted average values and using cumulative scores for each response will help indicate the level of each practice within and between companies.

A total of 400 manufacturers were randomly selected. Seventy responses were received for an overall response rate of 17.5%. Although the response rate was low but still better than or comparable with some other studies such as Koch and McGrath (1996) at 6.5%, and Gilgeous and Gilgeous (2001) at 15.4%.

Factor analyses were performed to develop items for the measurement of the manufacturing practices. This analysis has carried out to summaries the structure of a set of variables into a few principal factors that presented in Table 1. A widely practiced procedure to statistically determine the instrument reliability is the determination of Cronbach's coefficient alpha. Minimum α value of 0.60 for variables means that the variables are internally consistent and are good measures of the concept studied (Yusuf, Gunasekaran, Adeleye, and Sivayoganathan, 2004).

Table 1: The summary of factor analysis and the Reliability test of the constructs

VARIABLES	FACTOR LOADINGS (Using Principal Factoring)							
	Factor1	Factor2	Factor3	Factor4	Factor5	Factor6	Factor7	Factor8
Reduce the number of product recalls	.934							
Reduce warranty claim	.912							
Improve on time delivery	.907							
Improve the design of the product	.897							
Improve customer satisfaction	.889							
Process improvement	.846							
Mandatory requirement from customer	.829							
Improve product quality	.820							
Manufacturing people are aware about the product Q&R		.819						
All people involved in quality control know the quality target		.815						
Customer requirements are carefully reviewed before starting		.790						
The organization has a written quality policy		.743						
Organization currently has a program to assess & monitor the		.513						
Supplier use information to improve their product quality			.878					
Organization is benefited from the feedback from the supplier			.706					
Supplier rating continuously updated.			.673					
Effective information exchange between organization and			.551					
Incoming parts are inspected and results are recorded			.453					
Design and manufacturing capacity				.716				
Company reputation				.682				
Product quality and reliability				.577				
On time delivery				.499				
Customers are encouraged to provide feedback					.719			
Field failure and/or warranty claim data in collected and					.633			
The database is regularly updated					.614			
Design and quality control people have access to the					.523			
All contacts are systematically reviewed						.721		
Effective communication between design engineer and quality						.698		
Organization is aware of customer requirements and priorities						.560		
Quality of products in last two years							.765	
Customer return rate							.561	
On time delivery							.489	
Difficulties with product reliability								.762
Difficulties with manufacturing process								.718
Difficulties with failure analysis								.626
Difficulties with product development and design.								.530

Eigenvalues	7.231	3.937	3.186	3.096	2.779	2.480	2.300	2.093
Cumulative (%)	12.468	19.256	24.749	30.087	34.879	39.155	45.458	53.229
Cronbach's α	.965	.863	.830	.813	.800	.731	.633	.601

4. Discussion of Findings

While the central interest is to investigate the current manufacturing strategy and practices and establish relationship between the best practices and manufacturing performances, this section begins with the profiles of the responding companies. It then discussed several key findings. As described earlier, the survey instrument was split into a number of sections. Mean value and standard deviation for each question are presented with interesting features of the results being described, along with significant any differences between the performers and non-performers of these practices via an ANOVA test.

For manufacturing organizations in Malaysia, organizations with <$10million revenue and 5-50 full time employees are regarded as small businesses, $10 - $25 million revenue and 51-150 full time employees as medium and >$25 million revenue more than 150 full time employees as large (SMIDEC 2003). The distribution of manufacturers in terms of number of full time employees and annual revenue is presented in Table 2.

Table 2: The size of the manufacturing plants based on respondent's information

Question	Elements	Present study
No. of full time employee	5-50	8 (11.4)
	51-150	27 (38.6)
	150+	35 (50.0)
Annual Revenue	Less than10M	4 (5.7)
	10-25M	16 (22.9)
	More than 25M	50 (71.4)

Identification of competitive priorities (CF) of manufacturers in a contemporary situation is considered one of the key elements in manufacturing strategy. Manufacturers should carefully review their priorities to fulfil the demands of the current situation. However, relatively little effort has been devoted to measurement of these priorities in literature (Ward, McCreery, Ritzman, and Sharma 1998).

In this study, the respondents, mostly quality managers and other top executives were asked to rate the importance of a list of factors that impact the market success on a Likert scale ranging from 1 for strong agreement to 5 for strong disagreement. The results are presented in Table 3. In rank order Malaysian manufacturers placed company reputation as number one, product Q & R as number two, on time delivery as number three and design and manufacturing capability as number four. This can be concluded that company reputation is the main factor for success. It may not be surprising because it is generally true that company achieve good reputation mainly based on their product Q & R. This result is supported by the study of Karim, Smith, Halgamuge, and Islam (2006). Surprisingly, contrary to common belief, the Malaysian manufacturers do not consider price and marketing as important factor. There could be several reasons behind this. One of the reasons could be that, if the price was a factor

for the customers, they were already sourcing in cheap markets. Another reason could be that, the manufacturers already have adjusted price to a tight level and reached at the top-level marketing in the face of intense competition.

Table 3: Mean and Standard deviation for competitive factors

Variables	N	Mean	Std. Deviation
Company Reputation	70	1.0857	.40799
Product Quality & Reliability	70	1.1429	.51880
On time delivery	70	1.3430	.63441
Design & Manufacturing Capacity	70	1.3857	.76694

To place the results for Malaysia in a wider international context, a comparison was made with results from the world's leading industrial countries. Table 4 shows 50% of the leading manufacturers consider product Q & R as the main competitive factor and rest 50% considered company reputation as the main competitive factor. So it can be concluded that the world market is a battle of quality (and reliability).

Table 4: Comparison of competitive priorities (degree of importance)

Rank	US	Europe	Japan	Australia	Malaysia
1	Conformance quality	Conformance quality	Low price	Company reputation	Company Reputation
2	Product reliability	Product reliability	Product reliability	Product quality and reliability	Product quality and reliability
3	On-time delivery	On-time delivery	On-time delivery	Design and manufacturing capability	On time delivery
4	Low price	Low price	Fast delivery	On time delivery	Design and manufacturing capability
5	Fast delivery	Fast delivery	New products speed	Price	

In this section, the study shows how the above-mentioned competitive factors have contributed to the manufacturing performance. On-time delivery, customer return rate (of faulty products), and quality improvement in previous 2 years were considered as

performance measurement indices in this study (Table 1). An ANOVA analysis was carried out to establish the relationship between competitive factors and manufacturing performance as shown in Table 5. It can be seen that all performance measures except 'on time delivery' indicates the strong and significant relationships between competitive factors and manufacturing performances. So it can be ended that competitive advantages will reduce return of faulty products from customers as well as will improve product quality continuously.

Table 5: ANOVA relationship between manufacturing performance and QI

Manufacturing Performance	Relationship with	F	Sig.
Improvement in quality in previous 2 years	Competitive Advances	3.025	0.086
Customer return rate	Competitive Advances	2.892	0.008
On time delivery (OTD)	Competitive Advances	1.312	0.250

The respondents were requested to show the level of agreement to the quality initiatives (QI) listed in Table 6 between 1 and 5. The result indicates that mean values of all these quality initiatives are below 2 and are mostly around 1.7. This means that most companies in general either practicing or agreeable with the quality initiatives suggested in the questionnaire. This can be concluded that awareness of customer requirements and priorities is the main factor for quality initiatives.

Table 6: Mean and standard deviation for quality initiatives

Variables	N	Mean	Std. Dev.
Awareness of customer requirements and priorities	70	1.371	.618
Systematic review of contract	70	1.443	.629
Effective communication between design engineer and quality control team during design of a new product	70	1.743	.695

Now it is of interest how these quality initiatives have contributed to the manufacturing performance. From Table 7, it can be seen that all performance measures indicates the strong and significant relationships between quality initiatives and manufacturing performances.

Table 7: ANOVA relationship between manufacturing performance and QI

Manufacturing Performance	Relationship with	F	Sig.
Improvement in quality in previous 2 years	Quality Initiatives	4.099	0.047
Customer return rate	Quality Initiatives	3.943	0.051
On time delivery (OTD)	Quality Initiatives	2.822	0.098

The pattern of relationship cannot the understood from table 7. For this reason, a regression analysis has performed. Results showed that QIs are positively related to on time delivery and negatively related to customer return of faulty product (Table 8). This means that the companies who practice QIs have higher product quality and on-time delivery and lower customer return and warranty claims.

Table 8: Results of the regression analysis for Manufacturing Performance

Manufacturing Performance	Coefficient	"t" Value	Sig.
Improvement in quality in previous 2 years	0.29	2.024	0.047
On time delivery (OTD)	4.29	1.680	0.098
Customer return rate	-1.17	-1.986	0.051

Effective relationship with suppliers is one of the measures of advanced manufacturing practices. As reflected in Figure 2, Malaysian manufacturers place heavy emphasize (87.1%) on effective information exchange between the organization and supplier to improve product quality. In fact the supply of the quality parts by supplier is an important indirect effect of effective information exchange between the organization and supplier. It can be concluded that manufacturers' relationships with the suppliers are effective.

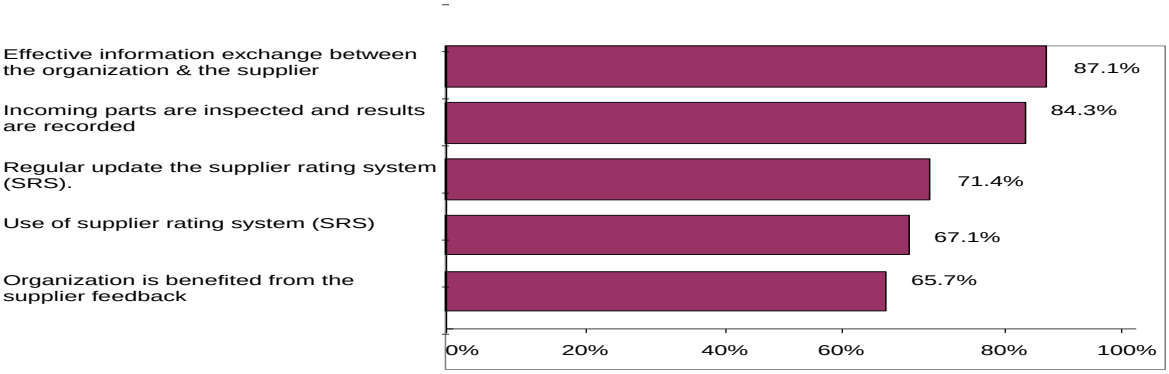

Figure 2: Adoption of supplier management practices

Adoption of Q & R practices/techniques by the manufacturers is presented in Table 9. It can be seen that mean values of all these Q & R practices/techniques are below 2 and are mostly around 1.2. This means that most companies in general either practicing or agreeable with the quality and reliability techniques suggested in the questionnaire. The manufacturers have strongly emphasized to carefully review of customers requirements before manufacturing their products. It can be concluded that Malaysian manufacturers' are very careful about customers' requirements and their product Q&R.

Table 9: Mean and standard deviation for quality and reliability practices/techniques

Variables	N	Mean	Std. Dev.
Customers' requirements are carefully reviewed before starting manufacturing.	70	1.028	.416
Manufacturing people are aware about the Q & R target	70	1.071	.519
All people involved in quality control know the quality target.	70	1.129	.541
The organization has a written quality policy	70	1.143	.582
The organization currently has a program to assess & monitor the Q&R	70	1.124	.624

Table 10 shows that other than on time delivery all performance measures indicate the strong and significant relationships between Q & R practices and manufacturing performances.

Table 10: ANOVA relationship between manufacturing performance and Q&R practices

Manufacturing Performance	Relationship with	F	Sig.
Improvement in quality in previous 2 years	Q & R practices	8.341	0.005
Customer return rate	Q & R practices	2.944	0.091
On time delivery (OTD)	Q & R practices	0.333	0.566

To understand the pattern of relationship a regression analysis has performed. Companies who practice suggested Q & R techniques managed to continuously improve the product quality (Table 11). Results showed that Q & R practices are negatively and significantly related to customer return of faulty product and positively related to on time delivery but not significant.

Table 11: Results of the regression analysis for Manufacturing Performance

Manufacturing Performance	Coefficient Value	"t" Value	Sig.
Improvement in quality in previous 2 years	0.412	2.888	0.005
Customer return rate	-1.046	-1.716	0.091
On time delivery (OTD)	1.535	0.577	0.566

Modern manufacturing is data driven. This study found that 92.9% manufacturers consider that regular database update is very important for improving product quality. Moreover, an ANOVA was carried between users and non-users of product and field data system. Results are presented in Table 12. It can be seen that in all dimensions of manufacturing performance measures companies maintaining a product and field data performed better than those who do not have such a data management. Users of PDM achieved significantly better performance in product reliability.

Table 12: Means and ANOVA significance for Product & field data management

Manufacturing Performance	Companies using PDM	Companies not using PDM	F	Sig.
Improvement in quality in previous 2 years	1.7	1.88	1.925	.167
Production yield rate	89	88	.219	.640
Customer return rate	1.68	3.33	4.272	.041
On time delivery (OTD)	86	80	3.008	.085

5. Conclusions

This study reported on manufacturing practices adopted by Malaysian manufacturers and their impact on performance. The results of the research support the basic assumption of the work, which states the improvement of practices ensure to reach superior level of performance. The companies surveyed showed that product quality & reliability and company reputation have come out as the main competitive weapons. More surprisingly product price has become a relatively unimportant factor to Malaysian manufacturers today. In fact the world market has become a battleground for quality and reliability. The study also found that manufacturing practices like competitive advantages, quality initiatives, supplier relationships, quality and reliability practices and

product and field data management are significantly influenced of manufacturing performance. These manufacturing practices should be considered as very important as all manufacturing performance indicators are correlated with them. The significant differences between well-performed and less performed companies were in the area of field data management (PDM) practices. This study has shown that majority of the manufacturers do not practice PDM to enhance customer satisfaction and timely delivery but PDM is found to be the excellent tools for customer satisfaction and timely delivery performance improvement.

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