A CONCEPTUAL KNOWLEDGE VALUE CHAIN MODEL FOR CONSTRUCTION ORGANISATIONS ENGAGED IN COMPETITIVE TENDERING

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ABSTRACT

With the world heading towards a knowledge economy, knowledge is contemplated as a critical organisational resource that creates competitive advantage for construction organisations, especially when they engage in competitive tendering. Knowledge Value Chain Model (KVCM) is a viable mechanism that employs organisational knowledge for the organisations to acquire competitive advantage in competitive tendering. However, it has yet not been adopted although there is a dire requirement for it in the construction industry. Hence, this study developed a conceptual KVCM to facilitate the full exploitation of the knowledge available in a construction organisation so that it can function with competitive advantage during competitive tendering. This conceptual KVCM was developed by analysing the generic KVCMs mentioned in the extant literature. The analysis was followed by 15 expert interviews. It is recommended that to facilitate its pragmatic implementation, the KVCM be customised in the future as a Knowledge Value Chain (KVC) Framework by incorporating organisational characteristics.

Keywords: *Competitive Advantage; Construction Organisations; Knowledge; Knowledge Management (KM); Knowledge Value Chain Model (KVCM).*

1. INTRODUCTION

Knowledge is the 'lifeblood of an organisation' which ensures the survival of the organisation within dynamic and competitive environments (Asrarulhaq and Anwar, 2016). Management of knowledge is vital for driving an organisation towards gaining a competitive advantage since knowledge is a strategic resource (Mahdi *et al*., 2019). An organisation acquires competitive advantage when it gains or generates specific characteristics to surpass its co-competitors (H. L. Wang, 2014). The value chain concept introduced by Porter (1985) disaggregates an organisation into value activities to act as "discrete building blocks of competitive advantage" (p.38). Competitive tendering is the most traditional and favoured procurement method adopted by the industry (Kang *et al*., 2018).

Betts and Ofori (1992) have defined construction organisations as business entities that are involved in any facet of construction (p.512). They have used the term 'construction organisation' to provide a deeper contextual meaning than what is implied by a

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'contractor' or a 'building company', although Tripathi and Jha (2018) have used the term "construction organisations" to indicate contracting organisations as well. The term "construction competition" is affiliated with competitive tendering undertaken by competing construction organisations that have profit maximisation as their prime goal (Reinschmidt and Kim, 2006). This competitiveness has compelled construction organisations to seek competitive advantage by boosting their organisational performance (Horta and Camanho, 2014).

Kivrak *et al*. (2009) have claimed that knowledge is indispensable for construction organisations to win tenders using competitive advantage. Yap and Lock (2017) have analysed the competitive advantage of construction organisations and the contribution to organisational performance made by their Knowledge Management (KM) practices. In these construction organisations, lessons learned are the key drivers of competitive advantage (Carrillo *et al*., 2013). However, the traditional way the contractors do business hinders knowledge integration and affects the decision making processes adversely (Saini *et al*., 2019). Yet, construction organisations do not value KM initiatives which can ultimately lead to a knowledge loss (Sun *et al*., 2019). Therefore, there is a critical need in construction organisations to use KM frameworks in order to systematically gain from the lessons learned (Ghasabeh and Chileshe, 2014).

Knowledge Value Chain Model (KVCM), a model that can identify value adding KM activities, is vital for fully exploiting the competitive potential of KM (Holsapple and Singh, 2001). It is a model of KM framework (Wong, 2004) that applies the value chain concept to knowledge (Powell, 2001). Almarabeh *et al*. (2009) have defined KVCM as a concatenation of intellectual tasks through which Knowledge Workers (KWs) can create a distinctive competitive advantage for their employers to reap social and environmental benefits. However, the literature mostly mentions the competitive advantage of manufacturing organisations and even the few studies conducted to ascertain the competitiveness of the tendering process have been unsuccessful as they have failed to address the competitive potential of organisations (Zhang *et al*., 2018). According to Resource Based View (RBV), knowledge is a valuable, rare, and inimitable resource that contributes to competitive advantage (Omerzel and Gulev, 2011). Since to exploit its resources and achieve its complete potential, an organisation has to organise itself (Barney, 1995), an appropriate mechanism that can exploit the knowledge base of a construction organisation through learning cycles to derive competitive advantage in competitive tendering has become essential. KVCM concept can, therefore, be proposed as a KM framework to recognise value creating KM activities of competitive tendering, thereby enabling organisational learning to move through the competitive edge. This study, thus, aimed to develop a KVCM for construction organisations engaged in competitive tendering so that they can gain competitive advantage.

2. KNOWLEDGE VALUE CHAIN (KVC) CONCEPT

Porter (1985) introduced the value chain to analyse the activities performed by an organisation and the interactions among them. KVCM applies the value chain concept to knowledge (Powell, 2001) and functions as a model of the KM framework (Wong, 2004). KVCM also demonstrates how the competitive position of an organisation can be ensured (M. C. Lee and Han, 2009). Different applications of KVCM in various fields have been explored. Some of those are 'Modified KVCM for new product development in a winery' (Wong, 2004); 'Knowledge Value Chain (KVC) framework implemented in supply chain

management' (M. C. Lee and Han, 2009); 'Employement of KVC concept in research and development collaborations to impact on process innovation' (Un and Asakawa, 2015); and 'KVC framework as a conceptual model for organisational performance' (M. C. Lee, 2016). This study attempts to develop a KVCM for competitive tendering by reviewing the KVCMs mentioned in the literature.

3. TYPES OF KVCMS

Many KVCMS have been mentioned in the literature. In order to achieve the research aim, the study analysed 14 of them by categorising them as 'KVCMs based on KM frameworks', 'KVCMs based on Data-Information-Knowledge-Wisdom (DIKW) hierarchy' and 'other KVCMs'. Table 1 presents the names of the researchers who have developed each type of KVCM.

Table 1: Categorisation of KVCMs

KVCMs based on KM frameworks	KVCMs based on DIKW hierarchy	Other KVCMs
Weggeman (1997) (A)	Ermine (2013) (G)	Spinello (1998) (J)
C. C. Lee and Yang (2000) (B)	Powell (2001) (H)	Eustace (2003) (K)
Holsapple and Singh (2001) (C)	King and Ko (2001) (I)	Chen *et al*. (2004) (L)
L. C. Wang and Ahamed (2005) (D)		Y. Xu and Bernard (2010) (M)
Almarabeh *et al*. (2009) (E)		Roper *et al*. (2008) (N)
Carlucci *et al*. (2004) (F)		

The KVCMs under the category 'KVCMs based on KM frameworks' deal with KM activities while those under the category 'KVCMs based on DIKW hierarchy' deal with DIKW transformation. 'Other KVCMs' are the KVCMs that cannot be categorised under any of the other two categories. Each model was given a code between **A** and **N** to enable its easy identification during the review.

4. COLLATION OF MODELS

4.1 KVCMS BASED ON KM FRAMEWORKS

Some KVCMs that are based on KM frameworks such as those developed by C. C. Lee and Yang (2000), Holsapple and Singh (2001), and L. C. Wang and Ahamed (2005) are exact replicas of the Porter's value chain with the primary and secondary activities of the latter replaced with KM activities and associated supportive activities respectively. Although the other models under this category differ from Porter's model structure, they are also based on the core concept of the KVCMs of this category. All the models except that proposed by Carlucci *et al*. (2004) have precise KM activities. While Carlucci *et al*.'s (2004) model promotes the KM framework for the KVCM concept, it also continues beyond mere KM activities, which is an outstanding feature. On the other hand, the model proposed by Almarabeh *et al*. (2009) is exceptional since it promotes the DIKW hierarchy although it is a KVCM based on the KM framework. However, Ermine (2013) objected the KVCMs based on KM frameworks emphasising that cognitive activities are too complicated to be chained by the knowledge activities of the KVCMs acting on the knowledge assets of an organisation, which frequently are the models based on KM

frameworks. KVCMs based on the DIKW hierarchy are thus deemed to chain the cognitive activities acting on the knowledge processes of organisations.

4.2 DATA-INFORMATION-KNOWLEDGE-WISDOM (DIKW) HIERARCHY

DIKW hierarchy demonstrates the distinction among knowledge, information, and data in the form of a hierarchy (Rowley, 2007). Nurulin and Skvortsova (2018) have considered data as observational results and measurements in both real and abstract worlds whereas Y. Wang (2015) considered data as the abstract representations of the real world. According to Nurulin and Skvortsova (2018), information is also a form of data that comes with ample descriptions, while according to Y. Wang (2015) information is a general form of abstract objects perceived by humans and represented by different systems. Wisdom is the strategic perspective of decision-making, which symbolises related cognitive capabilities of the Decision Maker (DM) (Nurulin and Skvortsova, 2018). Tuomi (1999) has argued that the DIKW hierarchy should actually be reversed contradicting the classical DIKW model. Another conceptualisation that has been forwarded by Spiegler (2000) states that DIKW relationship is a cyclical model in the form of a double hierarchy wherein data transforms to knowledge with information as the intermediate state with knowledge relapsing eventually to data with time, volume, reuse and application.

4.3 KVCMS BASED ON THE DIKW HIERARCHY

The model proposed by Ermine (2013) is based on conventional DIKW hierarchy. King and Ko (2001) and Powell (2001) have delineated DIKW transformation in customised or modified configurations. The KVCM presented by King and Ko (2001) is predetermined in the form of a conceptual framework for evaluating the advancement of KM processes of acquiring, disseminating, and utilising information and knowledge within a learning organisation and as a basis for planning and designing KM in a learning organisation. However, they conceded the linearity of the model as a limitation, since dissemination and feedback loops had not been set out. Powell's (2001) model is the most significant model out of the group since it provides KW and DM classifications designating KWs to acquire and develop data up to knowledge and DMs to exploit such knowledge for strategic planning to gain competitive advantage.

4.4 OTHER KVCMS

Other models vary considerably from one another in terms of the model basis, model features, model structure and applications. Even though Spinello's (1998) model has got certain characteristics of the Porter's value chain, it is not exactly analogous to the Porter's model. Its continuous knowledge flow in a circular motion in particular is a salient feature that deviates from Porter's concept. Y. Xu and Bernard (2010) have designed their model to overcome the limitation of linearity by acquiring a multi-dimensional facet of the knowledge context. Moreover, the model controverts DIKW hierarchy and affirms that knowledge matures in terms of state and context rather than from its upward evolvement through the DIKW pyramid. On the other hand, Eustace (2003) has presented a new dimension of KVCM by integrating different perspectives of discrete interest groups into the Porter's value chain system in terms of knowledge.

4.5 COMPARISON OF KVCMS DEVELOPED IN THE PREVIOUS STUDIES

When the KVCMs of the three categories are compared, it is revealed that each model has its own distinct features, each of which either curtails or compliments the others. Table 2 summaries these features.

Table 2: Summary of the KVCMs analysed

Feature / KVCM	A	B	C	D	E	F	G	H	I	J	K	L	M	N
Applicability to a specific functional unit														
Replacement of primary activities with KM activities														
Replacement of secondary activities with KM activities														
Existence of support activities														
Segregation into the two compartments assigned to KWs and DMs														
Understanding among KWs and DMs														
Endorsement of the conventional DIKW hierarchy														
Endorsement of an enhanced/extended DIKW hierarchy														
Establishment of feedback loops														
Emphasis placed on lessons learned practices														
Correlation of KM activities with the DIKW hierarchy														

Legend: Significant | Affirmative | Overlooked | Objected | Irrelevant

Features tabulated in Table 2 are considered as crucial in developing a KVCM for competitive tendering. It is noteworthy that in the previous models most of the decisive features such as KW/DM classification, DIKW hierarchy, feedback loops, and lessons learned practices have been overlooked. It has to be further noted that pitfalls could be avoided by establishing synergy through correlation of KM activities with the DIKW hierarchy, which is not present in any of the previous KVCMs.

5. RESEARCH METHODOLOGY

Critical reviewing of literature is an integral part of a research which is vital for the creation and fine-tuning of the research goals (Saunders *et al*., 2009). Therefore, this study too included a literature review, which was followed by 15 face-to-face semi-structured interviews conducted with practicing Chartered Quantity Surveyors (QSs) who had more than 10 years of experience in tendering. Each interview spanned for about 45-60 minutes. Purposive sampling was used to select the interviewees considering their knowledge and experience in the field as well as their availability for the interviews and their willingness to participate in the interviews (Etikan *et al*., 2016). The data collected were analysed manually using content analysis, since then the data volume to be handled

can be minimised and also be categorised to enhance their contextual meaning (Bengtsson, 2016).

6.   DEVELOPMENT OF THE CONCEPTUAL KVCM

The KVCM for competitive tendering in construction organisations was developed incorporating the above mentioned characteristics identified from the perspective of a construction organisation. The strategy was to incorporate into the new KVCM, the noteworthy features of the already available KVCMs and refining them further to suit the context, based on the expert interview findings. The new KVCM was based on Powell's (2001) model because of the strong resemblance of the latter to the tendering unit structure of construction organisations. Accordingly, the KVCM developed consisted of two sub-divisions, namely 'Knowledge Production' (KP) and 'Knowledge Utilisation' (KU) with their responsibilities assigned to 'KW's and 'DM's respectively. It also comprises a chain with 'States' for which cross links have been established to a set of activities termed 'Activities' which progress towards 'Competitive Advantage'. States delineate an extended DIKW hierarchy. Activities are classified as 'Primary Activities', 'Secondary Activities' and 'Support Activities'. A 'Feedback Loop' for lessons learned has been established along with 'Understanding' among KWs and DMs. Figure 1 presents the final outcome.
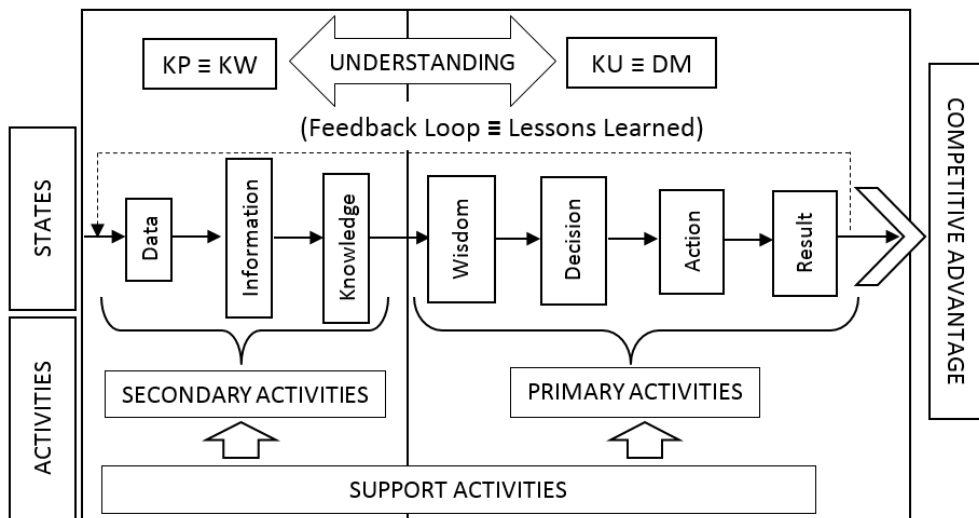
Figure 1: KVCM for competitive tendering in construction organisations

Sources that contributed to the attributes of the KVCM are tabulated in Table 3.

Table 3: Sources of the attributes of the KVCM

Attribute	Source
Sub-dividing as 'KP' and 'KU'	Adapted from Powell (2001) and J. Xu *et al*. (2010)
'KW' and 'DM' Assignment	Adapted from Powell's (2001) model
Terms 'States' and 'Activities'	Adapted from Powell's (2001) model
'States' of the KP Side	Based on Ermine's (2013) model and DIKW Hierarchy
'States' of the KU Side	Adapted from Powell's (2001) model
Linear Chaining of the Stages	Adapted from all models except Spinello's (1998) model

Attribute	Source
'Primary' and 'Secondary' Activities	Adapted from Almarabeh *et al.*'s (2009) model
'Support activities'	Adapted from all KVCMs based on Porter's value chain model except Almarabeh *et al.*'s (2009) model
'Understanding'	Adapted from Powell (2001) and Almarabeh *et al.* (2009)
'Feedback Loop'	Adapted from Spinello (1998), Powell (2001), and Chen *et al.* (2004)

The sub-division of the KVCM into two compartments was based on the two sets of activities given in the Powell's (2001) model, namely 'Knowledge Acquisition' and 'Knowledge Application'. The terminology used for KP and KU was adapted from J. Xu *et al.* (2010). KP considers knowledge as an organisational asset embedded in the 'business product', whereas KU focusses on the economic aspects (J. Xu *et al.*, 2010). J. Xu *et al.* (2010) were of the view that the two terms focussed on the physical aspects of knowledge embellishing knowledge in a business setting. Therefore, the adapted nomenclature justifies the DIKW transformation in a profit-oriented organisation which in this study is a construction organisation. Powell's (2001) model distinguishes between 'States' and 'Actions' with 'States" as "stages of processing" and 'Actions' as "transformation needed to move to the next stage of processing" (p.3). This feature is incorporated in the KVCM using the terminology 'Activities' in order to circumvent confusions with the state 'Action'.

The first four states of KVCM resemble the DIKW chain, which is a significant feature in Ermine's (2013) model. States of the KU side which succeed 'Wisdom' are 'Decision', 'Action', and 'Result' which are similar to what is given in the Powell's (2001) model. However, 'Intelligence' in the Powell's (2001) model has been replaced with 'Wisdom'. According to Ermine (2013), 'Wisdom' includes both individual wisdom and organisational wisdom. Therefore, the term 'Wisdom' is expected to be more explanatory in an organisational setting, even if it complements 'Intelligence'. Nurulin and Skvortsova (2018) have introduced 'Understanding' amidst knowledge and wisdom within the DIKW hierarchy to ensure a smooth transition of the states. 'Understanding' is the ability to create new knowledge from existing knowledge, while 'Wisdom' is the "evaluated understanding" (Grzegorzewski and Kochanski, 2019, p.18). According to Powell (2001), 'Shared Understanding' between a KW and DM governs the quality of the process. Besides, it would not be fruitful, if KWs' efforts were dedicated on a task that DMs are not interested in strategically implementing (Powell, 2001). Almarabeh *et al.* (2009) have also remarked that a pitfall in 'Common Understanding' would result in the failure to achieve the activities at the expected quality. Hence, 'Understanding' between a KW and DM is established as an integral component of the KVCM.

In Almarabeh *et al.*'s (2009) model, all generic activities are KM activities assigned distinctly to KW and DM. Thus, activities of this KVCM are categorised as 'Primary Activities' and 'Secondary Activities'. The postulation of knowledge related infrastructure or enablers was adopted from KVCMs based on the KM framework (except Almarabeh *et al.*'s (2009) model) and those were referred to as 'Support Activities'. Feedback loops are not straightforward except in Powell's (2001) model. However, knowledge circulation in Spinello's (1998) model is circular, which implies continuous

feedback. Chen *et al*. (2004) have included 'Two-way contribution' in their model, which is another intimation of feedback. King and Ko (2001) have considered the shortfall of feedback loops as a limitation of their model. Nevertheless, the feedback loop is an indispensable component of the KVCM developed in this study. Most importantly, the intention was to correlate KM activities with state transformation, which is absent in all of the other KVCMs. This feature was introduced to upgrade the KVCM through collaboration.

7.   DISCUSSION

Even though the term 'Knowledge' is used to indicate knowledge circulation, what is actually processed is data and not knowledge (Garrick and Chan, 2017). The KVCM developed is consistent with this notion as it illustrates DIKW transition in the model. According to Ye (2016), DIKW hierarchy is transferable from being a hierarchy to being a logic chain. KVCM has disintegrated the DIKW hierarchy into a chain with extended states of Decision, Action and Result. Spiegler (2000) put forwarded the concept of double hierarchy of the DIKW relationship in the form of a cyclical model. The KVCM developed in this study incorporates a feedback loop which is an important feature that promotes lessons learned practices. The strategic implementation of knowledge in an organisation is guaranteed by feedback loops in respect of learning, since they proliferate organisational learning (Versiani *et al*., 2018). Accordingly, feedback loops in the KVCM imply the concept of organisational learning. In addition, KP and KU compartments have been entrusted to KWs and DMs respectively. This terminology of KW and KP was prominent in the models of both Almarabeh *et al*. (2009) and Powell (2001). Besides, in L. C. Wang and Ahamed's (2005) model, the terms 'Knowledge Provider' and 'Knowledge Seeker' imply a corresponding notion. While Nonaka considered all employees of an organisation as KWs, Drucker considered only the employees with 'specialised knowledge' as KWs (Gao *et al*., 2008). Nevertheless, this study uses Nonaka's concept in order to ensure a comprehensive approach and considers all employees involved in competitive tendering as KWs who contribute to the KVCM.

8.   CONCLUSIONS AND THE WAY FOREWORD

The KVCMs developed in the past have been proposed for generic organisations with a holistic view. Since it was found that the concept would also be applicable to construction organisations, this study attempted to narrow down its scope to a specific function; competitive tendering. Accordingly, attention was focused specifically on competitive tendering rather than on the construction organisation as a whole. On the other hand, each individual KVCM that has been proposed so far has its own merits and demerits. Hence, synergy among these models would reduce the drawbacks and increase the benefits. The conceptual KVCM developed in this study contains the dominant features of the previously proposed KVCMs to minimise the drawbacks of those models and tailor their features to suit competitive tendering within construction organisations. However, it incorporates only the characteristics of the 14 models that were reviewed. It is also confined to estimating and pricing a tender by a construction organisation. Another limitation of the study is that the conceptual KVCM developed has not been validated using rigorous scientific methods. Nevertheless, the unique characteristics of these models include the feedback loop symbolising organisational learning and the correlation of the KM processes with the DIKW hierarchy. It has to be further noted that the

'Activities' of the KVCM have not been distinctly defined since certain features of construction organisations affect the KM processes. Therefore, it is recommended that the pragmatic implementation of the KVCM be made in the form of a 'KVC framework' to engage knowledge for value creation in competitive tendering so that competitive advantage could be gained. It is recommended that further studies be done to develop a KVC framework based on the primary, secondary and support activities of the KVC to suit the inherent features of the different genres of organisations.

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