CHAPTER 6

HYPOTHESES TESTING AND DISCUSSIONS

This chapter is divided into two parts. The first part outlines hypotheses testing of the study and the second part deals with the major discussions of the survey findings.

6.1 HYPOTHESES TESTING

The first hypothesis (H₁) focused on the current WCM practices, Key Business Priorities, Lean Initiatives, TQM Principles, IT Systems/Applications and Maintenance Practices that are considered to be most significant by the Chennai manufacturing firms for the effective implementation of WCMS. The second hypothesis (H₂) stated that the firms that undertake WCM efforts are also likely to adopt Key Business Priorities, Lean Initiatives, TQM Principles, IT Systems/Applications and Maintenance Practices for effective implementation of WCMS. According to Tables 4.1, 4.2, 4.3, 4.4, 4.5 and 4.6, the results are found to be very different from the mid-point 3.0. These results substantially support the first hypothesis (H₁) that the most of the modern WCM practices, Key Business Priorities, Lean Initiatives, TQM principles, IT Systems/Applications and Maintenance Practices were considered to be a key focus by Chennai manufacturers in their journey towards becoming world class. These results also support the second hypothesis (H₂) that the manufacturers who undertake the WCM efforts are likely to adopt most of Key Business Priorities, Lean Initiatives, TQM Principles, IT Systems/Applications and Maintenance Practices.
The third hypothesis (H₃) explored that there is an impact of WCM Practices, Lean Initiatives, TQM Principles and IT Systems/Applications on achievement of competitive advantage in operations performance of the firms and World Class Status (WCS). Results from Tables 4.17, 4.18, 4.19, 4.20, 4.21 and 4.22 show the research variables influence manufacturers’ attitudes toward achieving competitive advantage in the manufacturing operations and World Class Status (WCS) performance from the implementation of WCM practices, principles and techniques. Results from Tables 4.17, 4.18, 4.19, 4.20, 4.21 and 4.22 indicate that we can safely reject the null hypotheses (Hₒ) since the p-value for all the research variables was found to be less than 0.01. The β weights show that WCM Practices, Lean Initiatives, TQM Principles and IT Applications/Systems have a significant positive influence on competitive advantage of manufacturing operations and World Class Status (WCS).

The fourth hypothesis (H₄) focused on the association between WCM drivers and potential WCM principles and techniques implementation. A one-sample test was conducted to determine whether these observed means of the WCM drivers are significantly different from the mid-point 3.0. According to Table 4.10, the results are found to be very significantly different from the mid-point 3.0 (p<0.01). This confirms that all the WCM drivers are in the positive side and indicates that the basic drivers of WCM positively affect the implementation of the WCM principles and techniques by manufacturing firms in Chennai.

The fifth hypothesis (H₅) focused on the association between WCM barriers and potential WCM principles and techniques implementation. A one-sample test was conducted to determine whether these observed means of the WCM barriers are significantly different from the mid-point 3.0. According to Table 4.10, the results are found to be very significantly
different from the mid-point 3.0 (p<0.01). This confirms that all the WCM barriers are in the negative side and indicates that the basic barriers of WCM negatively affect the implementation of the WCM principles and techniques by manufacturing firms in Chennai.

The sixth hypothesis (H₆) was framed to test for a significant difference in the extent of WCM practices, principles and techniques considered to be a key focus for achieving world class status between SSEs and MSEs. Independent samples t-tests were carried out to investigate whether the observed means of the research variables (i.e., WCM Practices, Lean Initiatives, TQM Principles, IT Systems/Applications and Maintenance Practices) are significantly different between small scale and medium scale enterprises. According to Tables 4.23, 4.25, 4.27, 4.29 and 4.31, the results are found to be very significantly different in the most of the research variables considered to be a key focus in the journey towards becoming world class by small scale and medium scale enterprises. This would indicate that the mean responses of WCM practices, principles and techniques implemented by medium scale companies are better than that of the small scale companies.

The seventh hypothesis (H₇) was framed to test for a significant difference in the extent of WCM practices, principles and techniques considered to be a key focus for achieving world class status between MSEs and LSEs. Independent samples t-tests were carried out to investigate whether the observed means of the research variables (i.e., WCM Practices, Lean Initiatives, TQM Principles, IT Systems/Applications and Maintenance Practices) are significantly different between medium scale and large scale enterprises. According to Tables 4.24, 4.26, 4.28 and 4.30, the results are found to be very significantly different in the most of the research variables considered to be a key focus in the journey towards becoming world class by
medium scale and large scale enterprises. This would indicate that the mean responses of the WCM principles and techniques implemented by large scale companies are better than that of the medium scale companies.

The eighth hypothesis ($H_8$) was designed to test for a significant difference among demographic profile of the manufacturing companies with regard to the implementation of WCMS (i.e., WCM Practices, Lean Initiatives, TQM Principles, and IT Systems/Applications). ANOVA test was carried out to explore whether the observed mean responses of the research variables (i.e., WCM Practices, Lean Initiatives, TQM Principles, and IT Systems/Applications) are significantly different among the demographic characteristics of the manufacturing companies. According to Tables 4.33, 4.34, 4.35, 4.36, 4.37 and 4.38, the results support the eighth hypothesis ($H_8$) that there exists a significant difference between the demographic characteristics of the Chennai manufacturers and the research variables they considered to be a key focus in the journey towards becoming world class.

The ninth hypothesis ($H_9$) was framed to test whether a significant difference on the achievement of competitive advantage existed between small, medium and large scale Chennai manufacturing plants from the applications of WCM Principles and Techniques. ANOVA technique was carried out to investigate whether the observed mean responses of the competitive indicators are significantly different among the small, medium and large scale manufacturers. According to Table 4.39, the results support ninth hypothesis ($H_9$) and they were found to be very significantly different in the achievement of competitive advantage by the small, medium and large scale manufacturers.
6.2 DISCUSSIONS

Having described the survey results, this section attempts to present a broad evaluation of the current status of WCMS amongst Chennai manufacturers. The findings are anticipated to satisfy the following questions.

a) What have been the most accepted WCM practices, principles and techniques implemented so far?

b) Which of the research constructs have the highest degree of practice in the journey towards becoming manufacturing excellence?

c) How do the findings on the level of WCM practices, principles and techniques compare with the results from previous research?

When respondents were asked to check up the most important attributes of the world class manufacturer, the responses obtained in this regard present that product quality improvement, having a culture of continuous improvement throughout the whole company, improving efficiency and productivity of the organization, responding quickly to the changing needs of its customers, empowering employees to be involved and take responsibility, following lean manufacturing principles, the most efficient factory layout and production processes, having a fully integrated supply chain and bringing new products to market regularly and quickly were found to the most significant attributes of a world class manufacturer.

These results of the study are consistent with the findings from previous research done by Anand Sharma (2005). The survey findings, however, show that the importance of certain attributes is shared by many. Product quality was the single most common response, being selected in the top three by two thirds of respondents. Over half also felt that continuous improvement and rapid response to customers should be in the top three
attributes. Almost half selected employee empowerment. Lean manufacturing was being considered most important by a quarter of respondents. The fact that the majority chose individual aspects of the whole suggests that manufacturers still have rather a narrow view of what constitutes world class. The findings of this study also support and confirm the results of previous research conducted by Schonberger (1986), who stated that management of product quality, workforce participation, lean production, continual and rapid improvement, plant organization, employee training and education, supplier and customer relations, product design and equipment maintenance have been recognized as most critical success factors for the survival and prosperity of world class manufacturing firms.

The results of this study indicate that the Chennai manufacturers were found to have implemented at least any one of WCM practices, principles and techniques at least one year ago. Nevertheless, they still have a view of what constitutes world class. When asked about their extent of implementing the WCMS, 'just-in-time delivery from suppliers was one of the lean practices implemented by the Chennai manufacturing firms. This result is consistent with the findings of Green and Inman (2005), Kros et al (2006) and Mistry (2005) studies. They say that JIT philosophy and associated practices are alive and well within the manufacturing sector. Furthermore, the most modern WCM practices to emerge in the 1990s were considered as the most performed by the Chennai manufacturers which mean that they are still dominated by the new world class theme of “mass customizations” as compared to the conventional style “mass production theme”. These findings indicate that the Chennai manufacturers are still in the race to meet the business excellence of the world class manufacturers. It can be concluded that awareness of new practices such as CAD, CAM, E-commerce, EDI, lean production, ERP, TPM, Six-Sigma, SCM, etc can guarantee that the Chennai manufacturers are not in the WTO ascension. In
other words, they are very close to the competitive advantage that can be acquired in the manufacturing world today.

In order to explore the extent of implementation of key lean initiatives in Chennai manufacturing industries, the respondents were asked to rate the level of adoption on each of the key lean practices considered to be a key in the journey of work class manufacturing. Among all of the lean manufacturing practices, kaizen (continuous improvement), removal of wasteful processes, kanban, just in time delivery from suppliers, Total Productive Maintenance (TPM) and six-sigma were found to be the most significant key lean practices that have been extensively implemented by Chennai manufacturers. This result corroborates with the finding of previous research done by Wong et al (2009), which highlights that the highest implemented lean practices in Malaysian electrical and electronics industries were found to be kaizen, 5S principle, JIT and TPM. Whilst, group technology or cellular manufacturing was the least adopted lean tool because it demands large investment in equipment and facilities. Furthermore, an empirical evidence to support our findings is also found in the previous study carried out by Norani et al (2010). The findings of the study revealed that the kaizen, 5S principle, and Just-In-Time (JIT) were the leading lean manufacturing practices.

The results of this survey also support the work of Flynn et al (1995), which suggests that the use of JIT practices leads to improved quality performance. JIT provides a potent means of finding quality problems, which can then be solved using quality management tools and approaches. This may also provide support for the proposition of Flynn et al (1995) that there is a common infrastructure which supports the successful implementation of both JIT and quality management practices. The practices suggested by Hayes and
Wheelwright (1984) may function most effectively as that infrastructure, providing the foundation for the use of quality management and JIT.

A study conducted by Eng and Yusof (2003) in Malaysia revealed that almost 37.5% of organizations have obtained ISO Certification, but 77% of the total respondents admitted that they have been involved in implementing TQM principles in their organizations. A study of Beskese and Cebeci (2001) in Turkey revealed that almost 75% of organizations there have ISO Certification. Nevertheless, those which were found to be actively implementing TQM principles constituted 30.3%, and the corresponding figure was 60% in Australian manufacturing companies (Mandal et al., 1999). A study of the Irish manufacturing industry reported 66% of its respondents having ISO Certification but only 19% of that have implemented TQM principles (Ismail and Hashmi 1999).

It is quite apparent nowadays that the implementation of the various quality initiatives can produce significant improvements in productivity and competitiveness in various organizations. When asked about the TQM principles that are focused to be the key in the journey of world class manufacturing, customer focus, management commitment, continuous process improvement, training and education and empowerment and teamwork performance management and employee involvement were rated among the top priorities by Chennai manufacturers. This result has concurrence with Eng and Yusof (2003) findings on Malaysian manufacturing firms. Based on this evidence, the results indicate that management leadership, continuous improvement system, education and training, employee participation, customer satisfaction and feedback, and supplier quality management were found to be the significant TQM principles implemented by manufacturing firms in Malaysia.
Statistical sampling and the quality awareness programme were also found to be the top five popular quality activities in Idris et al (1996) survey. However, both of these activities were found to be less useful for the Chennai manufacturers in this study because both were rated least implemented practices among Chennai manufacturers. Thus, the researcher feels that these findings ought to be highlighted to ensure that measures are in the need to be taken so that Chennai manufacturers will benefit from implementing these activities effectively.

Chennai manufacturing firms have shown a very keen interest in implementing TQM principles and the rate of registration for a quality system in Chennai manufactures is still quite good compared with the studies mentioned earlier. The findings of this study are examined by comparing these results with those from other countries to the closest possible criteria presented in questionnaire. Based on the survey results, it appears that 84.0% of the manufacturing firms studied had obtained a certified quality management system, while 16.0 % admitted that they had not obtained a certified quality management system.

Our survey results also validate and support the previous findings (Schroeder and Flynn 2001; Matsui 2002a,b; Schonberger 2007). They revealed that the survival and prosperity of Japanese manufacturers are achieved by their Japanese way of management such as Total Quality Management (TQM), Just-In-Time (JIT) Production, and Total Productive Maintenance (TPM). Quality management has been recognized as single most critical success factor in Japan’s manufacturing. Quality management in Japan is characterized as company-wide participation, emphasis on employees training, quality circles, quality diagnoses, statistical methods, and national-wide campaign. People from all levels of management and workers are
involved in the company-wide quality management or total quality management.

In an attempt to discover the importance of latest information technology, the respondents were asked about the IT Systems/Applications currently used by them in the journey towards becoming world class. The results of the survey revealed that design systems (e.g., CAD, CAE and CAA), Material Requirements Planning (MRP), Enterprise Resource Planning (ERP), Financial Management Systems (FMS), Electronic Data Interchange (EDI), HR or other back office systems, Customer Relationship Management (CRM), Product Data Management (PDM) were considered to be the most powerful IT applications currently implemented by the Chennai manufacturers.

This result concurs with the findings of Schonberger (1987), who used it to refer to many techniques and technologies designed to enable a company to match its best competitors. These techniques includes for example, Material Requirements Planning (MRP), Flexible Manufacturing System (FMS), Computer Aided Design (CAD), Computer Aided Manufacturing (CAM), Computer Integrated Manufacturing (CIM), Manufacturing Resource Planning (MRPII), Electronic Data Interchange (EDI), Electronic Commerce (EC), Enterprise Resource Planning (ERP), Customer Relationship Management (CRM), Supply Chain Management (SCM), Business Process Reengineering (BPR), Concurrent Engineering, and Manufacturing Resource Planning (MRP II). At the same time, the need to improve the “range and quality of services” relates to Chan and Swatman (2000) who found that IT developments are forcing organizations to be up-to-date in their use of advanced technologies regarding the production and delivery of speedy and high quality information, as well as facilitating greater
degrees of communication and integration across business units and external partners.

Competitiveness generally refers to the ability of a business organization to survive in a competitive marketplace by offering products or services that attract and satisfy customers (Fujimoto 2004). This study uses seven competitive performance indicators to evaluate the competitiveness of each manufacturing plant. Of these, quality improvement, affordable price, constant innovation, cost reduction, improvement of efficiency, delivery speed and flexibility in operations. This result is parallel with the previous research findings (Schroeder and Flynn 2001). For manufacturing organizations, the research findings portray that quality, cost, delivery, price, flexibility, innovation, and time are recognized as the core of manufacturing capabilities that leads to their competitiveness. These indicators have been widely use in WCM framework and other WCM studies to measure whether implementation of WCM principles and techniques can simultaneously improve different dimensions of competitive performance (Flynn et al., 1995; Cua et al., 2001; Matsui 2002b; Kaynak 2003).

The primary aim of the study was to explore the extent of WCMS implementation by manufacturing firms and its impact on the competitive performance of an organization. The study found, as predicted, that the WCM practices implemented by manufacturers have a direct impact on the competitive performance of the company. This is consistent with the findings from previous research (Hayes and Wheelwright 1984). The use of the WCM practices which Hayes and Wheelwright described was strongly related to competitive performance of the company. Furthermore, this relationship was robust to differences in measurement of competitive performance, with the WCM practices, principles and techniques significantly related to cost, quality–performance, product flexibility and volume flexibility. Thus, we
have concluded that Hayes and Wheelwright’s set of world class manufacturing practices have stood the test of time.

Considering the WCM drivers and barriers, the results of this study are consistent with previous studies such as Schonberger (1987), Feldman (1991), Ozatalay and Saad (1988), Rohan (1990), and Steudel (1992) who see that WCM implementation is driven by the never-ending needs of customers to look for better services and products. However, all WCM drivers are in the upper end of Likert scale. Similarly, the need to avoid losing market share to competitors is a key incentive, since this research has found that competitors’ use of the WCM and response to customers also has a strong, (driving) effect on the adoption of the WCM techniques.

Some of the significant results of studies conducted based on this project are shown in Sakakibara et al (1993), Flynn et al (1994), Flynn et al (1995), Schroeder and Flynn (2001), Matsui (2002a,b and 2007), and Phan and Matsui (2009). These results concern with some important aspects of manufacturing plants: quality, JIT production, information systems, information technologies, and technology development, manufacturing strategy, improvement, and performance.

To sum up, the Chennai manufacturing firms are driven to adopt the WCM principles and techniques because of the incentives or gains achievable through the use of these new techniques where advantages outweigh disadvantages regardless of the barriers that might decrease its use. Previous studies assist us to interpret the findings of this research and to identify areas for future study. Except for differences in terms of demographic profile of the manufacturing companies, most of the findings in this study were in tune with the previous research studies conducted across the world.