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Concurrent Knowledge Sharing and its Importance in Product Development

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Abstract: Concurrent engineering and knowledge sharing are both competitive practices that help sustain cross-functional communication for improved product development performance. Concurrent engineering enables structured integrated design while knowledge sharing enables the ability of an organization to access knowledge. However, little is known about how these two approaches support each other in the product development process. This study aims to investigate the importance of concurrent knowledge sharing in product development with an emphasis on Malaysian electronics organizations. A total of 150 survey responses are collected and analyzed using reliability, correlations and multiple linear regression analyses. The results show that product development is significantly affected by concurrent knowledge sharing. A total of 53.3% of the variance in product development can be explained by the concurrent knowledge sharing variables. The correlation between concurrent product realization and product development is significantly higher than the other correlations ($R = 0.637$, $p < 0.001$) since concurrent product realization enables rapid product quality development through design time and lead time reduction. When all the variables were compositely tested against product development, the overall correlation increased ($R = 0.732$). These findings show that the support of knowledge sharing initiatives alongside concurrent engineering approaches can significantly affect product development performance. This study improves the understanding on the importance of concurrent knowledge sharing in product development which can help uncover strategies on how it can improve the electronics industry and support Malaysia's economy.

Key words: Knowledge sharing, concurrent knowledge sharing, concurrent engineering, electronics industry, product development

INTRODUCTION

One of the main reasons of why product development can fail, is due to the working culture of the organization that operates in functional silos (Cooke and Barnard, 2013). Although, it is evident that good communication within a product development project reduces the probability of errors or integration problems, development activities are still organized based on functional specialism (example: electronics manufacturing and product development activities) (Cooke and Barnard, 2013; Ng *et al.*, 2012a).

In association to the aforementioned issue, it was found that concurrent engineering can support multidisciplinary team values that share knowledge to enhance decision making and speed up product development processes (Addo-Tenkorang, 2011; Ng *et al.*, 2009a, 2010a, b). Studies also show that the facilitation of knowledge sharing and trust engenderment positively affects team effectiveness which can

eventually lead to improved product development performance (Lee *et al.*, 2010; Ng and Jee, 2011a, 2012a).

While, it is widely known that concurrent engineering is an organized approach for integrated design (Stark, 1998) and knowledge sharing is the ability of an organization to access to its own and other organization's knowledge (Cummings, 2003; Ng *et al.*, 2009b), little is known about how these two approaches support and complement each other in product development processes. Hence, this study aims to investigate how concurrent knowledge sharing (a combination of concurrent engineering and knowledge sharing) can be a competitive proponent for product development with an emphasis on Malaysian electronics organizations.

This outcome of study will help researchers and practitioners to understand the contribution of concurrent knowledge sharing in the product development processes of the Malaysian electronics industry. A better understanding of its importance in product development can help uncover new strategies on how it can further

accelerate Malaysia's economic growth and be a catalyst for the 10th Malaysian plan which aims to enhance the performance of the overall industry that includes the manufacturers, suppliers and end users.

CONCURRENT KNOWLEDGE SHARING

Concurrent knowledge sharing refers to the integration of knowledge sharing activities within simultaneous engineering processes (Cummings, 2003; Cummings and Teng, 2003; Ng and Anuar, 2011; Ng *et al.*, 2010c; Ng and Jee, 2011b). This philosophy basically emerged from the combination of concurrent engineering and knowledge sharing. Similar to concurrent engineering, concurrent knowledge sharing is a production management philosophy that is progressively receiving attention among manufacturing firms (Bogus *et al.*, 2005; Ng and Jee, 2011c, 2012b). In order to achieve the targeted and desired time-saving goals, concurrent engineering advocates concurrent, overlapped processes instead of sequential product and process design (Prasad, 1996).

In product development processes, knowledge sharing can act as a supporting initiative to concurrent engineering. Knowledge sharing promotes the sharing of ideas and information within and beyond the organization in order to create value and change the dynamics of the organization (Cummings, 2003; Ng and Jee, 2011d, 2012c, d; Norris *et al.*, 2003). Researchers suggest that knowledge sharing is a tool for promoting evidence-based practice, decision making, idea exchange and dialogue among researchers, policymakers and service providers (Ng *et al.*, 2011a; Tsui *et al.*, 2006).

Based on previous studies, there are basically four underlying variables encompassed under concurrent knowledge sharing which are cross-functional teams, concurrent product realization, incremental knowledge sharing and integrated project management (Ng and Jee, 2011a, 2012a, e, 2013).

Cross-functional teams: Cross-functional teams comprise of people who do tasks or projects to achieve a common goal (Fernandes *et al.*, 2005; Ng and Jee, 2012b; Ng *et al.*, 2012b, c). Cross-functional teams include people from all levels of the organization, such as project designers, hardware designers, engineers, purchasing executives, marketing executives, production executives and other technical experts (Fernandes *et al.*, 2005; Ng and Anuar, 2011; Ng and Jee, 2012c, d). In cross-functional teams, all team members from different functions simultaneously work together from the beginning to the end of the whole manufacturing process.

Cross-functional teams are an essential element in obtaining a competitive advantage in today's modern and rapidly changing world market (Wen, 1998). They help improve the transmission of knowledge and minimize the occurrence of major problems in the project (Barczak and Wilemon, 2001; Burke *et al.*, 2006; Ng and Jee, 2012e; Wen, 1998). Furthermore, they also help in reducing the time for decision making in the production process flow (Fernandes *et al.*, 2005). The preceding substantiations justify that cross-functional teams are potentially important in product development. Therefore, the hypothesis is proposed as:

- **H1:** There is a significant correlation between cross-functional teams and product development

Concurrent product realization: Concurrent product realization involves concurrent processes that occur across multiple disciplines and organizations (Prasad, 2000). It enables the rapid development of good quality products that attract customers and increase the organization's reputation in the competitive market (Gatenby *et al.*, 1994; Ng *et al.*, 2010d; Weber *et al.*, 1999).

Concurrent product realization significantly reduces the design time and lead time to produce the product (Ng *et al.*, 2011b; Ng and Jee, 2011c, 2012a; Prasad, 2000; Ragatz *et al.*, 1997). However, such concurrent processes in product realization can generate design conflicts among multiple life-cycle concerns (Prasad, 2000). The above mentioned substantiations suggest that although concurrent product realization is of paramount importance in production and product development, it may sometimes be a hindrance at the early stages of the development cycle which involves design. Therefore, the hypothesis can be proposed as:

- **H2:** There is a significant correlation between concurrent product realization and product development

Incremental knowledge sharing: Incremental knowledge sharing between Research and Development (R and D) groups and other team functions can lead to efficiently achieved project success since knowledge sharing within the organization and across organizations harnesses both incremental and radical product innovation (Andries and de Winne, 2013; Hansen, 1999).

With incremental knowledge sharing, the latest information on an organization's products can be shared immediately among team members of the supply chain in order for everyone to contribute ideas about the products on any of problems or design improvements

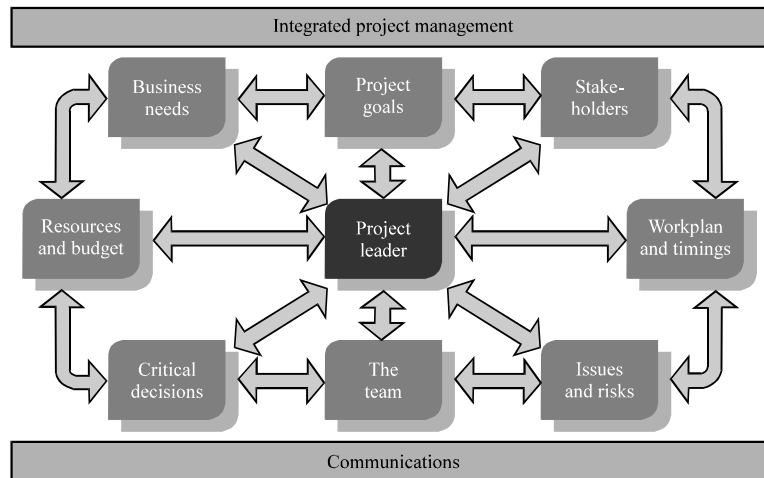


Fig. 1: Integrated project management model

(Andries and de Winne, 2013; Anumba *et al.*, 2000; Gold *et al.*, 2001). From the preceding statements, it can be hypothesized that incremental knowledge sharing can possibly be important to product development. Therefore, the hypothesis can be proposed as:

- **H3:** There is a significant correlation between incremental knowledge sharing and product development

Integrated project management: Project management can be integrated with forward visioning, commitment building, attention to people and attention to culture of change management (Hornstein, 2012). This integration enables the creation of integrated project management. Integrated project management involves the management of a project where a single leader (or project leader) is elected to head the entire project with several sections and functions reporting to him/her. Figure 1 illustrates a model for integrated project management where the leader is the center of the project and the other functions primarily support the leader and each other.

Integrated project management is basically a practice that aims to overcome organizational and departmental barriers in order for an organization to achieve completely integrated, enterprise-wide project management success (Barkley, 2006). From the aforesaid literature, it can be summarized that integrated project management can be important to product development. Therefore, the hypothesis is proposed as:

- **H4:** There is a significant correlation between integrated project management and product development

PRODUCT DEVELOPMENT

Product development is broad field of endeavors dealing with the design, creation and marketing of new products to fit the demands of customers and the market (Oliver *et al.*, 2004; Rouse, 2005). Sambandam (2013) suggests that a more straightforward way to understand product development processes would be to emphasize on idea generation, development of individual features, full product development and product testing.

Product development is a crucial process for the survival of firms, especially small businesses that are very dynamic and competitive (Adams, 2013). However, product development processes have the potential to be haphazard because of the inherent uncertainty in the processes, as well as the myriad methods available for product development (Sambandam, 2013).

With the help of concurrent knowledge sharing, organizations may be able to cultivate the most important ideas and information to be used in the product development and innovation (Ng and Anuar, 2011; Ng and Jee, 2011d, 2012b; Ng *et al.*, 2013; Partridge, 2013). Hence, the overall hypothesis is proposed as:

- **H5:** Product development is significantly affected by concurrent knowledge sharing

MATERIALS AND METHODS

Surveys were developed and sent to respondents through e-mail. The respondents of this study included executives from 10 major Malaysian electronics organizations. The respondents worked in job positions such as engineers, staff engineers, production executives,

business planners, engineering managers and quality managers. A total of 150 survey responses were collected back. The survey data were then analyzed using SPSS 19.

Statistical analysis: The statistical tests conducted were reliability, correlations and multiple linear regression analyses.

In the reliability analyses, Al Hujran and Chatfield (2008) suggested that if the alpha value is close to 1, the internal consistency of the data is considered high. Also, an alpha value that is above 0.7, signifies high reliability and good internal consistency (Cronbach and Shavelson, 2004; Nunnally and Bernstein, 1994).

RESULTS AND DISCUSSION

Table 1 presents the results of the reliability analysis of the product development and concurrent knowledge sharing variables. From the results, the alpha values obtained are all above 0.7. This signifies that the data is reliable enough for further analyses due to good internal consistency (Cronbach and Shavelson, 2004; Nunnally and Bernstein, 1994).

Table 2 shows a summary of the correlations analysis results. Based on Table 2, it appears that all of the individual relationships between the independent variables (CFT, CPR, IKS, IPM) and dependent variable (PD) are significant ($p < 0.001$). Table 3-6 present the individual correlations between the concurrent knowledge sharing variables and product development.

From the Table 3, the correlation between cross-functional teams and product development is significant ($R = 0.616$, $p < 0.001$). According to Fernandes *et al.* (2005), the function of cross-functional teams is to reduce the barriers of language, physics and thought. This allows cross-functional teams to improve the transmission of information within product development phases and help minimize the occurrence of major problems in the project.

Cross-functional teams also help reduce the time taken for decision making (Fernandes *et al.*, 2005) which is important to speed up product development. The significance in this relationship proves that H1 (There is a significant correlation between cross-functional teams and product development) is not rejected.

From the Table 4, the correlation between concurrent product realization and product development is significant ($R = 0.637$, $p < 0.001$). Concurrent product realization enables the rapid development of good quality products by reducing the design time and lead time in the production process (Gatenby *et al.*, 1994; Ng *et al.*, 2010f; Ng and Jee, 2011a; Weber *et al.*, 1999).

Table 1: Reliability analysis of the product development and concurrent knowledge sharing variables

Variables	Cronbach's Alpha	Significance (2-tailed)
Product development	0.883	0.000
Cross-functional teams	0.815	0.000
Concurrent product realization	0.814	0.000
Incremental knowledge sharing	0.771	0.000
Integrated project management	0.832	0.000

Table 2: Summary of the correlations analysis results

Variables	PD	CFT	CPR	IKS	IPM
PD					
Pearson Correlation, R	1	0.616*	0.637*	0.616*	0.533*
Significance (2-tailed)	-	0.000	0.000	0.000	0.000
N			150		

*Significance $p < 0.001$, CFT: Cross-functional teams, CPR: Concurrent product realization, IKS: Incremental knowledge sharing, IPM: Integrated project management PD: Product development

Concurrent product realization not only enables tools and techniques for successful product development but also encourages multidisciplinary team interactions in a concurrent engineering environment (Moustapha, 2006). The aforementioned substantiations prove that concurrent product realization is important for product development. Thus, H2 (There is a significant correlation between concurrent product realization and product development) is not rejected.

Table 5 show that the correlation between incremental knowledge sharing and product development is significant ($R = 0.616$, $p < 0.001$). According to researchers, incremental knowledge sharing between the R and D departments and other team functions can enhance the success of product development projects because the knowledge sharing across organizations harnesses both incremental and radical product innovation (Andries and de Winne, 2013; Hansen, 1999).

Besides that, sharing the latest information on newly developed products among various team members of the supply chain will allow everyone to contribute ideas about the products for any problems or design improvements (Andries and de Winne, 2013; Anumba *et al.*, 2000; Gold *et al.*, 2001). The preceding substantiations prove that incremental knowledge sharing is important for product development. Thus, H3 (There is a significant correlation between incremental knowledge sharing and product development) is not rejected.

Table 6 show that a significant correlation between integrated project management and product development ($R = 0.533$, $p < 0.001$). Since integrated project management involves the management of a single project leader in an entire project, more control and orderliness can be allowed in the product development team (Ng *et al.*, 2009c).

Table 3: Correlation between cross-functional teams and product development

Variables	Cross-functional teams and product development
N	150
Pearson correlation, R	0.616
Significance (2-tailed)	0.000

Table 4: Correlation between concurrent product realization and product development

Variables	Concurrent product realization and product development
N	150
Pearson correlation, R	0.637
Significance (2-tailed)	0.000

Table 5: Correlation between incremental knowledge sharing and product development

Variables	Incremental knowledge sharing and product development
N	150
Pearson correlation, R	0.616
Significance (2-tailed)	0.000

Table 6: Correlation between integrated project management and product development

Variables	Integrated project management and product development
N	150
Pearson correlation, R	0.533
Significance (2-tailed)	0.000

Table 7: Multiple linear regression analysis results for the effects of concurrent knowledge sharing on product development

Model	Concurrent knowledge sharing and product development
R	0.732*
R Square	0.536
Adjusted R Square	0.533
Std. Error of the estimate	0.32084

*Significance $p < 0.001$

By decreasing the uncertainty and haphazardness of the product development process through more control and clear-cut directions from the project leader, organizational and departmental barriers can be overcome easily (Barkley, 2006; Ng *et al.*, 2010e). This increases the possibility for the organization to achieve completely integrated, enterprise-wide project management success (Barkley, 2006; Ng and Jee, 2013). The preceding justifications prove that integrated project management is important for product development. Thus, H4 (There is a significant correlation between integrated project management and product development) is not rejected.

A multiple linear regression analysis was also carried out to test whether there is a significant statistical effect from concurrent knowledge sharing (which comprises of cross-functional teams, concurrent product realization, incremental knowledge sharing and integrated project management) on product development. Table 7 presents the multiple linear regression analysis results for the effects of concurrent knowledge sharing on product development.

According to the model summary, there is a significant correlation between concurrent knowledge sharing and product development ($R = 0.732$, $p < 0.001$). Based on the adjusted R^2 results, it was found that 53.3% of the variance in product development can be explained by concurrent knowledge sharing.

On the whole, concurrent knowledge sharing is important for product development. It allows the optimization of the product and process design to improve the quality of newly developed products (Evbomwan and Anumba, 1998; Ng and Jee, 2012c). This optimization enables products to be developed in a shorter time frame with simultaneous knowledge sharing and integration of manufacturing and design activities (Evbomwan and Anumba, 1998; Ng and Jee, 2011b; Ng and Jee, 2012d). The aforementioned rationalization substantiates that concurrent knowledge sharing is indeed important in product development. Hence, H5 (Product development is significantly affected by concurrent knowledge sharing) is not rejected.

CONCLUSION

From the correlations analyses, it was found that every variable that describes concurrent knowledge sharing is significantly correlated with product development. It was also observed from the multiple linear regression analysis that product development is significantly affected by concurrent knowledge sharing. Furthermore, 53.3% of the variance in product development can be explained by concurrent knowledge sharing.

Even though, all the correlations were significant, the correlation between concurrent product realization and

product development was found to be predominantly higher than the other correlations ($R = 0.637$). Since this survey was conducted among Malaysian electronics manufacturing organizations, the tendency of obtaining this result may have been due to the nature of electronics manufacturing organizations that emphasize on many levels of product development. The reason for this may be because of the dynamics of the firm that impel their development, process and production teams to release products ahead of the market demands.

When all the variables were compositely tested against product development, it was found that the overall correlation improved ($R = 0.732$). This, evidently, shows that with the support of knowledge sharing initiatives (such as incremental knowledge sharing and cross-functional teamwork) alongside concurrent engineering approaches, product development performance can be positively and significantly influenced.

It, perhaps, takes just a few delays to throw a whole development process off balance and disrupt the schedule to release a product on time into the market. In the uncertain and sometimes chaotic process of designing and developing new products, it is important to cultivate an efficient concurrent and cross-functional knowledge sharing culture to double ensure a more organized and smooth flow of development activities. An organization that manages to nurture a concurrent knowledge sharing culture among their employees can perhaps prevent major business losses due to time constraints, resources constraints, lack of creativity and innovation and poor product development performance.

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