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The Impact of ISO 14001 on Production Management Practices: A Survey of Malaysian Wooden Furniture Manufacturers

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Abstract: A study was undertaken to evaluate the deterrents to the adoption of the ISO 14001, environmental management system and also analyze the transformation in production processes that had taken place among the certified companies in the Malaysian wooden furniture industry. The adoption of ISO 14001 environment management system among wooden furniture manufacturers in Malaysia is limited, primarily due to its high implementation cost as well as the low market demand. However, the ISO 14001 certified-companies value the cultural and technical manufacturing factors and hence, are inclined towards employee training for continuous improvement and high-technology application in furniture manufacturing. Further, the certified-companies are also focused on better product design, logistics services and environmental-friendly production processes, which leads to cost-effective manufacturing. Contrary to common belief, the adoption of ISO 14001 environment management system contributes towards cost competitiveness in wooden furniture manufacturing, which may encourage more manufacturers to adopt the system.

Key words: Environment management system, furniture, cost-effective, market-demand, environmental-friendly, continuous improvement

INTRODUCTION

With the growing environmental concern, the global wooden furniture manufacturing industry is forced to embark on environmental-friendly manufacturing practices, which is fast becoming a strategic marketing tool for furniture (Parikka-Alhola, 2008). Generally, the furniture manufacturing industry has been receptive to management tools that could increase productivity, such as Statistical Process Control (SPC), Total Quality Management (TQM) and Lean Manufacturing (LM). Increasing productivity has been the main driver of competitiveness in the price-sensitive furniture market (Ratnasingam and Ioras, 2003). With a recent rise in worldwide environmental awareness, these conventional management systems fall short of the needs of the increasingly environmental-conscious furniture customers (Bovea and Vidal, 2004). In this context, one of the most promising management tools that could address the environmental concerns is the ISO 14001, environmental management system (Kitazawa and Sarkis, 2000).

The ISO 14001 standard specifies a series of requirements that must be met by the Environmental Management System (EMS) of a company, that is, by the system used to organize and coordinate all the environmental activities and initiatives that the company develops. This standard is intended to be useful to those companies that wish to become involved with a more proactive environmental management and its implementation allows the company to obtain a certificate of compliance that recognizes that the EMS meets the established requirements. The ISO 14001 certification has reached high levels of popularity and the number of certified companies, especially in Europe and Japan, has increased significantly since its introduction in 1996 (Viadiu *et al*., 2006). Nevertheless, the linkages between the adoption of the ISO 14001 and the operational practices of the companies as well as the benefits derived from the system have remained an academic curiosity (Gonzales-Benito and Gonzales-Benito, 2005).

Malaysia being a large producer and exporter of wooden furniture is also under increasing pressure to adopt the ISO 14001, environmental management system (Ratnasingam and Ioras, 2003). However, the total number of certified companies was 35, which was less than 5% of the total number of furniture enterprises operating the

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country (Ratnasingam, 2006). Therefore, the reasons that deterred the adoption of the ISO 14001 among wooden furniture manufacturers in Malaysia warranted a study. Further, the extent to which the adoption of the ISO 14001 had transformed the production processes and operations among the certified companies is also of interest. Therefore, a study was undertaken to evaluate the deterrents to the adoption of the ISO 14001, environmental management system and also analyze the transformation in production processes that had taken place among the certified companies in the Malaysian wooden furniture industry. The findings of this study will be useful, as it provides information about the extent of which the use of ISO 14001 will bring out real environmental transformation of the furniture manufacturing enterprises.

MATERIALS AND METHODS

Direct interviews of 60 medium-sized (i.e., with an average workforce of 100) wooden furniture manufacturers in Malaysia were carried out between May-October in 2008. The samples (which included 30 ISO 14001 certified-companies) were selected based on the listing of the Malaysian Furniture Industry Council (MFIC) and their agreement to participate in the study was obtained, prior to the interview. The interview was conducted using a structured questionnaire, which was pre-tested in 15 companies in the Klang Valley in Malaysia, in order to remove possible ambiguities and confusions in the questions, as well as its structure and wording.

The questionnaire used had four parts. Part I of the questionnaire was applicable to non-certified companies only, while Part II and II were targeted at certified companies. Part IV was applicable to both certified and non-certified companies.

Part I required the respondents to choose the degree of agreement with 8 assertions referring to the deterrents that prevented their companies from adopting the ISO 14001, environmental management system. A six-point Likert scale from 1 (strong disagreement) to 6 (strong agreement) was used to ascertain the degree of agreement of the respondents. An even number of points was used to avoid neutral responses. This compels the respondents to position their companies, rather than choose the ambiguous middle point. The responses were analyzed and the factors that deterred the adoption of the ISO 14001, environment management system, among wooden furniture manufacturers, were ranked in the order of its importance.

Part II of the questionnaire required the respondent to choose the degree of agreement with 10 assertions referring to the implementation of 10 environmental-friendly operational practices. A six-point Likert scale from 1(strong disagreement) to 6 (strong agreement) was used. Principal components analysis of the 10 operational practices was performed in order to identify the underlying dimensions of the implementation of these practices and two factors with eigen-values higher than 1.0 which explained 60.3% of the variance resulted from this analysis, were identified. One of the factors with a high score was the factor, which suggested that the company thinks of employees as resources, instead as costs, considers their suppliers as collaborators and promotes dynamism and continuous improvement. This factor seems, therefore, to capture the more cultural side of manufacturing and was labeled as cultural manufacturing factor. The second factor mainly took in account the tools and techniques used in furniture manufacturing, such as CAD/CAM system, CNC system, etc. and were consequently labeled as technical manufacturing factor. Nonetheless, it must be taken into account that some practices cannot be strongly allocated to the factor in which they show the higher loading, because their loading on the other factor is not much lower. Thus, the labels given to the factors represent main trends and should not be interpreted in a strict manner.

Part III measured the implementation of environmental practices in the operational function of the furniture enterprises. It consisted of a broad list of environmental practices built from the previous studies by Handfield *et al.* (1997) and Bovea and Vidal (2004) and also from consultations with industrial experts. The respondents were asked to rate the degree of implementation of each of these practices on a six-point Likert-scale (1-not at all; only what the regulation/standard requires and 6-to a great extent; it has been the priority of the company). To identify the main dimensions explaining the implementation of the environmental practices, principal components analysis was applied and three factors with eigen-values higher than 1.0, which explained 67.5% of the variance, were obtained. The first factor primarily takes into account those practices related to the design of ecological furniture products, the second factor distinguishes the implementation of environmental practices in logistics/support processes and the third factor refers to the environmental transformation of the internal production processes. However, some factors do not clearly load on a single factor and hence, factor labels should only be viewed as representing major trends.

Part IV of the questionnaire required the respondents to provide the average values of processing wastage, rejection/rework rate, downtime loss and other operational inefficiencies related to the furniture manufacturing processes.

RESULTS AND DISCUSSION

Factors deterring wooden furniture manufacturers from adopting ISO 14001: Almost all the respondents (5.79) of the respondents reported that the high cost involved in the implementation of the ISO 14001 standard prevented their companies from the adopting the standard. This was followed by the lack of customer demand (5.43), no government regulation (5.25), the lack of government incentives (4.94) and the lack of trained personnel to implement and maintain the system at the companies (4.33), as the other reasons that deterred wooden furniture manufacturers from adopting the ISO 14001, environmental management system (Table 1). The results clearly suggest that the cost-benefit factor related to environmental management is not a pressing issue among wooden furniture manufacturers in Malaysia, which is parallel to the finding reported by Delmas (2002) and Gonzales-Benito and Gonzales-Benito (2005). It has been found that the furniture industry is the least sensitive to environmental requirements due to varied demands by the different market segments throughout the world (Delmas, 2002). Therefore, until sufficient incentives and market demand exist, the adoption of the ISO 14001, environmental management system among wooden furniture manufacturers in the country will be limited.

Adoption of advanced manufacturing practices among ISO 14001 certified wooden furniture manufacturers: Generally, ISO 14001 certified wooden furniture manufacturers showed high cultural manufacturing factor and technical manufacturing factor. Table 2 shows that these companies paid greater attention to employee training and were focused on continuous improvement, both from the perspective of the product as well as the manufacturing practices. As a result, these companies also showed greater willingness to adopt high technology production methods, which contributed towards better manufacturing practices. The results from this study support the notion that the adoption of ISO 14001 ensures that the company keeps in line with the latest and advanced manufacturing practices, as previously reported by Nakamura *et al*. (2001) and Morrow and Rondinelli (2002).

Table 1: Reasons that deter the implementation of ISO 14001 among wooden furniture manufacturers

Reason	Mean±SD
High cost of implementation	5.79±1.24
Lack of demand from customers	5.43±1.31
Not required by the law/government	5.25±1.31
Lack of government incentives	4.94±1.28
Lack of trained personnel to implement the system	4.33±1.57
Limited benefits to be gained	3.87±1.13
Lack of social responsibility	3.58±1.44
Lack of awareness	3.15±1.21

Adoption of environmental management practices among ISO 14001 certified wooden furniture manufacturers: The results shown in Table 3, suggest that ISO 14001 certified wooden furniture manufacturers are proactive towards undertaking environmental management practices. The practices adopted could be broadly divided into three major categories, namely; (1) product design, (2) logistics/support processes and (3) production processes. The product design factor was geared towards using certified wood resources, water-based coatings, formaldehyde-emission free adhesives, recycled fiber packaging and the reduced use of non-degradable materials. Such practices ensured that the furniture produced were environmentally-friendly and could be sold as green products in the environmentally conscious furniture market segments. On the other hand, the logistics or support factor was focused on using less-polluting transportation methods and aggressively adopting the 3R concept of reduce, reuse and recycle in the logistics/support processes. The production processes among ISO 14001 certified wooden furniture manufacturers employed high-technology equipments, which ensured lesser wastage and energy efficient. Further, the production planning and control functions focused on reducing wastage and rejections. At the same time, process design ensured built in quality which contributed to a more cost-efficient production process of acceptable quality levels.

Table 2: Principal component analysis of advanced manufacturing practices among ISO 14001 certified wooden furniture manufacturers

Elements of manufacturing practices	Mean±SD	Cultural	Technical
Employee training	5.28±1.19	0.728	0.144
Continuous improvement	5.15±1.24	0.735	0.165
Employee participation	4.93±1.21	0.710	0.179
Innovative product design	5.24±1.17	0.668	0.211
Total quality management	4.98±1.44	0.624	0.248
Collaboration with suppliers	3.85±1.31	0.613	0.515
Advanced manufacturing technologies (CNC)	4.75±1.24	0.315	0.644
CAD/CAM technologies	4.50±1.31	0.288	0.533
Computerized production planning (MRP)	4.15±1.35	0.244	0.635
Lean manufacturing (SPC)	4.38±1.21	0.194	0.801

Total variance explained 60.3% -Varimax orthogonal rotation. Greatest loading of each item appears in bold

Table 3: Principal component analysis of environmental management practices among ISO 14001 certified wooden furniture manufacturers

		Factor		
Environmental management practices	Mean±SD	1	2	3
Use of environmental-friendly materials and resources	5.32±1.21	0.895	0.256	0.188
Product design focused on waste and pollutant reduction during processing	5.13±1.37	0.815	0.312	0.207
Product design focused on reusability and recycling	4.69±1.24	0.737	0.219	0.170
Environmental criteria in supplier selection	3.41±1.31	0.552	0.805	0.355
Use of cleaner transportation methods	3.11±1.79	0.234	0.775	0.321
Recyclable or reusable packaging materials	4.14±1.09	0.403	0.724	0.220
Responsible disposal of waste and mill residues	4.88±1.39	0.261	0.697	0.323
Processing methods focused on waste, pollutants and energy reduction	5.41±1.21	0.317	0.278	0.884
Production planning and control focused on optimization and maximizing use of resources	4.89±1.44	0.412	0.256	0.835
Application of high-technology equipment to reduce waste and energy consumption	4.65±1.13	0.469	0.212	0.720

Total variance explained 67.5% - Varimax orthogonal rotation. Greatest loading of each item appears in bold. Factor 1: Product design, Factor 2: Logistics/support processes, Factor 3: Production processes

Table 4: Comparative cost-benefit from the adoption of ISO 14001 system

Manufacturing cost factor	Non-certified manufacturers	ISO 14001 certified manufacturers
Rough milling yield (%)	80	87.5
Rejection/rework rate in machining section (%)	15	5.0
Wastage in finishing operation (%)	10	7.0
Downtime loss (%)	15	8.0
Average quality problems (%)	10	5.0

Figures indicate average values

Against this background, it appears that ISO 14001 certified wooden furniture manufacturers are geared towards the production of environmental-friendly furniture, cost effectively. This result which is in line with the finding by Gonzales-Benito and Gonzales-Benito (2005) highlights the fact that contrary to common belief, the adoption of the ISO 14001 system contributes towards cost-effective furniture manufacturing processes. This is particularly important for wooden furniture manufacturers who are faced with increasing production costs and reducing profitability (Ratnasingam and Ioras, 2003).

Operational inefficiencies among wooden furniture manufacturers: The results of the survey reveal that ISO 14001 certified-companies had much lower operational inefficiencies than their non-certified counterparts. The application of high-technology equipments and environmental friendly production processes results could have attributed to the cost-effective operation, as suggested previously in this study. This finding provides ample evidence to support the argument that the adoption of ISO 14001 system among wooden furniture manufacturers leads to cost-effective manufacturing practices (Table 4). This finding is contrary to the common belief that adopting the ISO 14001 standard is not cost-beneficial, as the operational competitiveness gained may off-set the initial implementation cost. Gonzales-Benito and Gonzales-Benito (2005) have shown that the primary motivation for implementing the ISO 14001 in the manufacturing industries has been the anticipated cost-benefits and in this context, this study shows that adopting the ISO 14001 system does contribute toward economic benefits.

Industrial implications: The results of this study show that the high cost related to the implementation of the ISO 14001 environment management system, is the main reason that deter companies from adopting the standard. Nevertheless, those companies that are certified have reported positive cultural and technical manufacturing practices within their companies, which contributed towards cost-effective manufacturing of furniture. In this context, although the demand for environmental-friendly furniture is limited in the global market, the benefits of adopting environment management system are warranted as it paves the way for cost-effective manufacturing practices (Ratnasingam *et al*., 2008). This is particularly through for Malaysian wooden furniture manufacturers who must become more cost-competitive in order to overcome the competition from cheaper producing nations, such as China and Vietnam (Ratnasingam and Ioras, 2003). In this context, the government needs to provide fiscal and other incentives that will encourage the adoption of environment management system among wooden furniture manufacturers, which will in turn help alleviate the polluting and wasteful practices associated with the industry.

CONCLUSION

The adoption of the ISO 14001 environment management system among wooden furniture manufacturers in Malaysia, contributes towards continuous improvement and cost-effective manufacturing practices. Despite its current limited adoption, the cost-effective manufacturing practices that could be brought about by the environment management

system will serve as a strong motivation for non-certified companies to pay greater attention to the system. Further, the government could also encourage the adoption of the system through the provision of financial incentives that would improve the environmental-friendliness of the wooden furniture manufacturing industry.

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