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The Product Success through the Integration Between Procedural and Technology Knowledge of Production

By

Mariam Ibrahim Hamood Al Karaawi
School of Administration and Economics, University of kufa, Najaf, IQ
Email: Mariama.hamood@uokufa.edu.iq

Hadeel Mohammed Ali Al-Qamousi
School of Administration and Economics, University of kufa, Najaf, IQ
Email: hadeelm.alqamousi@uokufa.edu.iq

Zaid AbdulZahra Jaffar
School of Administration and Economics, University of kufa, Najaf, IQ
Email: zaida.ali@uokufa.edu.iq

Abstract

The purpose of this study is to investigate how technological knowledge (TK) and procedural knowledge (PK) influence the overall success of a product (PS). Without information, a product will never be able to attain competitive advantage (CA). Consequently, one ought to look into the nature of this connection. The majority of businesses do not value knowledge and do not recognise its significance to the overall success of the business. In order to combat this apathy, we are conducting study into TK and PK in Product success. A total of 200 questionnaires were sent out to different businesses in Wuhan in order to collect data for the purpose of putting theories to the test. According to the findings, in order for businesses to be able to provide CA, they need to produce goods that cater to the requirements of customers. This can be accomplished by developing goods in a way that is compliant with specifications, which are supported by knowledge and technology. It is impossible for a product to be successful if the characteristics of the product and its qualities are unknown. Companies who wish to give CA in the design of their goods must, as a result, use the knowledge to achieve their aims, and they must also be compatible with the requirements of the customer in order to achieve customer happiness. This study makes a significant contribution to the existing body of literature on manufacturing by introducing Knowledge Management (KM) in the context of product success via TK and PK, as well as elucidating the true economic value of product design (PD).

Keywords: Product success, competitive advantage, technological knowledge, procedural knowledge, Knowledge Management.

Introduction

One of the key inputs in product industry is the integration of methodology to identify, run, and share all types of information assets in the manufactory Jiao and Helander (2006). According to Haug (2013), KM affects the reduction of production costs and increase of product quality by improving PD, avoiding errors, and reducing the response time through the information on supplier needs and customer product specifications.

Clearly, knowledge and PD are closely related in all stages. KMhelps designers, manufacturers, and inspectors in designing products effectively and in commanding activities Cristofolini, Filippi, Bandera (2009). PD identifies the outer appearance, materials used, dimensions, and allowable range of variations in dimensions as well as performance standards

from initial idea design (idea generation) to product launch and manufacturing. PD increases productivity and improve quality, while reducing costs and meeting all customer requirements Russell and Taylor-Iii (2011). Conversely, Gemser and Leenders (2001) indicated that PD positively affects firm performance and helps in achieving competitive advantage. PD is also crucial in succeeding in competition and achieving a higher revenue. Previous studies demonstrated that powerful manufactories that achieve CA in the market allocate design budgets for their growth (8%–20% per annum).

PD is a strategic tool for marketers to match customer requirements, such as durability, quality, performance, appearance, and price, and it is a part of product development. Most studies indicated that PD positively affects firm performance and financial success Sundar and Kardes (2012); Roper (2016).

Recently, now regarded as the most important determinant of product success. Manufacturers focus on price and quality in PD Hertenstein, Platt, and Veryzer (2012). Nevertheless, Noble & Kumar (2010) explained that a successful PD cannot be achieved individually but collectively through many fields, such as consumer behavior, art, work environment, geometry, marketing, and human factors. Industrial designers often have the crucial role of determining the characteristics and features of the final PD after knowledge is provided. Lehoux, Hivon, Williamsjones and Urbach (2011) confirmed that PD is a complex process, involving diverse participants and knowledge contribution, while assuming the roles of engineers and industrial designers in decision making. To raise quality and save costs, a combination of statistical and engineering techniques is used Krajewski and Ritzman (2013). Decision making in PD comes from available knowledge, which affects the rationality of the decision Calabretta, Gemser, Wijnberg, and Hekkert (2012). Without data and information flow, PDs cannot achieve satisfactory results and customer satisfaction Kamrani and Abouel Nasr (2008). Customer satisfaction depends on the features and elements of PDs, which provide the standards that govern customers when deciding whether to buy products Seva, Gosiaco, Santos, and Pangilinan (2011). PD is one of the broadest product development activities that translate a set of product requirements to achieve customer satisfaction and Scholars agreed that PD is a competitive tool and an opportunity to gain preferential advantage in the market Chiva and Alegre ((2009).

Most manufactories see PD as a competitive advantage, so they increase their investment on this field. PS is a critical element for CA Talke, Salomo, Wieringa, and Lutz (2009), and KM is one of its dimensions Matteoni and Almeida (2012). Therefore, a successful PD cannot be achieved without knowledge management.

Model for research and hypotheses

The model suggested in this study, shown in Figure 1, consists of four variables: knowledge Management (KM), technological knowledge (TK), procedural knowledge (PK) and product success (PS). KM has an impact on PS through TK and PK.

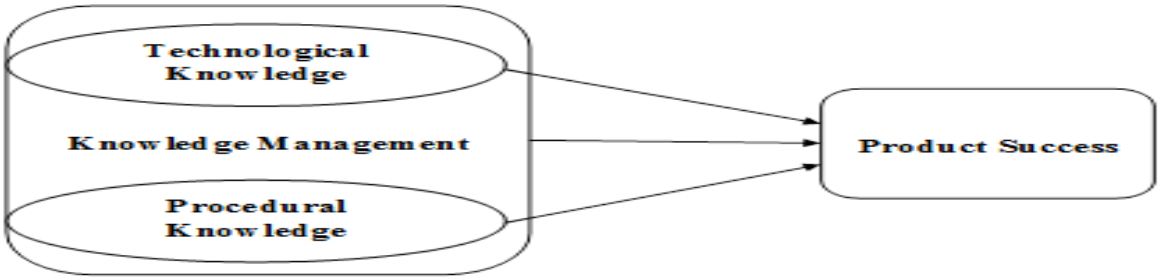

Figure 1. Model proposed research.

KM

Currently, knowledge is the basis of firm success. It is the central force for a high firm growth and is considered a significant contributor to work, creativity, and competitive advantage. KM creates value, increases productivity, and maintains CA by identifying and improving effective management of intellectual assets Yusof and Bakar (2012).

Research and development are one of the primary sources of knowledge in the success of a product, wherein knowledge is acquired internally and externally. KM is the process of compiling, organizing, analyzing, and utilizing information to meet customer needs in PD Danskin, Englis, Solomon, Goldsmith and Davey (2005). Manufactories rely on KM for enhanced productivity, efficiency, and quality Herder, Veeneman, Buitenhuis, and Schaller (2003). The essence of KM is to acquire competitive knowledge and use it to create products that meet customer needs and build unique capabilities Gao, Li and Clarke (2008). It achieves or enhances a variety of results, such as the long-term success, value, and corporate goals, and overall success through knowledge development and utilization Nguyen (2010). Whenever manufactories realize continuous competition, the importance of KM increases because success depends on the effective management of diverse and extensive knowledge Kulkarni and Freeze (2004). Especially by the use of CA, KM is the official management to knowledge Zhen, Jiang and Song (2011). After identifying, creating, or acquiring new information, a company may gain a competitive advantage through its organisational competence, as well as the conveyance and distribution of existing knowledge Walters (2002). Knowledge management helps businesses make better decisions, quickly solve problems, reduce the number of errors and the frequency with which they occur, lower the cost of research, develop and improve customer relationships, and improve production. It also assists businesses in creating, acquiring, transferring, and disseminating vital information and experiences (Shankar, Narain and Kumar, 2006; Kulkarni et al., 2020).

Knowledge has two types: implicit and explicit Lucarelli and Peters (2001), Explicit knowledge effectively affects PS through information technology (Baxter et.al., 2009), The CAof firms lies in implicit knowledge Kim and King (2004), The application of explicit knowledge relies on implicit knowledge. Implicit knowledge often consists of embodied experiences and a deep understanding of interconnected and bundled elements, which enable pioneers to dynamically specify problems in context. However, not everything can be coded, such as documents or tools. The use of implicit knowledge requires interaction, and acquiring it is informal, such as through chat, training, and apprenticeship Vat (2004), Manufactories need to manage knowledge efficiently and effectively to stay in the competition, which is currently built on knowledge. The conversion between these two types of knowledge, from explicit and implicit, is the essence of knowledge creation Nonaka, Reinmoeller and Senoo (2000); Nonaka, Toyama and Konno (2000), Along with tasks linked to creation, conservation, and distribution, KM is the organisation and establishment of collaboration. Support is given via timely and enough knowledge assets. interchange of knowledge and avoiding information overload Dignum and Dignum (2003), KM is effective, and it supports products (Xu, 2016; Lalfamkima et al., 2021; Mittal & Bansal, 2020).

which is expressed in the following hypothesis:
H1: KM has a significant and favourable impact on PS.

TK

Industrialized countries depend primarily on TK through creativity, innovation, and patents Lubango (2015). TK results in increased productivity and high-quality PDs Afonso 2013). It involves knowledge about new available technology, requirements and problems

encountered in past designs, possible solutions to problems, and standards and attributes of performance. In technological knowledge, existing cases are reused as appropriate references, and functional requirement models are adopted. TK helps in making the right decision, choosing the most precise solution, and generating new solutions for different situations or new problems. Right decisions in PS can be made by setting up goals. Goal setting is part of basic specialization in teams.

As previously mentioned, TK comes in forms such as patents marks, trade publications and inventions, and knowledge qualities Fu, Chui and Helander (2006). It is used to stay in the competition, and it relies on human knowledge (Jeong et.al., 2012). TK is an integral part of the other kinds of knowledge Gao, Li and Clarke (2008). Magnier-Watanabe and Seno (2009) mentioned that TK is related with participation How know and technical skills, such as how acquire and develop this knowledge through practicing, training, and using booklets, evidence, and other written documents. It is also related with the means of dissemination of clear knowledge and other related knowledge, such as technical product specifications.

Technological knowledge is important in achieving competitive advantage. describes the knowledge of certain techniques and the use of those techniques in finding appropriate solutions. TK includes knowledge of all matters related to technology, from operating systems to software applications. Improvement of TK through expansion and perception affects performance positively Cegarra-Navarro, Cepeda-Carrion and Eldridge (2011). This has been confirmed in performance at work. In addition, TK is important because we live in a continuously changing environment, and manufactories keep abreast with these changes to survive in the market and achieve CA by offering products that meet customer needs Keith, Demirkan and Goul (2010). From the above discussion, we deduced the following hypothesis:

H1a: TK has a significant and favourable impact on PS.

PK

PK is knowing how to work through scientific knowledge and experience, and it is one of the necessary kinds of knowledge in PS Ammann (2009). It determines the appropriate ways for work, which leads to reduced production cost and time Hori (2004). It also guides the designers by identifying useful procedures that can lead to success Gillan and Cooke (2001).PK includes rules and principles in the production process as well as requirements and steps. It is acquired through the mechanics from Inferred rules, and necessary to converts the knowledge to achieve their goals. It defines how actions should be implemented Dillard-Eggers and Roberts (2010), what to do, and what not to do Brodbeck (2002). It is a set of skills, rules, and strategies to realize how to perform tasks, and its implementation affects performance Camerer and Hogarth (1999). PK can make performance efficient and effective Motowidlo, Crook, Kell and Naemi (2009). Task completion must be adhered to by everyone Baets (2006). Banks and Millward (2007) explained that every requirement in accomplishing certain tasks or procedural actions determine work completion, which can positively affect work performance. Previous studies demonstrated that PK help in achieving superior performance Aminu and Mahmood (2016).

PK indicates how a final product is completed and implemented. It deals with structures and mechanisms, It is support infrastructure to market, human, and TK to achieve the ultimate goals in PS Fu, Chui and Helander (2006). PK include theoretical and practical knowledge. Aside from learning by using possible ways and innovation indicators increase the importance of PD Junior et.al., (2014). Constant practice, problem solving, and high expertise are the sources of flexibility and efficiency in design, in which actions can be implemented efficiently

Schneider, Rittle-Johnson and Star (2011). Researchers confirmed that one of the competitive advantages of PK is to market products faster than competitors. Speed increases the likelihood of success of PD. Knowing how to work and following the correct procedures can lead to achieving CA Lynn, Akgün and Keskin (2003). Akgün, Dayan and Di Benedetto (2008) demonstrated that PK has a positive effect on PS because it has prior knowledge and expertise regarding the demands and wants of customers, as well as how to execute those demands in PS. Other researchers also confirmed the positive effect of PK on PS Lynn and Akgun (2000). From the above statements, we conclude the following hypothesis:

H1b:PK a significant and favourable impact on PS.

DATA AND SAMPLE

A questionnaire was used to gather the data, and respondents responded with responses ranging from strongly agreeing with 5 to strongly disagreeing with 1. The SPSS and Excel systems were utilised in order to conduct the analysis on the responses to the questions. The sample is extremely significant due to the fact that it will determine whether or not the study is successful. The sample consisted of two hundred questionnaires that were sent out to corporate managers, department heads, designers, engineers, and other employees associated with PS at manufactoriesin Wuhan.

Table 1: *Description of the sample*

z	Category	Percent
The manufactory Type	Foreign funded	10%
	Joint venture	10%
	State-owned	60%
	Joint stock	10%
	Private	10%
Period of the manufactory development	Less than 20	10%
	more than 20	90%
period of service in the manufactory	Less than 5	24%
	5-10	31.5%
	10-15	7.5%
	more than 15	37%
Number of stuffs	more than 5000	20%
	1000-5000	40%
	less than 1000	40%
Education	Less than a Bachelor's	0.5%
	bachelor’s	67%
	Master's degree or higher	32.5%

Validation Of Instruments and Operationalization of Structures

The means of questionnaire is designed based on other questionnaire criteria and the literature review, In addition to the opinions consistent with the research requirements. Table (2) displays items of the variables, main variables and reference to each variable.

Table 2: *Description of the variables*

Main Variables and Dimensions	Items	Symbols	Reference
Technological Knowledge	TK	TK 1 TK 2 TK 3	Fu, Chui and Helander (2006); Qiu, Chui and Helander (2008).
Procedural Knowledge	PK	PK1 PK2 PK3 PK4	Fu, Chui and Helander (2006); Qiu, Chui and Helander (2008); Baxter, Gao, Case, Harding, Young, Cochrane and Dani (2008).
Product Success	PS	PS1 PS2 PS3	Chiva and Alegre (2009); Fu, Chui and Helander (2006); Qiu, Chui and Helander (2008); Baxter, Gao, Case, Harding, Young, Cochrane and Dani (2008); Chen and Li, (2010).

	PS4
	PS5

As shown in Table 3, Cronbach's coefficient was higher than 0.60, demonstrating the reliability of the questionnaire Sekaran (2003); Hair, Black, Babin and Anderson (2010) (3).

Table 3: *Statistics on Reliability*

Main Variable	The dimensions	Cronbach Alpha
KM	TK	0.89
	PK	0.86
PS	PS	0.68

The internal correlation among variables items, as shown in Table (4), indicates that the questionnaire's validity is more than 20 and less than 90. If the following information is correct, we can perform statistical analysis on it.

Table 4: *Results of Intercorrelation matrix*

	TK1	TK2	TK3	PK1	PK2	PK3	PK4	PS1	PS2	PS3	PS4	PS5
	1	.587**	.536**	.428**	.385**	.382**	.396**	.354**	.212**	.291**	.348**	.380**
TK1		.000	.000	.000	.000	.000	.000	.000	.003	.000	.000	.000
	200	200	200	200	200	200	200	200	200	200	200	200
	.587**	1	.741**	.674**	.495**	.585**	.673**	.476**	.373**	.420**	.341**	.526**
TK2	.000		.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	200	200	200	200	200	200	200	200	200	200	200	200
	.536**	.741**	1	.584**	.541**	.696**	.723**	.493**	.334**	.309**	.503**	.454**
TK3	.000	.000		.000	.000	.000	.000	.000	.000	.000	.000	.000
	200	200	200	200	200	200	200	200	200	200	200	200
	.428**	.674**	.584**	1	.758**	.502**	.513**	.421**	.384**	.150*	.499**	.450**
PK1	.000	.000	.000		.000	.000	.000	.000	.000	.034	.000	.000
	200	200	200	200	200	200	200	200	200	200	200	200
	.385**	.495**	.541**	.758**	1	.614**	.600**	.544**	.370**	.187**	.709**	.392**
PK2	.000	.000	.000	.000		.000	.000	.000	.000	.008	.000	.000
	200	200	200	200	200	200	200	200	200	200	200	200
	.382**	.585**	.696**	.502**	.614**	1	.680**	.427**	.337**	.226**	.560**	.441**
PK3	.000	.000	.000	.000	.000		.000	.000	.000	.001	.000	.000
	200	200	200	200	200	200	200	200	200	200	200	200
	.396**	.673**	.723**	.513**	.600**	.680**	1	.532**	.377**	.403**	.502**	.448**
PK4	.000	.000	.000	.000	.000	.000		.000	.000	.000	.000	.000
	200	200	200	200	200	200	200	200	200	200	200	200
	.354**	.476**	.493**	.421**	.544**	.427**	.532**	1	.325**	.349**	.582**	.182**
PS1	.000	.000	.000	.000	.000	.000	.000		.000	.000	.000	.010
	200	200	200	200	200	200	200	200	200	200	200	200
	.212**	.373**	.334**	.384**	.370**	.337**	.377**	.325**	1	.277**	.331**	.171*
PS2	.003	.000	.000	.000	.000	.000	.000	.000		.000	.000	.016
	200	200	200	200	200	200	200	200	200	200	200	200
	.291**	.420**	.309**	.150*	.187**	.226**	.403**	.349**	.277**	1	.266**	.206**
PS3	.000	.000	.000	.034	.008	.001	.000	.000	.000		.000	.003
	200	200	200	200	200	200	200	200	200	200	200	200
	.348**	.341**	.503**	.499**	.709**	.560**	.502**	.582**	.331**	.266**	1	.280**
PS4	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000		.000
	200	200	200	200	200	200	200	200	200	200	200	200
	.380**	.526**	.454**	.450**	.392**	.441**	.448**	.182**	.171*	.206**	.280**	1
PS5	.000	.000	.000	.000	.000	.000	.000	.010	.016	.003	.000	
	200	200	200	200	200	200	200	200	200	200	200	200

**A correlation exists at the (0.01) level of significance: ((2-tailed)).
*A correlation exists at the (0.05) level of significance: ((2-tailed)).

Table 5 displays the means of the variables, as well as each item (i.e., agree) that is

consistent with the study's objectives. As a result, the organisations that have been tested at an appropriate level of search variable implementation Mathew (2011).

Table 5: *Measurement Direction*

items	Item Mean	Std.	The direction of the sample	The direction and Main Variable
TK1	4.34	.48	agree	
TK2	4.04	.76	agree	4.08AGREE
TK3	3.99	.78	agree	
PK1	4.17	.827	agree	
PK2	3.99	.853	agree	4.02AGREE
PK3	4.02	.719	agree	
PK4	3.90	.753	agree	
PS1	4.00	.638	agree	
PS2	4.10	.657	agree	
PS3	4.28	.593	agree	4.122AGREE
PS4	4.15	.693	agree	
PS5	4.08	.694	agree	

Result

We are able to determine whether or not our hypotheses are correct by using linear regression in the following order

H1: KM has a significant and favourable impact on PS.
As shown in tables 6-8, the following results were obtained:

Table 6: *Results of Model Summary*

R	R^2	Adjusted R^2	Std. Error of the Estimate
.78a	.60	.60	.27

a. Predictors: Constant, KM

Table 7: *Results of ANOVAa*

	Sum of Squares	df	Mean Square	F Value	Sig.
Regression	22.54	1	22.54	301.04	.000[b]
Residual	14.83	198	.08		
	Total	37.37	199		

a: Variable of Dependent. PS
b: Predictors. ((Constant)), KM

Table 8: *Results of Coefficients*[a]

	(Unstandardized Coefficients.)		(Standardized Coefficients).	T Value	Sig.
	B	Std. Error	β		
(Constant)	1.90	.13		14.61	.000
KM	.55	.03	.78	17.35	.000

a: Variable of Dependent. PS

Wherein Correlation coefficient is 0.78, and the R-square is 0.60, which signifies that 60% of the change in PS is due to KM as shown in table (7).

The value of (F) is 301.04, which is the largest from the tabular value 6.76, The significance level is also equals to zero, which is less than the significance level required 0.5% as shown table 8, Therefore, we accept the hypothesis.

The table 8, shows the regression between KM and PS, and the equation is as follows:
Y = 1.90 + 0. .55 X

where (y) is the measurement for the dependent (PS) variable and (X) is the measurement for the independent variable (KM). Table 9 shows that the coefficient B, which measures how KM affects PS, has a value of 0.55. The equation below can be used to determine this value.

H1a: TK has a significant and favourable impact on PS.

The same procedures were used to demonstrate the correctness of the hypothesis made below: PS is significantly impacted by TK.

Table 9: *Results of Model Summary*

R	R^2	Adjusted R^2
.71[a]	.51	.51

a: Predictors. ((Constant)), TK

According to Table 9 the correlation coefficient is 0.71, and the R-square value indicates that TK is responsible for 51% of the change in PS because it is 0.51.

Table10. *Results of ANOVA*[a]

	Sum of Squares	df	Mean Square	F Value	Sig.
Regression	18.99	1	18.99	204.49	.000[b]
Residual	18.38	198	.09		
Total	37.37	199			

a: Variable of Dependent. PS
b: Predictors, ((Constant)), TK

The results of the F-test indicate that there is an effect of TK on PS that is statistically significant. Its value is 204.49, which is the highest out of all the values that have been tabulated, and its significance level was zero, which is lower than the required $\alpha = 0.05$. As a result, we decided to accept the hypothesis. as can be seen in the table (10).

Table11. *Results of Coefficients*[a]

	(Unstandardized Coefficients)		(Standardized Coefficients)	T Value	Sig.
	B	Std. Er.	β		
(Constant)	2.11		.14		14.86
TK	.49		.03	.71	14.30

a: Dependent Variable. PS

The following is the equation for the straightforward linear regression of TK and PS:
Y=2.11+ 0.49X

This equation uses the coefficient (b), which, based on the information in table 11, has a value of 0.49, to show the effect that TK has on PS.

H1b: PK has a significant and favourable impact on PS.

Based on the information in tables 12–13, we adopted the following hypothesis: Statistics show that PK has a major impact on PS.

Both the correlation and determination coefficients are quite high, with 0.76 and 0.58 respectively. This demonstrates the degree to which the dependent variable changed in response to the shift in the value of the independent variable. The table (12) demonstrates that there is a connection between PK and the 58 percent shift in PS.

The F-test demonstrates that PK affects PS in a manner that is statistically significant. As indicated in table 13, the estimated F value is 268.12, which is the highest from the tabular value, and the level of statistical significance is zero, which is higher than the approved significance level of 0.05.

Table 12: *Results of Model Summary*

R	R^2	Adjusted R^2
.76a	.58	.57

a: Predictors: ((Constant)). Procedural knowledge

Table 13. *Results of ANOVAa*

Model		Sum of Squares	df	Mean Square	F Value	Sig.
1	Regression	21.50	1	21.50	268.12	.000[b]
	Residual	15.87	198	.08		
	Total	37.37	199			

a: Dependent Variable. PS
b: Predictors: ((Constant)), PK

Table 14. *Results of Coefficientsa*

	Unstandardized Coefficients		Standardized Coefficients	T Value	Sig.
	B	Std. Error	β		
(Constant)	2.13	.12		17.35	.000
PK	.50	.03	.76	16.37	.000

a: Dependent Variable. PS

From the outputs listed on the table 15, the linear regression equation of PK and PS is as follows:

Y=2.13+0.50X

This equation demonstrates how PK affects PS by using the coefficient B, which has a value of 0.50.

Discussion

This is the first study that attempts to integrate TK and PK and PS into the theory and practise of industrial enterprises in Wuhan, and this study gives a knowledge application and its framework. according to several research samples,

we have seen the importance and effect of KM in providing CA to companies through performance and PD based on customer requirements. To meet client demands, industrial companies require information and knowledge about their surrounding environment. The factory's performance is built on reaching clients at the lowest possible cost, which can be accomplished by KM based on trends. CA will also be able to attain during this time.

This study focuses on two classifications of knowledge that affect PS Fu, Chui and Helander (2006). PS is influenced positively by these two classes. To attain their goal, industrial companies must obtain these two classes. Industrial firms benefit from TK and PK

because they increase their competitiveness. Instead of complementing each other, they are unable to function independently Gao, Li and Clarke (2008).

There are many studies between KM and product success. But it is very rare that these studies have discussed the effect of KM Through technological and PK in product success.

Finally, KM, in addition to its two classifications, namely, technological, and procedural knowledge, have a positive impact on PS Qiu, Chui and Helander (2008).

Conclusions, Limitations and Future Research

All industrial companies need KM in PS because industrial companies based on the principle of meeting customers' requirements. As well as Companies can create opportunities for PS to confront continuous environmental changes with the use of PD tools and background from technological knowledge. And also, Companies can achieve a successful PD with increased procedural knowledge, which can lead to CA through meeting customer requirements. Finally, the two types of KM (technical and procedural knowledge) have a considerable impact on PS.

However, this study did not look at the general information, (ei: The companies Type, Period of the company's development, education and other information that may affect the relationship between KM and PS.

In addition, the research did not go in two different directions but rather solely in one direction throughout the entire process. The influence of the relationship between KM through TK and PK on PS was demonstrated in this study; however, the study did not test the correlation between KM and PS, nor did it test the interrelationship between the two classifications and KM. Additionally, it did not evaluate the complementary relationship between different KM classifications or their effect on PS in a realistic setting.

References

Afonso, O. (2013). Diffusion and directed technological knowledge, human capital and wages. Economic Modelling, 31, 370-382.

Akgün, A. E., Dayan, M., & Di Benedetto, A. (2008). New product development team intelligence: Antecedents and consequences. Information & Management, 45(4), 221-226.

Aminu, M. I., & Mahmood, R. (2016). On the relationship between procedural and declarative organizational memory and their effects on SME performance. International Business Management, 10(3), 241-247.

Ammann, E. M. (2009). The knowledge cube and knowledge conversions. In Proceedings of the World Congress on Engineering (Vol. 1).

Baets, W. (Ed.). (2005). Knowledge management and management learning: extending the horizons of knowledge-based management. Boston, MA: Springer US.

Banks, A. P., & Millward, L. J. (2007). Differentiating knowledge in teams: The effect of shared declarative and procedural knowledge on team performance. Group Dynamics: Theory, Research, and Practice, 11(2), 95.

Baxter, D., Gao, J., Case, K., Harding, J., Young, B., Cochrane, S., & Dani, S. (2008). A framework to integrate design knowledge reuse and requirements management in engineering design. Robotics and Computer-Integrated Manufacturing, 24(4), 585-593.

Baxter, D., Roy, R., Doultsinou, A., Gao, J., & Kalta, M. (2009). A knowledge management

framework to support product-service systems design. International journal of computer integrated manufacturing, 22(12), 1073-1088.

Brodbeck, P. W. (2002). Complexity theory and organization procedure design. Business Process Management Journal, 8(4), 377-402.

Calabretta, G., Gemser, G., Wijnberg, N., & Hekkert, P. P. M. (2012). Improving innovation strategic decision-making through the collaboration with design consultancies. In Leading innovation through design: Proceedings of the 2012 DMI international research conference, Boston (USA), 8-9 Aug. 2012. DMI.

Camerer, C. F., & Hogarth, R. M. (1999). The effects of financial incentives in experiments: A review and capital-labor-production framework. Journal of risk and uncertainty, 19(1), 7-42.

Cegarra-Navarro, J. G., Cepeda-Carrion, G., & Eldridge, S. (2011). Balancing technology and physician–patient knowledge through an unlearning context. International journal of information management, 31(5), 420-427.

Chagas Junior, M. D. F., & Campanário, M. D. A. (2014). Systems architecture, procedural knowledge and learning by using implications on systems integration capabilities. BAR-Brazilian Administration Review, 11(1), 1-21.

Chen, J. S., & Li, E. Y. (2010). The effect of information technology adoption and design customisation on the success of new product development. International Journal of Electronic Business, 8(6), 550-578.

Chiva, R., & Alegre, J. (2009). Investment in design and firm performance: The mediating role of design management. Journal of Product Innovation Management, 26(4), 424-440.

Cristofolini, I., Filippi, S., & Bandera, C. (2009). The role of product feature relations in a knowledge-based methodology to manage design modifications for product measurability. International journal of production research, 47(9), 2373-2389.

Danskin, P., Englis, B. G., Solomon, M. R., Goldsmith, M., & Davey, J. (2005). Knowledge management as competitive advantage: lessons from the textile and apparel value chain. Journal of Knowledge Management, 9(2), 91-102.

Dignum, V., & Dignum, F. (2003, June). The knowledge market: Agent-mediated knowledge sharing. In International Central and Eastern European Conference on Multi-Agent Systems (pp. 168-179). Springer, Berlin, Heidelberg.

Dillard-Eggers, J., & Roberts, M. L. (2010). An efficient method for acquiring auditing procedural knowledge. In Advances in accounting behavioral research. Emerald Group Publishing Limited, 13, 89-111.

Fu, Q. Y., Chui, Y. P., & Helander, M. G. (2006). Knowledge identification and management in product design. Journal of Knowledge Management, 10(6), 50-63

Gao, F., Li, M., & Clarke, S. (2008). Knowledge, management, and knowledge management in business operations. Journal of knowledge management.

Gemser, G., & Leenders, M. A. (2001). How integrating industrial design in the product development process impacts on company performance. Journal of Product Innovation Management: an International Publication of the Product Development & Management Association, 18(1), 28-38.

Gillan, D. J., & Cooke, N. J. (2001). 3. Using pathfinder networks to analyze procedural knowledge in interactions with advanced technology. In Advances in Human Performance and Cognitive Engineering Research. Emerald Group Publishing Limited.

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2010). Canonical correlation: A supplement to multivariate data analysis. Multivariate Data Analysis: A Global Perspective, 7th ed.; Pearson Prentice Hall Publishing: Upper Saddle River, NJ, USA.

Haug, A. (2013). Improving the design phase through interorganisational product knowledge models. International Journal of Production Research, 51(2), 626-639.

Herder, P. M., Veeneman, W. W., Buitenhuis, M. D. J., & Schaller, A. (2003). Follow the rainbow: a knowledge management framework for new product introduction. Journal of Knowledge Management.

HERTENSTEIN, J., PLATT, M., & VERYZER, R. (2012). What is "Good Design"?: An investigation of the structure and complexity of design. Leading Through Design, 175.

Hori, S., Hirose, K., & Taki, H. (2004, September). Acquiring After-Sales Knowledge from Human Motions. In International Conference on Knowledge-Based and Intelligent Information and Engineering Systems (pp. 188-194). Springer, Berlin, Heidelberg.

Jeong, S., Ahn, J., & Rhee, B. (2012, August). A study of knowledge management system activation methods based on knowledge market theory. In International Conference on Hybrid Information Technology (pp. 103-110). Springer, Berlin, Heidelberg.

Jiao, J. R., & Helander, M. G. (2006). Development of an electronic configure-to-order platform for customized product development. Computers in Industry, 57(3), 231-244.

Kamrani, A. K., & Abouel Nasr, E. S. (2008). Product design and development framework in collaborative engineering environment. International Journal of Computer Applications in Technology, 32(2), 85-94.

Keith, M., Demirkan, H., & Goul, M. (2010). The influence of collaborative technology knowledge on advice network structures. Decision Support Systems, 50(1), 140-151.

Kim, J., & King, J. (2004). Managing knowledge work: specialization and collaboration of engineering problem-solving. Journal of knowledge Management.

Krajewski, L. J., Ritzman, L. P., and Malhotra, M. K., (2013) Operations management. processes and supply chains, 10th ed., Pearson, New York, USA.

Kulkarni, U., & Freeze, R. (2004). Development and validation of a knowledge management capability assessment model. ICIS 2004 Proceedings, 54.

Kulkarni, S., Solomon, M., Chandrashekar, C., Shetty, N., & Carnelio, S. (2020). Spalt-like transcription factor 4 expression in oral epithelial dysplasia and oral squamous cell carcinoma: An immunohistochemical appraisal. *J Carcinog, 19*, 12. https://doi.org/10.4103/jcar.jcar_13_20

Lalfamkima, F., Georgeno, G. L., Rao, N. K., Selvakumar, R., Devadoss, V. J., Rajaram, N., Farid, S., Lalchhuanawma, T., & Nayyar, A. S. (2021). Clinical diagnostic criteria versus advanced imaging in prediction of cervical lymph node metastasis in oral squamous cell carcinomas: A magnetic resonance imaging based study. *J Carcinog*, *20*, 3. https://doi.org/10.4103/jcar.jcar_27_20

Lehoux, P., Hivon, M., Williamsjones, B., & Urbach, D. (2011). The worlds and modalities of engagement of design participants: A qualitative case study of three medical innovations. Design Studies, 32(4), 313-332.

Lubango, L. M. (2015). The effect of co-inventors' reputation and network ties on the diffusion of scientific and technical knowledge from academia to industry in South Africa. World Patent Information, 43, 5-11.

Lucarelli, C. M., & Peters, L. S. (2001, July). Developing competencies and capabilities through knowledge management: a contingent perspective. In PICMET'01. Portland International Conference on Management of Engineering and Technology. Proceedings Vol. 1: Book of Summaries (IEEE Cat. No. 01CH37199) (pp. 257-267). IEEE.

Lynn, G. S., & Akgun, A. E. (2000). A new product development learning model: antecedents and consequences of declarative and procedural knowledge. International Journal of Technology Management, 20(5-8), 490-510.

Lynn, G. S., Akgün, A. E., & Keskin, H. (2003). Accelerated learning in new product development teams. European Journal of Innovation Management, 6(4), 201-212.

Magnier-Watanabe, R., & Senoo, D. (2009). Congruent knowledge management behaviors as discriminate sources of competitive advantage. Journal of Workplace Learning.

MATTEONI, R., & ALMEIDA, L. (2012). ABOUT PRODUCTS AND THE DESIGN PROCESS: AN HISTORICAL APPROACH ON DESIGN AND AUTHORSHIP. LEADING THROUGH DESIGN, 261.

Mittal, S., & Bansal, S. (2020). Expression of Ki-67 in early glottic carcinoma and its relation to oncological outcomes following CO(2) laser microsurgery. *J Carcinog*, *19*, 7. https://doi.org/10.4103/jcar.jcar_7_20

Motowidlo, S. J., Crook, A. E., Kell, H. J., & Naemi, B. (2009). Measuring procedural knowledge more simply with a single-response situational judgment test. Journal of Business and Psychology, 24(3), 281-288.

Nguyen, T. N. Q. (2010). Knowledge management capability and competitive advantage: an empirical study of Vietnamese enterprises (Doctoral dissertation, Southern Cross University).

Noble, C. H., & Kumar, M. (2010). Exploring the appeal of product design: A grounded, value-based model of key design elements and relationships. Journal of Product Innovation Management, 27(5), 640-657.

Nonaka, I., Reinmoeller, P., & Senoo, D. (2000). Integrated IT systems to capitalize on market knowledge. In Knowledge Creation (pp. 89-109). Palgrave Macmillan, London.

Nonaka, I., Toyama, R., & Konno, N. (2000). SECI, Ba and leadership: a unified model of dynamic knowledge creation. Long range planning, 33(1), 5-34.

Qiu, Y. F., Chui, Y. P., & Helander, M. G. (2008). Cognitive understanding of knowledge processing and modeling in design. Journal of Knowledge Management, 12(2), 156-168.

Roper, S., Micheli, P., Love, J. H., & Vahter, P. (2016). The roles and effectiveness of design in new product development: A study of Irish manufacturers. Research Policy, 45(1), 319-329.

Schneider, M., Rittle-Johnson, B., & Star, J. R. (2011). Relations among conceptual knowledge, procedural knowledge, and procedural flexibility in two samples differing in prior knowledge. Developmental psychology, 47(6), 1525.

Sekaran, U. (2003). Research methods for business: A skill building approach. 4th ed., John Wiley & Sons, inc, new York.

Seva, R. R., Gosiaco, K. G. T., Santos, M. C. E. D., & Pangilinan, D. M. L. (2011). Product design enhancement using apparent usability and affective quality. Applied ergonomics, 42(3), 511-517.

Shankar, R., Narain, R., & Kumar, A. (2006). Survey of knowledge management practices in Indian manufacturing industries. Journal of Knowledge Management, 10(6), 110-128.

SUNDAR, A., & KARDES, F. (2012). DON'T FOLLOW THE CROWD TO PAYING MORE FOR LESS. LEADING THROUGH DESIGN, 86.

Susan Mathew, K., & Baby, M. D. (2011). Impact of Information Communication Technology (ICT) on professional development and educational needs of library professionals in the universities of Kerala (Doctoral dissertation, Cochin University of Science & Technology).

Talke, K., Salomo, S., Wieringa, J. E., & Lutz, A. (2009). What about design newness? Investigating the relevance of a neglected dimension of product innovativeness. Journal of product innovation management, 26(6), 601-615.

Taylor, B. W., & Russell, R. S. (2011). Operations management: creating value along the supply chain.

Vat, K. H. (2004, October). Conceiving a learning organization model for sustainable development: The IS manager's perspective based on soft systems methodology. In 2004 IEEE International Engineering Management Conference (IEEE Cat. No. 04CH37574) (Vol. 2, pp. 500-504). IEEE.

Walters, D., (2002). Operations Strategy. Palgrave Macmillan, New York.
Xu, H., Feng, Y., & Zhou, L. (2016). Market knowledge development of indigenous Chinese firms for overseas expansion: Insights from marketing ambidexterity perspective. In Asian Businesses in a Turbulent Environment (pp. 115-141). Palgrave Macmillan, London.
Yusof, M. N., & Bakar, A. H. A. (2012). Knowledge management and growth performance in construction companies: a framework. Procedia-Social and Behavioral Sciences, 62, 128-134.
Zhen, L., Jiang, Z., & Song, H. T. (2011). Distributed knowledge sharing for collaborative product development. International Journal of Production Research.