Sharing Knowledge For Creative Product Development In A Malaysian Electronics Company

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ABSTRACT:

The purpose of this paper is to investigate the influence of knowledge management on creative product development in a Malaysian electronics company. Using a survey-based method, a total of 226 survey responses were collected back from product development personnel. These were then analyzed using reliability, linear regression and multiple linear regression analysis. It was found that combination had the strongest influence on creative product development. Despite the drawback in socialization's influence, it would be still be beneficial for this company to provide more room for socialization activities to enrich the idea generation for more creative product development performance. This study stresses on the applied mechanism of knowledge sharing in an electronics company with an emphasis on creative product development, which is important for other electronics companies to identify for a sustainable competitive advantage in the market. The findings suggest key implications for the practice and research concerning knowledge management and product development in companies and related initiatives.

Keywords*: Knowledge management, Malaysia, Sharing, Electronics.*

1. Introduction.

As new businesses begin to grow and advance, knowledge sharing activities are seen to become increasingly more important in developing strategic partnerships and boundary spanning activities (Quah, 2001). Companies that face difficulties in developing policies and organizing resources often turn to knowledge management practices to sustain their competitive advantage and innovativeness (Love and Roper, 2009).

Many countries such as Malaysia have made the move towards becoming a knowledge-based society as their primary national development goal (Baber, 2001). On the contrary, although many Malaysian companies claim that they are practicing knowledge management, few were successful mainly due to the fact that there appears to be no studies on the relationship between knowledge sharing practices and performance outcomes (Cong and Pandya, 2003).

In addition, literature search seems to indicate that little if any studies have been conducted on factors that promote or impede creative product development performance in companies from developing countries such as Malaysia. It was found that few studies have been carried out on the systemic effects of industrial practices such as knowledge management on creative product development performance in Malaysian companies today. Hence, the main objective of this paper is to investigate the roles of knowledge management in creative product development performance with the following developed hypothesis:

> *Hypothesis 1: Knowledge management influences creative product development in a Malaysian electronics company.*

In this empirical study, the factors that affect knowledge sharing behaviours among the engineers, managers and other executives of a Malaysian electronics company will be analysed and discussed.

The roles of all the knowledge management elements will be linked to creative product development performance by using statistical analyses methods such as reliability analysis, linear regression and multiple linear regression.

2. Literature Review

According to Thamhain (2004), successful product development is achieved through effective knowledge sharing among teams in very complex, uncertain and equivocal environments. This process requires the combination of knowledge management skills and the technology for better and productive management of activities in engineering design phases (Thamhain, 2004).

For this study, the sub-variables of knowledge management that are further discussed in the next section include socialization, externalization, combination and internalization. These knowledge management sub-variables are based on the SECI model by Nonaka and Takeuchi (1995).

2.1. Socialization

Socialization can be defined as the act of creating new tacit knowledge by relying on tacit knowledge sources through social interaction (Vaccaro et al., 2009). Socialization results in sympathized knowledge (Shared mental models, technical skills, and shared experience) and is usually driven through apprenticeship rather than documents or manuals (Nonaka and Takeuchi, 1995; Choi and Lee, 2002; Salmador and Bueno, 2007).

Through the socialization process, individuals can acquire tacit knowledge by observation, imitation and practice (Bolloju et al., 2002). Through socialization, individuals share experiences to understand one another and incorporate the others' feelings and beliefs in discussions (Linderman et al., 2004).

However, tacit knowledge is often a result from implicit learning, which is context-specific, personal and difficult to communicate (Mittendorff et al., 2006). Companies have to carefully transform aspects of tacit knowledge into explicit knowledge to avoid the loss in production efficiency and innovativeness (Gold et al., 2001). Nevertheless, excessively controlling socialization to quantify that knowledge could also limit the creativity in product development. Hence, the following hypothesis is proposed:

> *Hypothesis 2: Socialization influences creative product development in a Malaysian electronics company.*

2.2. Externalization

Externalization is defined as an act of codifying or converting tacit knowledge into explicit knowledge, characterized by more formal interactions (such as expert interviews) and activities (such as the documentation of lessons learned from a project) (Hoegl and Schulze, 2005). It occurs in the process of concept creation and is triggered by dialogue(s) or collective reflection (Choi and Lee, 2002).

The externalization process aims at diminishing the knowledge dependence among individual organization members, thus making knowledge independent from individuals (Berends et al., 2007). In new product development, externalization can make an abstraction tangible enough to be integrated, elucidated and disseminated as product design knowledge among design teams (Tseng and Huang, 2008).

Nevertheless, externalization processes are time consuming and not easily supported by existing communication technologies, causing them to remain largely based on face-to-face interactions or in documentation (Vaccaro et al., 2009). This reflects strongly on a company's creative product development performance. Thus, the following hypothesis is proposed:

Hypothesis 3: Externalization influences creative product development in a Malaysian electronics company.

2.3. Combination

Combination is defined as an act of creating new explicit knowledge by exchanging, merging, categorizing, reclassifying and synthesizing existing explicit knowledge held by individuals in a company (Bolloju et al., 2002; Vaccaro et al., 2009). Combination gives rise to systemic knowledge that can be used to create prototypes and new technological components (Nonaka and Takeuchi, 1995).

Combination involves collecting internal and external explicit knowledge from a company, combining them into a more structured manner and disseminating them among members of the company (Hoegl and Schulze, 2005). The formation of the more complex and systematic explicit knowledge by sorting, categorizing and re-contextualizing of its former form can be embodied into action and practice (Linderman et al., 2004; Li et al., 2009).

However, it may not be certain whether combination leads to efficient new product development or productivity improvement (Sapienza et al., 2004). There appears to be limited evidence on the effects of combination on creative product development performance. Therefore, the following hypothesis is proposed:

Hypothesis 4: Combination influences creative product development in a Malaysian electronics company.

2.4. Internalization

Internalization is defined as an act of converting an organization's explicit knowledge into individual and group level tacit knowledge (Vaccaro et al., 2009). Through internalization, individuals integrate shared explicit knowledge with their previous knowledge in order to update their mental models and produce new tacit knowledge (Bolloju et al., 2002).

Internalization occurs through re-experiencing what was learned, as is often the case in learning-by-doing (Linderman et al., 2004). Internalization leads to knowledge creation which can change the practice of understanding and doing things in a company and promote the actualization of new product development (Martın-de-Castro et al., 2008; Li et al., 2009).

However, the unwillingness to internalize knowledge among teams is a challenge when it becomes more costly and difficult to transfer knowledge from a company's headquarters to its subsidiaries (Li and Hsieh, 2009). This drawback in internalization restricts a company's creativity in product development. Hence, the following sub-hypothesis is proposed:

Hypothesis 5: Internalization influences creative product development in a Malaysian electronics company.

3. Creative Product Development

Understanding creative product development in a development team is of paramount importance, especially in the high technology industries where creativity is a key resource (Tu, 2009). Creative product development can be broken down into two components which include creativity and product development performance.

3.1. Creativity

Creativity is defined as a skill that can generate and translate ideas, talents and vision into a practical, new and useful external reality (Goel and Singh, 1998). Creativity is important in product

development because the starting idea is almost never commercialized until after some substantial and innovative modification or redesign (Stevens et al., 1999).

Ill-informed interventions, however, may also have a negative impact on team creativity and innovativeness, and ultimately on the quality and performance of the final product (Bonner et al., 2002). Also, there are times when paying too much attention to operational concerns and practicalities at a too early stage of a project can constrain the conceptual flexibility and creativity of a team (Olson et al., 2001).

3.2. Product Development Performance

Product development performance is defined as the level of successfulness in commercializing new products that involves the entire supply chain (Customers, suppliers, distributors, engineers and marketing executives) (Iyer et al., 2006). For a competitive product development performance, knowledge from many different specialists with extensive education and training is required to design and produce new products (Schmickl and Kieser, 2008).

However, high failure rates suggest that the management's knowledge on the transformation process (Where ideas are turned into successful new products) is far from perfect, particularly for more innovative development projects (Bonner et al., 2002). This shows that companies need to effectively understand and manage risks associated with developing new products since there is a persistently high probability of new product failure and large financial loss (Schmidt et al., 2009).

The abovementioned issues show that in order for companies to survive the dynamic changes in the current market, there is a need to integrate high levels of creativity in product development to expand a company's competency in developing highly complex and novel products. Figure 1 presents the proposed hypothetical research framework of this study.

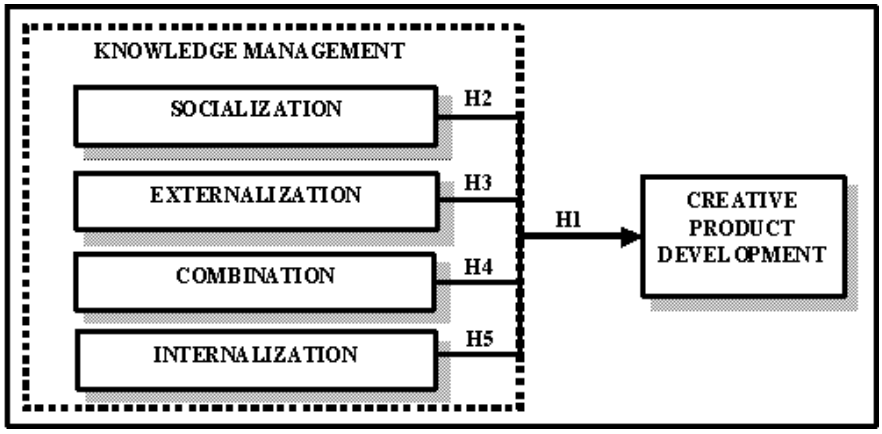

Figure 1: The Hypothetical Research Framework

4. Research Method

The selected company for this study started up in Malacca, Malaysia, at the year 1999. This company has about 43,000 employees worldwide. Out of that amount, 6000 of them are engaged in research and development. Besides Malaysia, this company also functions in Germany, Austria, France, Taiwan, Singapore and China.

Data provided by this company on projects since 2009 suggests that the company has 3000 projects in total. Due to turnover rates, transfers and resignations of project leaders, some projects are

discontinued. As a result, 2100 survey forms were handed out to all the product development managers and engineers in the company.

The unit of analysis was the product development personnel's respective projects in the company. A total of 6 weeks was used to gather the data. Overall, 226 usable surveys responses were collected back, which produced a response rate of 11%. The data was analyzed using the SPSS 18, a quantitative application used for multivariate analysis. The statistical methods utilized were reliability analysis, linear regression and multiple linear regression.

5. Results

Reliability analysis was used to determine the reliability of the survey items in this study. Table 2 presents the results of the analysis for all four sub-variables of knowledge management (Socialization, Externalization, Combination and Internalization) and creative product development.

Table 2: Reliability Analysis For Knowledge Management And Creative Product Development

iable	Cronbach's alpha, α	Number of items	Sources
owledge management	0.891	20	(Lee and Choi, 2003)
ialization	0.859	5	
ernalization	0.869	5	
nbination	0.897	5	
rnalization	0.883	5	
ative product development	0.766	8	(Lee and Choi, 2003; Tan and Vonderembse, 2006)

The reliability analysis results show that the Cronbach's alpha for every single component is adequately above 0.700, which signifies high reliability (Nunnally and Bernstein, 1994; Cronbach and Shavelson, 2004). These results provide evidence that the items in the survey instrument used for this study are reliable.

Linear regression analysis was used to evaluate hypotheses 2, 3, 4 and 5. Table 3 presents the results of the linear regression analysis to evaluate ***'Hypothesis 2: Socialization influences creative product development in a Malaysian electronics company.'*** An R^2 of 0.249 is reported with this regression analysis, indicating that 24.9% of the variance in creative product development can be explained by socialization. This relationship is considered to be moderately correlated due to the correlation coefficient calculated (R=0.499). Socialization establishes an importance towards creative product development with a reported β of 0.404. In addition to that, the model is significant as indicated by the ANOVA results of F (1, 225) = 74.444, p<0.001. Therefore, the influence of socialization on creative product development is positive and significant, and hypothesis 1 is not rejected.

Table 3: Linear Regression For Socialization – Creative Product Development

Predictor	β	Std. Error	t	F	R	R^2
(Constant)	2.495	0.185	13.500			
Socialization	0.404	0.047	8.628***	74.444***	0.499	0.249

(Notes: * p<0.05; ** p<0.01; *** p<0.001; N=226; Durbin Watson = 1.343)

Table 4 presents the results of the linear regression for ***'Hypothesis 3: Externalization influences creative product development in a Malaysian electronics company'***. An R^2 of 0.338 is reported with this regression analysis, indicating that 33.8% of the variance in creative product development

can be explained by externalization. The strength of the relationship is considered to be moderately correlated due to the correlation coefficient computed (R=0.582). Externalization establishes an importance towards creative product development with a reported β of 0.480. Additionally, the model is significant as indicated by the ANOVA results of F (1, 225) = 77.214, p<0.001. Therefore, the influence of externalization on creative product development is positive and significant. Hence, hypothesis 3 is not rejected.

Table 4: Linear Regression For Externalization – Creative Product Development

Predictor	β	Std. Error	t	F	R	R^2
(Constant)	2.129	0.184	11.574			
Externalization	0.480	0.045	10.704***	77.214***	0.582	0.338

(Notes: * p<0.05; ** p<0.01; *** p<0.001; N=226; Durbin Watson = 1.462)

Table 5 displays the results of the linear regression analysis used to evaluate ***'Hypothesis 4: Combination influences creative product development in a Malaysian electronics company'***. An R^2 of 0.419 is reported with this regression analysis, indicating that 41.9% of the variance in creative product development is explained by combination. This relationship is considered to be moderate due to the correlation coefficient (R=0.711). Combination establishes an importance towards creative product development with a reported β of 0.471. In addition to that, the model is significant as indicated by the ANOVA results of F (1, 225) = 161.306, p<0.001. Therefore, the influence of combination on creative product development is positive and significant. Hence, hypothesis 4 is not rejected.

Table 5: Linear Regression For Combination – Creative Product Development

Predictor	β	Std. Error	t	F	R	R^2
(Constant)	2.193	0.152	14.441			
Combination	0.471	0.037	12.701***	161.306***	0.647	0.419

(Notes: * p<0.05; ** p<0.01; *** p<0.001; N=226; Durbin Watson = 1.559)

Table 6 presents the results of the linear regression analysis used to evaluate ***'Hypothesis 5: Internalization influences creative product development in a Malaysian electronics company'***. An R^2 of 0.399 is reported with this regression analysis, indicating that 39.9% of the variance in creative product development is explained by combination. This relationship is considered to be moderate due to the correlation coefficient (R=0.631). Internalization establishes an importance towards creative product development with a reported β of 0.512. In addition, the model is significant as indicated by the ANOVA results of F (1, 225) = 148.548, p<0.001. Therefore, the influence of internalization on creative product development is positive and significant. Hence, hypothesis 5 is not rejected.

Table 6: Linear Regression For Internalization – Creative Product Development

Predictor	β	Std. Error	t	F	R	R^2
(Constant)	1.989	0.174	11.452			
Internalization	0.512	0.042	12.188***	148.548***	0.631	0.399

(Notes: * p<0.05; ** p<0.01; *** p<0.001; N=226; Durbin Watson = 1.670)

A multiple linear regression using the stepwise method was conducted to evaluate **'*Hypothesis 1: Knowledge management influences creative product development in a Malaysian electronics company*'**. The total amount of independent variables tested was four (Socialization, Externalization, Combination and Internalization) for hypothesis 1. Using the formula provided by

Tabachnick and Fidell (2001), the minimum sample size required would be 50 + (8 × 4) or 82 respondents. As such, the sample size criterion was met for this study.

Regression formulae are based on the assumption that residuals are normally distributed around the predicted dependent variable scores. For this study, normal probability plots were generated to test this. In the normal probability plots, since the points were in a reasonably straight diagonal line from bottom left to top right, it can be confirmed that there were no major deviations from normality (Tabachnick and Fidell, 1996; Pallant, 2005). For the normality test, the measure of kurtosis and skewness values for the variables tested were within the prescribed |1.0| range (Tabachnick and Fidell, 1996).

With the aforementioned assumptions satisfied, all of the four independent variables were regressed against creative product development and the results are summarized in Table 7.

Table 7: Multiple Linear Regression For Knowledge Management – Creative Product Development

Predictor	*β*	Std. Error	*t*	*F*	*R*	R^2
(Constant)	1.750	0.166	10.534***			
Combination	0.294	0.049	6.045***			
Internalization	0.286	0.054	5.287***	104.331***	0.695	0.483

(Notes: * $p<0.05$; ** $p<0.01$; *** $p<0.001$; $N=226$; Durbin Watson = 1.645)

During the stepwise multiple linear regression, it was found that two out of the four sub-variables of knowledge management (Socialization and combination) were automatically excluded from the further analysis. This was due to their insignificance ($p>0.05$) in terms of relationship with creative product development. The remaining sub-variables (Combination and internalization) which were found to be significant ($p<0.001$) were hence regressed against creative product development.

An R^2 of 0.483 is reported with this regression analysis, indicating that 48.3% of the variance in creative product development is explained by both combination and internalization. The relationship between the variables for hypothesis 1 is considered to be moderate due to the correlation coefficient obtained ($R=0.695$). In addition, the model is significant as indicated by the ANOVA results of F (4, 221) = 104.331, $p<0.001$. Table 7 presents the results of the analysis to assert that knowledge management makes a significant and unique contribution (with reported significance levels of less than 0.001) to creative product development. As such, it can be concluded that knowledge management influences creative product development, resulting in hypothesis 1 not being rejected.

6. Discussion

From the linear regression analyses of hypotheses 2, 3, 4 and 5, it is evident that all of the four modes of knowledge management (Socialization, externalization, combination and internalization have a positive and significant influence on creative product development. This finding is consistent with the fact that knowledge management does indeed help to foster successful product development and generates significant value to a company through its indefinable advantages (Liebowitz, 1999; Thamhain, 2004).

Also, from the linear regression analyses, it was found that the relationship between combination and creative product development is the strongest ($R=0.647$) among that of the other sub-variables. These findings indicate that this company practices extensive and systematic documentation of their standards and processes so that they can be embodied easily into trainings, workshops and projects (Linderman et al., 2004; Li et al., 2009).

The socialization aspect however, appears to be the weakest among the four modes in relation to creative product development (R=0.499), probably because this electronics company runs based on highly sequential and systematic manufacturing processes that are not only long by nature, but also complex. Thus, the management and staff may not emphasize much on capturing tacit knowledge to enhance creative product development. Instead, it may appear to be more important for the company to focus more on existing problems and backend technologies in their manufacturing processes.

In addition, the relative predictive importance of internalization towards creative product development was also found to be the highest (β=0.512), followed by that of externalization (β=0.480), combination (β=0.471) and socialization (β=0.404). This finding shows that it was also equally important for this firm to internalize their product development processes apart from combining them. Although it may not always be easy due to cost and location constraints (Li and Hsieh, 2009), converting combined and systemic knowledge into operational knowledge is essential for this firm to ensure that their policies, standards and procedures are put into practice.

Furthermore, upon using stepwise multiple linear regression to evaluate hypothesis 1, it was found that only combination and internalization were significantly correlated with creative product development. The socialization and externalization sub-variables were removed from the regression due to their insignificance in the overall relationship. This finding strengthens the preceding suggestion on the company's manufacturing strategy and processes which are geared towards solving existing problems and developing existing processes.

However, the relationship between all the sub-variables of knowledge management and creative product development appear to be only moderately correlated. This finding is consistent with the contingency theory, which suggests that there is no optimal, near optimal or uniformly efficient way in managing an organization (Galbraith, 1973). It is plausible that the dominance in complete effectiveness of knowledge sharing practices in this firm with respect to creative product development is muddied by other industrial practices such as total quality management, concurrent engineering or supply chain management.

7. Conclusion

In this study, it was found that the influence of combination on creative product development was the strongest in the company among the other sub-variables. This was most likely due to the company's efficient systems, documentation processes and standards. Apart from that, socialization proved to be the weakest influence among the four modes. However, in order to nurture creativity in product development, it would be wise for a company to provide more room for socialization activities to enrich the idea generation among employees. Thus, socialization activities in fact are not to be taken lightly, much less ignored in product development.

Also, from the overall multiple linear regression analysis, it was found that socialization and externalization were excluded due to their insignificance in the relationship. This may be because externalization activities are time consuming and socialization activities capture tacit knowledge which is cognitive and subjective. The company chosen for this study may need to identify various means such as coffee klatches or brown bag sessions in order to promote socialization activities that can enrich the shared information among employees.

Also, since externalization activities often tend to remain largely in face-to-face interactions, the company can actually make a compromise by investing in various communication facilities that cater for face-to-face meetings or social interactions. Access to various social networks such as Facebook, Rypple or Twitter should also be encouraged to promote a less structured and non-stressful environment, which in turn leads to creativity development.

The limitation in this study is the sampling method employed which limits the generalizing of this study beyond the context of this firm. Due to time and budgetary constraints, this study took on a case study approach in which it was only conducted within a large Malaysian electronics company. As such, the findings of this study needs to be interpreted within this context. Apart from that, a simultaneous modelling analysis in this study is not possible because the variables cannot be simultaneously tested against each other. This limits the possibility of discovering more relations among the dependent and independent variables.

In addressing the above, it is suggested as a future method, to conduct the study in as many electronics companies in Malaysia as possible. This certainly would allow generalizing the findings and hypotheses put forward in this study. Another suggestion is to conduct in-depth qualitative studies in each technology cluster or business unit of this company to further examine its organizational context for more in depth understanding on the role of knowledge management in creative product development.

In addition, a structural equation modelling (SEM) approach using a combination of statistical data and qualitative causal assumptions can be used in order to test and estimate causal relationships. AMOS software can be utilized for this analysis. Using this approach, the variables for this study are capable of being tested simultaneously instead of the conventional method where they are linearly tested with only one variable against another.

All in all, this study provided empirical evidence that knowledge management does indeed influence creative product development in a Malaysian electronics manufacturing company. In this study, socialization and externalization factors are found to be often overlooked in creative product development and deserve serious attention towards the progress and eventual success of product development projects.

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9. References

Baber, Z. (2001), The Emerging Triple-Helix of Science-Industry-University in Japan and Singapore, Bulletin of Science, Technology & Society, 21(5), 401-408.

Berends, H., Vanhaverbeke, W. and Kirschbaum, R. (2007), Knowledge Management Challenges in New Business Development: Case Study Observations, Journal of Engineering and Technology Management, 24(4), 314-328.

Bolloju, N., Khalifa, M. and Turban, E. (2002), Integrating Knowledge Management into Enterprise Environments for the Next Generation Decision Support, Decision Support Systems, 33(2), 163-176.

Bonner, J. M., Ruekert, R. W. and Walker, O. C. (2002), Upper Management Control of New Product Development Projects and Project Performance, Journal of Product Innovation Management, 19(3), 233-245.

Choi, B. and Lee, H. (2002), Knowledge Management Strategy and Its Link to Knowledge Creation Process, Expert Systems with Applications, 23, 173-187.

Cong, X. and Pandya, K. V. (2003), Km Issues in Public Sector, Journal of Knowledge Management, 1(2), 25-33.

Cronbach, L. J. and Shavelson, R. J. (2004), My Current Thoughts on Coefficient Alpha and Successor Procedures, Educational And Psychological Measurements, 64(3), 391-418.

Galbraith, J. R. (1973), Designing Complex Organizations, Addison-Wesley, Boston, Massachusetts.

Goel, P. S. and Singh, N. (1998), Creativity and Innovation in Durable Product Development, Computers & Industrial Engineering, 35(1-2), 5-8.

Gold, A. H., Malhotra, A. and Segars, A. H. (2001), Knowledge Management: An Organizational Capabilities Perspective, Journal of Management Information Systems, 18(1), 185-214.

Hoegl, M. and Schulze, A. (2005), How to Support Knowledge Creation in New Product Development: An Investigation of Knowledge Management Methods, European Management Journal, 23(3), 263-273.

Iyer, G. R., LaPlaca, P. J. and Sharma, A. (2006), Innovation and New Product Introductions in Emerging Markets: Strategic Recommendations for the Indian Market, Industrial Marketing Management, 35, 373-382.

Lee, H. and Choi, B. (2003), Knowledge Management Enablers, Processes and Organizational Performance: An Integrative View and Empirical Examination, Journal of Management Information Systems, 20(1), 179-228.

Li, C.-Y. and Hsieh, C.-T. (2009), The Impact of Knowledge Stickiness on Knowledge Transfer Implementation, Internalization, and Satisfaction for Multinational Corporations, International Journal of Information Management, 29(6), 425-435.

Li, Y.-H., Huang, J.-W. and Tsai, M.-T. (2009), Entrepreneurial Orientation and Firm Performance: The Role of Knowledge Creation Process, Industrial Marketing Management, 38(4), 440–449.

Liebowitz, J. (1999), Key Ingredients to the Success of an Organization's Knowledge Management Strategy, Knowledge and Process Management, 6(1), 37–40.

Linderman, K., Schroeder, R. G., Zaheer, S., Liedtke, C. and Choo, A. S. (2004), Integrating Quality Management Practices with Knowledge Creation Processes, Journal of Operations Management, 22(6), 589–607.

Love, J. H. and Roper, S. (2009), Organizing Innovation: Complementarities between Cross-Functional Teams, Technovation, 29(3), 192-203.

Martın-de-Castro, G., Lopez-Saez, P. and Navas-Lopez, J. E. (2008), Processes of Knowledge Creation in Knowledge-Intensive Firms: Empirical Evidence from Boston's Route 128 and Spain, Technovation, 28(4), 222-230.

Mittendorff, K., Geijsel, F., Hoeve, A., Laat, M. d. and Nieuwenhuis, L. (2006), Communities of Practice as Stimulating Forces for Collective Learning, Journal of Workplace Learning, 18(5), 298-312.

Nonaka, I. and Takeuchi, H. (1995), The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation, Oxford University Press, New York.

Nunnally, J. and Bernstein, I. (1994), Psychometric Theory, McGraw-Hill Publication, New York.

Olson, E. M., Walker, O. C., Ruekert, R. W. and Bonner, J. M. (2001), Patterns of Cooperation During New Product Development among Marketing, Operations and R&D: Implications for

Project Performance, Journal of Product Innovation Management, 18(4), 258-271.

Pallant, J. (2005), Spss Survival Manual: A Step by Step Guide to Data Analysis Using Spss Allen & Unwin, NSW.

Quah, D. (2001), The Weightless Economy in Economic Development, Information Technology, Productivity and Economic Growth: International Evidence and Implications for Economic Development, M. Pohjola, Oxford University Press, Oxford.

Salmador, M. P. and Bueno, E. (2007), Knowledge Creation in Strategy-Making: Implications for Theory and Practice, European Journal of Innovation Management, 10(3), 367-390.

Sapienza, H. J., Parhankangas, A. and Autio, E. (2004), Knowledge Relatedness and Post-Spin-Off Growth, Journal of Business Venturing, 19(10), 809–829.

Schmickl, C. and Kieser, A. (2008), How Much Do Specialists Have to Learn from Each Other When They Jointly Develop Radical Product Innovations?, Research Policy, 37(3), 473-491.

Schmidt, J. B., Sarangee, K. R. and Montoya, M. M. (2009), Exploring New Product Development Project Review Practices, Journal of Product Innovation Management, 26(5), 520-535.

Stevens, G., Burley, J. and Divine, R. (1999), Creativity + Business Discipline = Higher Profits Faster from New Product Development, Journal of Product Innovation Management, 16(5), 455-468.

Tabachnick, B. G. and Fidell, L. S. (1996), Using Multivariate Statistics, HarperCollins College Publishers, New York.

Tabachnick, B. G. and Fidell, L. S. (2001), Using Multivariate Statistics Allyn and Bacon, Boston.

Tan, C. L. and Vonderembse, M. A. (2006), Mediating Effects of Computer-Aided Design Usage: From Concurrent Engineering to Product Development Performance, Journal of Operations Management, 24(5), 494-510.

Thamhain, H. J. (2004), Linkages of Project Environment to Performance: Lessons for Team Leadership, International Journal of Project Management, 22(7), 533-544.

Tseng, T.-L. B. and Huang, C.-C. (2008), Design Support Systems: A Case Study of Modular Design of the Set-Top Box from Design Knowledge Externalization Perspective, Decision Support Systems, 44(4), 909–924.

Tu, C. (2009), A Multilevel Investigation of Factors Influencing Creativity in Npd Teams, Industrial Marketing Management, 38(1), 119-126.

Vaccaro, A., Veloso, F. and Brusoni, S. (2009), The Impact of Virtual Technologies on Knowledge-Based Processes: An Empirical Study, Research Policy, 38(8), 1278–1287.

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