Knowledge Management, Total Quality Management and Innovation: A New Look

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Abstract

In the present challenging dynamic environment, innovation is considered as a capability that renews the competitive advantage of a company. In recent years, considerable effort has been made to examine the factors that affect innovation in organizations. Knowledge management and total quality management, which play an important role in the contemporary management progress, are among the factors investigated. On the one hand, knowledge management has been recognized as an enabler that can deploy innovation by creating, storing, transferring, and applying knowledge, while on the other hand, the implementation of total quality management practices are addressed as one of the important factors that can influence innovation in a positive way. Lately, although a few researchers have shown some interest in the relationship of total quality management and knowledge management and their have not reached a consensus to conceptualize this relation. Looking at it from the methodological perspective, this problem can be tackled by using the Joint Variance analysis method where it can demonstrate correlation among independent variables and the effect of them on innovation. This study aims to propose a framework that shows how total quality management and knowledge management are reciprocally related to each other and how this affinity can impact innovation.

Keywords: total quality management; knowledge management; innovation; joint variance analysis.

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Introduction

Innovation as a main source of competitive advantage, has attracted considerable attention in academia and practice (Aramburu et. al., 2006; Damanpour, 1991; Dooley and O Sullivan, 2007; Huang and Li, 2009; Swan et. al., 1999; Taddese and Osada, 2010). In recent years, a wide range of effort has been made to examine the factors that affect Innovation in organizations. Among all the identified factors that affect innovation, total quality management and knowledge management have attracted a significant consideration in scholarly research (Hung et. al., 2011). In the last two decades, TQM is considered as a management practice that provides an organization with better performance (Feng et. al., 2006; Pinho, 2008). Concurrently, a wide range of studies have examined the relationship between TQM and innovation (Abrunhosa and Moura E Sá, 2008; Hoang et. al., 2006; Lopez-Mielgo et. al., 2009; Lorente et. al., 1999; Perdomo-Ortiz, Gonzalez-Benito, et. al., 2009; Prajogo and Sohal, 2003). Prajogo and Sohal (2003) stated that TQM and its cultural factors foster innovative activities in the organization. They argued that customer focus and related practices lead organizations to find new customer needs, consequently, to fulfil these requirements they develop new products or adapt changes. By implementing continuous improvement, employees learn to think more creatively regarding the way that work is being done. Likewise, people management and teamwork are innovation success factors that can nurture innovative activities. They found a positive association between TQM and innovation. In addition, they indicated a casual relationship between quality performance and innovation that confirms the view that quality and innovation can be improved simultaneously. Based on Perdomo-Ortiz et al. (2009) the positive effects of TQM on innovation can be conceptualized in three aspects. First, market orientation and customer focus related practices which provide organizations with the customer needs information that leads to new ideas to meet these demands (Fuentes et. al., 2006; Hoang, et. al., 2006; Hung, et. al., 2011; Perdomo-Ortiz et. al., 2006). The next contribution of TQM to innovation is related to continuous improvement. This practice aids to improve know-how within the organization by recognizing the necessary changes in processes (Perdomo-Ortiz, et. al., 2009; Prajogo and Sohal, 2004a; Satish and Srinivasan, 2010). Finally, Teamwork, employee empowerment, and people management which encourage autonomy and sharing ideas among employees that consequently leads to innovation (Fuentes, et. al., 2006; Hoang, et. al., 2006; Perdomo-Ortiz, et. al., 2009; Prajogo and Sohal, 2004a).

Alongside these investigations, knowledge management as one of the growing fields of management research has been the subject of a large number of studies. Some researchers have shown that knowledge management has a positive impact on organizational performance (Zack et. al., 2009;

Zaim et. al., 2007). Meanwhile, a large number of academic studies have found a positive association between knowledge management and innovation (Chung-Jen et. al., 2010; Darroch, 2005; Huang and Li, 2009; Jiang and Li, 2009; Liao and Wu, 2010; Mei and Nie, 2007). The association between the knowledge management processes and innovation is well established in the literature. Acquiring knowledge from inside and outside of the organization advances the knowledge assets within the organization that leads to knowledge modification (Andreeva and Kianto, 2011; Chang and Lee, 2008; Chen and Huang, 2009; Hung et. al., 2010). This process increases the innovative outcomes (Chen and Huang, 2009). Knowledge dissemination, transferring and sharing tacit and explicit knowledge among the organization, entails learning and modifying existing knowledge that consequently enhances innovation (Chen and Huang, 2009; Hung, et. al., 2010; Liao and Wu, 2010). Likewise, applying new knowledge by means of solving problems and embodying knowledge to new products is directly related to innovation (Chen and Huang, 2009; Huang and Li, 2009).

On the one hand, it is supposed that knowledge is an intangible and unique asset (Jantunen, 2005), which provides an organization with innovation (Chen and Huang, 2009; Chung-Jen, et. al., 2010; Darroch, 2005; Huang and Li, 2009; Liao and Wu, 2010), while on the other, TQM contributes significantly to the innovation performance (Abrunhosa and Moura E Sá, 2008; Feng, et. al., 2006; Hoang, et. al., 2006; Lopez-Mielgo, et. al., 2009; Perdomo-Ortiz, et. al., 2006; Prajogo and Sohal, 2003). Considering the organizational life and structure, both TQM and KM are management practices that are positioned at different points in their maturity lifecycle (Dvir, 2002). However, they have similar aims and positions in regard to management. It appears that both TQM and KM are interrelated, if not congruous (Waddell and Stewart, 2008), practices that are both long-term for the intention of gaining competitive advantage and innovation. They hold some similar basic assumptions, e.g. the importance of cultural changes and process improvement (Dvir, 2002). The relationship between TQM and KM regarding the innovation is at the heart of this study.

Lately, a few researchers have shown some interest in the relationship of TQM and KM but they have not reached a consensus to conceptualize this relation. All but two of these studies are conceptual or case studies. These empirical studies are the ones conducted by Hung et al. (2010) and Molina et al. (2007). Hung et al. (2010) considered this relationship regarding innovation while in Molina et al. (2007) performance is the criterion. However these findings have different settings regarding the nature of the relationship. Hung et al. (2010) showed that TQM is a mediator in the relationship between KM and innovation. In contrast, Molina et al. (2007) considered knowledge transfer as mediator between

TQM and performance. Concerning the methodological aspect of the mediator concept, the mediator "represents the generative mechanism through which the focal independent variable is able to influence the dependent variable of interest" (Baron and Kenny, 1986), which means that not only does TQM generate KM in respect of performance but also that KM generates TQM concerning innovation. These findings confirm the related literature of the relationship. While some researchers considered KM as a facilitator of TQM (Barber et. al., 2006; Hung, et. al., 2010; Stewart and Waddell, 2008) other scholars concerned TQM as an antecedent for KM (Choo et. al., 2007; Colurcio, 2009; Jayawarna and Holt, 2009; Lin and Wu, 2005; Molina et. al., 2007).

These diverse results highlight the importance of looking at this relationship more closely from the methodological perspective. This problem can be tackled by using Joint Variance analysis method where it can demonstrate a correlation among independent variables and the effect of them on innovation. The structure of this paper is as follows. The next section focuses on the relationship between TQM and KM in the literature, while the third section explains the joint variance analysis method. In section 4, the joint variance analysis results are discussed. The last section explains the conclusions of this study.

TQM-KM Relationship

As stated above the relationship between TQM and KM is conceptualized in different ways. From one perspective, KM is determined as an enabler for TQM. Stewart and Waddell (2008) argued that widening the concept of quality, from product/service specification to rapid response to customer needs, clears the relationship between KM and TQM. Acquiring knowledge and disseminating it provides a quality culture that leads to effective quality management implementation. Barber et al. (2006) addressed the role of knowledge management systems in supporting continuous improvement. They showed that a knowledge management system enables continuous improvement by "utilization of available data already held within the company's management databases". Hung et al. (2010) empirically examined the relationship between KM, TQM, and innovation. The results of this study revealed that there is a significant association between KM and TQM. In addition, KM contributes to innovation through TQM. In other words KM is an antecedent for TQM and innovation.

The other approach supposes that TQM is a supporter for KM. Lin and Wu (2005) presented "ISO 9000 process-based knowledge management system architecture", which supports knowledge flow in the organization. Colurcio (2009) in a case study research revealed that TQM practices are facilitators of knowledge creation and dissemination. Choo

et al. (2007) introduced a conceptual framework based on quality programs and KM. Based on this study, quality programs are effective enablers of KM. Jayawarna and Holt (2009) analysed the relationship between knowledge creation and transformation in the R&D context. Based on their case study research, they concluded that TQM practices improve knowledge creation and transformation. In an empirical study that was conducted by Molina et al. (2007), the relationship between TQM practices and knowledge transfer is examined. They indicated that there is a significant and positive association between TQM and knowledge transfer. The criterion of this study is performance and the finding of the study shows that TQM contributes to performance through knowledge transfer.

Joint variance analysis

Most of the published empirical studies examine the direct relationship between predictor variables and dependent variables; however, if a correlation exists among independent variables then the effect of this correlation on the criterion is disregarded (Schoen et. al., 2011). In particular, Schoen et. al. (2011) stated that, "joint variance is the shared capability of multiple predictors to explain variance in a criterion". This method aims to partition the multiple correlation squared and show how much of it is related to predictor variables uniquely and how much is due to common variance among predictors (Zientek and Thompson, 2009). To solve this problem Schoen et al. (2011) introduced the joint variance analysis. This analysis is based on Mood's (1971) partitioning variance and conceptualizes the joint variance concept. It also introduces a method to extract the joint variance effect. For the case of two predictors and a criterion this analysis is presented in this study and for more than two variables it is explained in Schoen et al. (2011) and Mood (1971). Suppose that x_1, and x_2 are independent variables and y is the dependent. The Venn diagram that is depicted in Figure 1 shows two independent variables' variances by x_1 and x_2 and the variance of dependent variable by Y. The intersection between x_1 and x_2 circles is the "shared variance" (D+C) or "the squared correlation between predictors". Similarly, the shared variance between the dependent variable and x_1 and x_2 are A+D and B+D respectively. Joint variance is the intersection among the three circles, which is denoted by D.
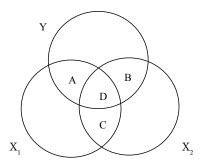

Figure 1. Variables Shared Variance (evaluated from Schoen et al. (2011))

"Mood Decomposition" or "commonality analysis" is the method that Schoen et. al. (2011) offered in their study to extract joint variance value (D). Based on this method joint variance, in the case of two independent variables, it can be calculated from the formula presented below:

$$JV = R^2_{yx1} + R^2_{yx2} - R^2_{yx1x2}$$

In this formula, R^2_{yx1} is squared semipartial of $_{x1}$, R^2_{yx2} is squared semipartial of $_{x2}$, and R^2_{yx1x2} is total variance explained. In the next section, this method is used to explain the relationship between TQM and KM based on published studies. The purpose of this study is not to criticize published empirical results; but to reevaluate the findings by use of new statistical methods to develop the related theory.

Findings

As mentioned before there are two empirical studies that examined the relationship between TQM and KM in the related literature. These empirical studies are the ones conducted by Hung et. al. (2010) and Molina et. al. (2007). Since they have conceptualized TQM and KM (in Hung et al. 2010) and TQM and knowledge transfer (in Molina et al. 2007) as multi-construct variables, in this study the correlation between the variables are substituted with the average of constructs correlations. The data that is used in this study is presented in Table 1 and the detailed correlations are available in the appendix.

To analyse the data, a spreadsheet as provided by Shoen et al. (2011) is used. Independently, the multiple correlation squared has been calculated based on available data, then semipartial correlations were calculated from the zero order correlations. In the next step, Mood decomposition analysis was conducted, and significance and confidence intervals of the joint components were calculated. In the last step, the results were compared and checked. Based on the calculations there was not any difference between the outcomes of the two calculations. The results of the analysis are presented in Table 2.

In the first study, since the multiple correlation squared is .339 then a large amount of innovation variance (near 34 percent) is explained by TQM and KM. However, nearly half of this explanation (47 percent) is related to the joint variance between TQM and KM. This amount is much more than the variances that are accounted for by TQM and KM uniquely. In addition, as presented in Table 3, unlike the specific variance that is accounted for each specific variable uniquely, it can be claimed that the explained variance of innovation due to TQM and KM joint variance is significantly more than zero.

In the next study (Molina, et. al., 2007) researchers used knowledge transfer, which is one of the main processes of KM. Similar to the other study, almost half of the extracted variance in performance is due to TQM and KT joint variance. None of the confidence intervals for extracted variances related to unique variables and common variances are significant, however as shown in Table 3, the confidence interval of the TQM and KT joint variance estimate is almost more than zero.

(Hung, *et. al.*, 2010)	KM	TQM	INN	(Molina, *et. al.*, 2007)	KT	TQM	PERF
KM	1			KT	1		
TQM	0.425563	1		TQM	0.479333	1	
INN	0.38675	0.541375	1	PER	0.356667	0.368	1

Table 1. Hung et al. (2010) and Moolina et al. (2007) correlations of TQM, KM, KT, Innovation, and performance.

	multiple correlation squared	KM semipartial correlation	TQM semipartial correlation	Extracted Joint Variance
(Hung, *et. al.*, 2010)	.3390	.0459 (14%)	.1315 (39%)	.1616 (47%)
(Molina, *et. al.*, 2007)	.1776	.0422 (24%)	.0504 (28%)	.0850 (48%)

Table 2. Mood Decomposition components and Calculations

	KM			TQM			Joint Variace		
	Lower CI	Estimated Variance	Upper CI	Lower CI	Estimated Variance	Upper CI	Lower CI	Esti-mated Variance	Upper CI
(Hung, *et. al.*, 2010)	-.0842	.0459	.1759	-.0014	.1315	.2644	.0115	.1616	.3117
(Molina, *et. al.*, 2007)	-.0500	.0422	.1345	-.0432	.0504	.1440	-.0212	.0850	.1912

Table 3. Confidence Intervals

As shown in the Table 2, nearly half of all explained variances in both studies are accounted for by the joint variance of the TQM and KM processes. Construct redundancy could be one of the explanations of this joint variance, however since these two variables are separate variables (conceptually and empirically indistinguishable) in the management literature it is unlikely to be a potential cause of the shared variance. This result can be justified as a conceptual reciprocal causation between TQM and KM. By implementing TQM organizations are encouraged to improve their relationship with suppliers and customers. To do this, they have to acquire more knowledge about them, and develop their relationship, which leads to acquiring knowledge from outside and within the organization. In addition, they have to disseminate acquired knowledge within their organization and with their suppliers. They also have to modify their existing knowledge and apply new knowledge to respond to customer need. To fulfil these aims they have to find and solve the problems to improve the processes of the organizations by creating teams, encouraging collaboration among employees, and training the personnel. All of these actions include acquiring, sharing and applying knowledge. Alternatively, formal and informal practices that lead to acquiring knowledge from outside and inside the organization make the organization aware of the environmental changes and its potential to respond to these changes. Obviously, more knowledge of customer and supplier lead to better management of the relationship with them. In addition, awareness of the knowledge capability of the organization results in solving the problems and improving the processes.

In general "MD is a tool that researchers can use to further theory development, although this development will generally take the form of hypothesis generation rather than the confirmation/disconfirmation of causal inferences" (Schoen, et. al., 2011). The result of this analysis justifies the various conceptualization of the relationship between TQM and KM in the literature. As stated above some researchers de-clared that TQM can be conceptualized as a forerunner of KM(Choo, et. al., 2007; Colurcio, 2009; Jayawarna and Holt, 2009; Lin and Wu, 2005; Molina, et. al., 2007), while other researchers considered KM as a forerunner of TQM (Barber, et. al., 2006; Hung, et. al., 2010; Stewart and Waddell, 2008). Since the joint variance between TQM and KM is responsible for near half of the variances of the criteria in different studies it could be concluded that there is a reciprocal causation between TQM and KM.

TQM-KM-Innovation

TQM is considered as an antecedent of innovation in a quite number of studies (Fuentes, et. al., 2006; Hoang, et. al., 2006; Hung, et. al., 2011; Perdomo-Ortiz, González-Benito, et. al., 2009; Prajogo and Sohal, 2004b; Sadikoglu and Zehir, 2010; Satish and Srinivasan, 2010). Customer focus practice supplies organizations with the customer needs information that results in generating new ideas to fulfil their customers' demands (Fuentes, et. al., 2006; Hoang, et. al., 2006; Hung, et. al., 2011; Perdomo-Ortiz, et. al., 2006). Continuous improvement improves know-how within the organization by providing the changes in processes and adapting new methods to do work (Perdomo-Ortiz, et. al., 2009; Prajogo and Sohal, 2004a; Satish and Srinivasan, 2010). Since Suppliers generally possess superior expertise and knowledge concerning the specifications, parts and components which may be crucial to a firm's new product development. Consequently, supplier relationship management can assist firms combine the expertise and different perspective of a supplier to enhance their solutions or generate new procedures for product development (Sun et. al., 2010). Finally, people management develops autonomy and ideas exchange among employees that results in innovation (Fuentes, et. al., 2006; Hoang, et. al., 2006; Perdomo-Ortiz, et. al., 2009; Prajogo and Sohal, 2004a). Hence the following proposition is formulated:

P1. TQM positively associates with innovation.

Many studies considered the relationship between KM and innovation (Chung-Jen, et. al., 2010; Darroch, 2005; Huang and Li, 2009; Jiang and Li, 2009; Liao and Wu, 2010; Mei and Nie, 2007). Knowledge acquisition improves the knowledge assets within the organization that contribute to knowledge modification and finally leads to innovation (Andreeva and Kianto, 2011; Chang and Lee, 2008; Chen and Huang, 2009; Hung, et. al., 2010). By acquiring knowledge from outside the organizations, firms are able to make amendments to the operating principle effectively (Chang and Tzeng, 2010). Disseminating knowledge leads to learning and knowledge modification, which consequently increases innovation (Chen and Huang, 2009; Hung, et. al., 2010; Liao and Wu, 2010). Similarly, knowledge application is directly related to innovation (Chen and Huang, 2009; Huang and Li, 2009). Thus the following proposition is formulated:

P2. KM positively associates with innovation.

Based on the joint variance analysis findings, nearly half of all explained variances in empirical studies that considered the relationship between TQM and KM (Hung, et. al., 2010; Molina, et. al., 2007), disregarding the criteria, are accounted for in the joint variance of TQM and KM processes. In addition, both TQM and KM can be seen as a facilitator of each other in different studies (Barber, et. al., 2006; Choo, et. al., 2007; Colurcio, 2009; Hung, et. al., 2010; Jayawarna and Holt, 2009; Molina, et. al., 2007; Waddell and Stewart, 2008). Therefore the following proposition is formulated:
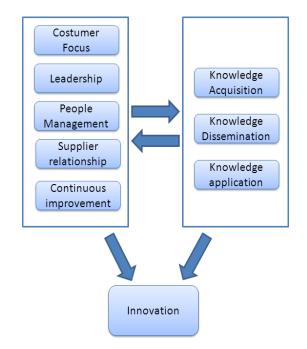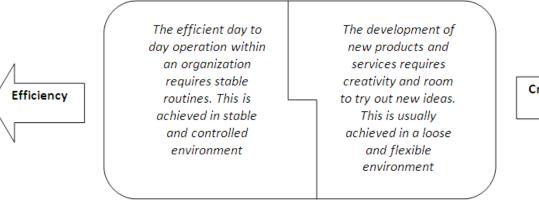

Figure 2. Conceptual model
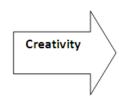
P3. There is a reciprocal causation between TQM and KM.

Based on these propositions the conceptual model of the relationship among TQM, KM, and innovation is depicted in Figure 2.
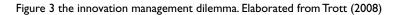
Conclusion

This study indicated that KM and TQM are positively related to innovation. In addition, it has been revealed that by considering TQM and KM as predictors a large amount of variance (nearly half) of the criterion can be accounted for by the joint variances of TQM and KM. Thereby meaning that the reciprocal causation between TQM and KM has synergetic effects. This mutual interaction can have a significant impact on the innovation or performance. The results of this study confirm the findings of the other study in the literature that tried to explore the relationship between TQM and KM (Ju et. al., 2006). Based on a case study Ju et al. (2006) developed a questionnaire on themes of the relationship between TQM and KM which was sent to 30 companies. They declared that there is a possible interaction between TQM and KM. Therefore, it can be concluded that TQM and KM are synergistically related to each other and that this interaction can have a positive effect on their possible outcomes especially innovation. This study has implications both for theory and practice. The relationship between TQM and KM and their impact on possible performance outcomes has been neglected in the literature. The empirical studies that examine the relationship between TQM practices and KM processes are quite a few and future studies should focus on investigating the interaction between TQM and KM and possible variables that contribute to this relationship. From the practical point of view, one of the crucial strains within organizations is their desire to be stable and creative simultaneously. As it is depicted in figure 3 on the one hand, stability is needed to attain task efficiency for competing today's market, on the other hand organizations for being able to compete in the future require advancing new idea and products (Trott, 2008). Highly organized and routinized environment is needed to reduce any slack in the process for lowering costs as low as possible. In addition, organizations need to be open about slacks for making rooms for creativity.

The problem arises when organizations try to find "how do firms try to reduce costs and slack to improve competitiveness on the one hand and then try to provide slack for innovation on the other?" The results of this study suggest that to overcome this dilemma, by implementing TQM and KM simultaneously firms are able improve innovation and efficiency. On the one hand, TQM implementation increases the efficiency of the firms and lowers the costs of production. On the other hand, TQM synergy with KM will have a positive impact on innovation. Therefore, the practitioners that aim to improve innovation are encouraged to apply TQM and KM simultaneously, to improve the innovative activities and lowering costs in their organizations through the synergistic collaboration of TQM and KM.

Figure 3 the innovation management dilemma. Elaborated from Trott (2008)

Appendix
Tables 4 and 5.

	KM1	KM2	KM3	KM4	TQM1	TQM2	TQM3	TQM4	IN1
KM1									
KM2	0.583								
KM3	0.627	0.625							
KM4	0.607	0.634	0.702						
TQM1	0.383	0.415	0.441	0.385					
TQM2	0.444	0.416	0.544	0.407	0.763				
TQM3	0.34	0.409	0.463	0.309	0.641	0.729			
TQM4	0.403	0.485	0.545	0.42	0.581	0.621	0.682		
IN1	0.35	0.366	0.398	0.309	0.517	0.484	0.505	0.55	
IN2	0.387	0.412	0.513	0.359	0.537	0.594	0.561	0.583	0.809

Table 4. Source: Hung, Lien et al. (2010) Notes: KM1= knowledge creation, KM2 = knowledge storage, KM3 = knowledge transfer, KM4 = knowledge application, TQM1 = top management support, TQM2 = employee empowerment, TQM3 = continuous improvement, TQM4 = customer focus, IN1 = product innovation performance, IN2 = process innovation performance.

		1	2	3	4	5	6	7	8
1	Internal knowledge transfers								
2	Suppliers knowledge transfers	0.33							
3	Customers knowledge transfers	0.32	0.17						
4	performance	0.45	0.32	0.3					
5	teamwork	0.81	0.27	0.34	0.4				
6	autonomy	0.86	0.29	0.36	0.4	0.8			
7	process control	0.59	0.49	0.35	0.3	0.6	0.59		
8	supplier cooperation	0.68	0.34	0.5	0.4	0.7	0.72	0.7	
9	customer cooperation	0.75	0.26	0.3	0.4	0.7	0.63	0.52	0.6

Table 5. Source: Molina, Llorens-Montes et al. (2007)

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