

KNOWLEDGE CREATION IN CONSTRUCTION: THE SECI MODEL

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Creation of knowledge and the management thereof is of great importance if industry players are to survive in competitive environments. The Socialisation-Externalisation-Combination-Internalisation (SECI) model of Nonaka is one theoretical model of how tacit and explicit knowledge is processed within organisations. Research on knowledge creation in Construction Management (CM) has made reference to the SECI model, yet its applicability is not without criticism. Through a structured review of journals based in the CM domain the application of the SECI model to construction enterprises, as well its acceptability is explored. Drawing from this review, arguments for and against the adoption of the model are presented and contextualised with critique from mainstream management research. The review thus provides the basis for judging the applicability and merits of the SECI model in Knowledge management research; and more specifically reference to knowledge dealing with CM related issues and how the SECI model can adequately be employed here.

Keywords: knowledge creation, learning, review.

INTRODUCTION

The role of knowledge in determining a company's ability to succeed in its domain has been highlighted by various authors (Egbu and Botterill, 2001, Dodgson, 1993, Spender and Grant, 1996). Knowledge is seen as an essential ingredient for the economic success of any organisation (Drucker, 1993). Over the past decade or so this notion has led to the increased interest by academics in organisational learning; a field in management sciences which incorporates aspects such as information processing, knowledge creation and knowledge management (Easterby-Smith, 1997).

Various theories on how companies create and manage knowledge have been proposed. These theories often stem from work around quality management where the objective is to improve processes as part of (internal) quality management systems (e.g. Argyris, 1977), or from work on competitiveness and the need to expand a companies' knowledge base (e.g. Szulanski, 1996). A further theory on knowledge within organisations has been developed by Nonaka and his colleagues. Judging by the amount of citations identified by the SCOPUS database that were linked to the work of Nonaka (284 citations linked to 4 out of the more than 30 published articles by Nonaka and his co-authors), this theory has obviously attracted the attention of other researchers. Nonaka is attributed with introducing the differentiation of tacit and

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explicit knowledge into organisational learning theories (Gourlay, 2006, Hari *et al.*, 2005). The developed SECI model sees knowledge converting through a continuing spiral of Socialisation, Externalisation, Combination and Internalisation (Nonaka, 1994). This work has later been extended through work by Nonaka and Konno (1998) to address the place or contexts where these conversions take place; the Ba's and Basho.

While the theory developed by Nonaka has led to a degree of consensus amongst academics, critiques concerning various aspects of the model exist. The actual process on how the model was developed (e.g. Gourlay, 2006), the theoretical underpinnings of the model (e.g. Griffin *et al.*, 1999), as well as the final product (e.g. McAdam and McCreedy, 1999) are just some arguments used to question Nonaka's theory. Since knowledge management (KM) and organisational learning are playing an increasingly important role in the construction industry (Palaneeswaran *et al.*, 2004, Suresh and Egbu, 2006) support for, and critiques of Nonaka's theory from other academic disciplines need to be taken into account before one can attempt to judge the applicability of the SECI model in construction management (CM) research.

In order to focus on Nonaka's theory and its contribution to CM research a systematic review of the application on the SECI model within the CM discipline was conducted. The results frame the current use, status and popularity within the CM research community, help to identify existing support and critiques from within the CM domain, and thus aid the understanding of the current relevance of the SECI model for CM research. Following this a wider review of the SECI model is presented, to inform CM researchers of the existing support and critiques that have emerged from other academic realms. Through this CM researchers can relate their own experiences to the opinions of peers in other fields. By having a fully rounded understanding of the role of the SECI model within CM research, backed up with the observations by scholars from other fields, researchers will be better placed to judge the applicability and relevance of the SECI model in CM research. In pointing out specific areas within CM research where the model might prove to be useful or not, researchers will be assisted as they contrast their work against Nonaka's.

ORGANISATIONAL LEARNING AND THE SECI MODEL

As previously mentioned a variety of models and theories on organisational learning exist. Examples include the work of Argyris (1977) and later Argyris and Schön (1978), who developed the concept of loop learning, or Levitt and March (1988) who stress the point of the ecology of learning. The model of Argyris and Schön (1978) essentially differentiates between various levels of how organisations learn and the actions they take resulting from the lessons learnt. 'Single loop learning' is where an action is taken due to an experience and the resulting (remedial) action only influences the same possible future experience but does not necessarily address underlying assumptions, routines etc. In contrast 'double loop learning' (Argyris and Schön, 1978) is concerned with recognising past experiences and rather than simply reacting with an immediate responses, involves questioning underlying organisational problems or assumptions – and consequentially addressing or changing these problems or assumptions.

Levitt and March (1988) describe a more subtle way in which organisations learn. Conscious efforts resulting from experiences are less pronounced and promoted, yet actions resulting from experiences – learning by experience – are the crux of their discussion. For Levitt and March learning is embedded in organisations and they

emphasise the importance of ‘encoding inferences from history into routines’ in organisational learning.

Nonaka and Konno (1998) take a wider approach to learning than either Levitt and March or Argyris and Schön. The SECI model of Nonaka and Konno constitutes four stages of learning – as opposed to the more limited single stage of translation of Levitt and March. The four stages proposed by Nonaka and Konno (1998) are Socialisation, Externalisation, Combination, and Internalisation. All stages of the SECI model are based on the Japanese concept of ‘Ba’ (meaning ‘place’). Socialisation is concerned with experiencing circumstances, ideas or values. In essence the knowledge experienced can be described as tacit. ‘Physical proximity’ (Nonaka and Konno, 1998) is essential to this experience. This Socialisation occurs in the ‘Originating Ba’ (Nonaka and Konno, 1998). In order to disseminate tacit knowledge, originating through Socialisation, a form of Externalisation needs to take place. Externalisation is concerned with making tacit knowledge explicit. According to Nonaka and Konno Externalisation is supported by two factors, namely: articulation of tacit knowledge and the translation of tacit knowledge. The platform in which this happens is called the ‘Interacting Ba’ (Nonaka and Konno, 1998). Combination refers to capturing, disseminating, and editing explicit knowledge. Knowledge that has surfaced through Externalisation can now be captured and presented to other group members in a formal manner. At this stage the new tacit knowledge often held by an individual of a group is now made available to the group through the process of Externalisation and combination in the ‘Cyber Ba’ (Nonaka and Konno, 1998). The final stage through which knowledge runs is called the Internalisation stage. At this stage the new knowledge will be internalised by the group members. New working patterns are entrenched in organisational behaviour through repetitive application. The platform of this Internalisation is called the ‘Exercising Ba’ (Nonaka and Konno, 1998), through which group members exercise new explicit knowledge and subsequently internalise this knowledge. At this stage the new knowledge is made tacit again. Experiences of the new knowledge are then communicated with other team members through face-to-face interaction (Socialisation), adding new features to knowledge and thus the spiral continues. The explicit and tacit form of knowledge, the environments of the conversions, and the role of the carriers of knowledge are emphasised in this model.

THE SECI MODEL AND CM RESEARCH

Systematic review

The use of the SECI model to explain findings or develop models in the CM discipline is explored through a review of CM publications. Through this exploration the extent of the acceptance of Nonaka’s theory within the CM domain can be framed. Due to the absence of access to an all-encompassing CM database, the systematic review included four of the highest ranked journals in the Construction Management field. This ranking was taken from Wing (1997). Of these publications contribution published since 2004 were scrutinised. Further ARCOM proceedings from 2005 to 2008 were used as a base for the literature search. The bibliographic references of the concerned publications were screened for references to Nonaka. The search within the four journals resulted in a total of 28 papers which refer to Nonaka’s work. The ARCOM proceedings delivered 14 sources. Counteracting the limitation of this systematic review with its restriction on few publications only, the base for the latter discussion of the role of the SECI model in CM was enriched through papers collected by the authors over several years. The limitations of the findings presented below,

stemming from the number of publications accesses, are acknowledged. A wider review might have resulted in more CM contributions dealing with the matter. Yet it is believed that most of the core-authors in the field dealing with KM were captured.

In the cases where Nonaka was used as a reference, the role of Nonaka's reference within the respective paper was assessed. Two broad categories in the use of the SECI model in publications can be distinguished: Firstly, the use of the Nonaka's work to prop an (own) argument, and secondly, the discussion of the SECI model and possible further development and enrichment thereof. Thus the analysis of the publications screened can thus be separated into these two categories accordingly. A similar approach in classifying citations to particular research work can be found in Søndergaard (1994) who distinguished between four categories in his meta-analysis when reviewing the work of Hofstede.

The use of the SECI model in CM

The bulk (30 of the 42 papers) of the literature found referring to Nonaka's work used his initial ideas to underpin their own starting points. Typically scholars refer to Nonaka's book 'The knowledge creating company', co-authored by Takeuchi (Nonaka and Takeuchi, 1995) which elaborated on Nonaka's initial SECI model, presented in earlier publications (Nonaka, 1994, Nonaka, 1991). Two points raised in the book, which are also discussed in the earlier work of Nonaka, are frequently referred to by CM scholars. Firstly; that a differentiation between tacit and explicit knowledge needs to be considered (e.g. Hari *et al.*, 2005, Carrillo and Chinowsky, 2006) and secondly; that knowledge (management) is key to success for companies to survive (e.g. Xiao and Boyd, 2006). Both these points are neither original to Nonaka, nor new of themselves. Nonaka himself draws from the work of Polanyi (1966) to introduce the distinction between tacit and explicit knowledge. However it was Nonaka who first saw the importance of this distinction and the need to apply this to organisations (Nonaka, 1991). He sees the organisations role of importance when creating knowledge, as "the organisation supports creative individuals or provides a context for such individuals to create knowledge". (Nonaka, 1994). Yet this contribution of Nonaka to KM research per se has also been acknowledged by CM scholars in their respective texts (e.g. Egbu, 2004). As mentioned above the second notion attributed to Nonaka refers to knowledge as being key for companies to survive in a competitive environment. While Nonaka illustrates and emphasises this point through his work, using mostly Japanese companies as examples, it was not Nonaka who brought this argument forward. Nonaka (1994) refers to P. Drucker's text 'The Age of Discontinuity: Guidelines to Our Changing Society' of 1968 and other texts to point out the importance of knowledge in modern societies. As such these references could have been used by CM scholars to underpin their opening statements found in the earlier parts of the respective texts (e.g. Kivrak *et al.*, 2008).

While various CM authors actually engaged with Nonaka's work and point out particular ideas developed by Nonaka, only 12 of the found articles engage with Nonaka's core work—the SECI model in its entirety. These 'Nonaka using contributions' (NUC) typically use the SECI model as a base or 'starting point' (Maqsood *et al.*, 2007) for empirical work presented. Implicitly most of these NUCs support the application of the SECI model and its validity. KM and knowledge creation practices are scrutinised by various authors. Using the SECI model as a base, the NUCs scrutinise KM practices in client organisations (Boonyanan *et al.*, 2008), client representative practices (Lu and Sexton, 2006), contracting companies

(Teerajetgul and Charoenngam, 2006) but also in looking at projects and KM herein holistically (Senaratne and Sexton, 2008). While all of the NUCs use the SECI model as a base for their own work, either as a general framework, analytical tool, or as a vehicle for developing their own perspective of the knowledge creation process (resulting in variations of the SECI model), the absence of critique of the SECI model is startling. Only four of the above mentioned NUCs show signs of critical engagement with the SECI model. Senaratne and Sexton (2008) point out that the SECI model is criticised on its premise that knowledge can be codified and that a process view of KM is underrepresented. They develop a modified SECI model with an emphasis on the 'S' – the social interaction – and hence affirm the support for social construct models for KM. This base is further supported by Maqsood *et al.* (2007) who take the SECI as a starting point, using its differentiation of tacit and explicit knowledge, yet indirectly criticise it by pointing out the same under-representation of the 'S'. Arif *et al.* (2009) use the SECI model as well as other KM models to develop their own model which has an emphasis on knowledge retention. While generally endorsing the SECI model, for Arif *et al.* (2009) the SECI model does not adequately address the issues of organisational memory and knowledge storage. The developed model does however mirror the SECI model with its emphasis on the 'I'. Through a case study using a construction consultancy, Arif *et al.* then validate their own model. The fourth NUC to be mentioned is Boonyanan *et al.* (2008). While not directly criticising Nonaka's work, the authors identify imbalances in the SECI model through their findings. Here it appears that the 'S' and 'E' stage of the SECI model play a more important role in the creation of knowledge.

GENERAL CRITIQUE OF THE SECI MODEL

The work of Nonaka is widely used and is acknowledged as a key work in the KM domain (Schütt, 2003), some authors even refer to Nonaka as a 'guru' (Li and Gao, 2003). At the time of an early publication of Nonaka's work (1994) Arie Lewin wrote in the editorial preamble to this publication: "It provides a conceptual framework for research on the differences and similarities of learning by individuals, groups, and organisations." The work of Nonaka points out the complex relation of knowledge, knowledge creation and learning (Easterby-Smith, 1997), distinguishing between tacit and explicit knowledge, and introducing contextual factors to the KM domain by pointing out the various 'Ba' in which the two modes of knowledge are converted. Literature using and positively supporting the SECI model is available in abundance (see Capurro, 1998). Yet critiques on the work of Nonaka exist, although they are not to be found in large numbers (Gourlay, 2006). The critiques found often touch on issues such as the empirical evidence of Nonaka's work, the apparent misinterpretation of existing theories evident in Nonaka's work, and the usability of the developed model per se.

In a battering publication Gourlay (2006) stresses the lack of scientific evidence in Nonaka's work for the developed SECI model. For Gourlay this is proof that the methodological approach in developing the model was ill-suited and that the model was largely based on intuition. Acknowledging a survey conducted by Nonaka and others, he argues that questions were focused on the content of knowledge, whilst the resulting SECI model is concerned with processes (Gourlay, 2003). Furthermore, the approach taken by the survey is questionable, as constructs were introduced through a questionnaire without prior work to verify these constructs. For Gourlay (2003, 2006) the oft-cited example of the bread-making machine (Nonaka, 1991:98) is not good enough. The work of Nonaka (e.g. Nonaka, 1991, Nonaka, 1994) does indeed lack

methodological clarity and appears to be a theoretical construct based on case-study observations. In general this critique possibly is best countered by referring it to the ongoing paradigm debate of constructivism vs positivism. As such it is less a critique of Nonaka's work as much more a critique of the mixed approach taken. However, and Gourlay acknowledges this, Nonaka asks for his model to be tested and enriched through evidence – a situation possibly similar to Einstein's relativity theory or Hofstede's dimensions of culture. With some of the above NUCs using and enriching Nonaka's SECI model, some CM scholars have already contributed to the needed testing of the model and giving it empirical underpinnings.

A further point of critique is Nonaka's interpretation and employment of the notion of tacit knowledge. By adopting Polanyi's (1966) distinction between tacit and explicit knowledge, Nonaka uses this distinction as the base for his model in which tacit and explicit knowledge sees ongoing conversions. Some (e.g. Schütt, 2003) argue that Nonaka's treatment of the nature of knowledge and its convertibility from one form to the other does not capture the essence of Polanyi's thoughts. Gourlay (2006) interprets Polanyi to see tacit and explicit knowledge as a continuum, both interwoven with each other. Nonaka indeed appears to distinguish knowledge in two discrete types (Nonaka, 1994). McAdam and McCreedy (1999) join the critique and state that a "Nonaka's categorisation of knowledge is perhaps limited or unidimensional". This criticism of mis-using Polanyi's thought and fateful differentiation of knowledge must however, been seen in the correct light. Nonaka (1994) aims to make the philosophical description of Polanyi more workable and in attempting to do so he possibly simplifies Polanyi's position. Yet through the notion of the spiral and the ongoing SECI process with the underlying conversions of tacit and explicit knowledge, a certain degree of continuum of tacitness-explicitness is implied and evident. To portray the SECI model as a model that relies on a distinction between the two forms of knowledge equally a simplification of Nonaka's work in return. Should Nonaka have seen these two forms of knowledge as separate entities, a 359 degree circle with two ends, rather than a spiral, would have been the model. Further it may be added that in later works of Nonaka (e.g. Nonaka and Konno, 1998) an emphasis is placed on the place ('Ba') of knowledge conversion, rather than on the type of knowledge. A far more striking point with regards to the form of knowledge is made by Li and Gao (2003) who warn scholars not to use the SECI model without understanding the meaning of the term 'tacit' in a Japanese context. They point out that in fact Nonaka's tacit knowledge has two parts: tacitness and implicitness. With the latter somewhat easier to manage and mobilise than the former.

The final point of criticism of Nonaka's hinges around the final product; the SECI model itself. While some writers caution that the model should not be used as the elixir for understanding KM issues in organisations without prior thorough investigation of the organisation concerned, including an assessment of tacit knowledge present (Li and Gao, 2003), others argue that the model is too mechanistic (McAdam and McCreedy, 1999). For McAdam and McCreedy the SECI model is part of an old (positivist) paradigm and misses the 'social side of knowledge construction'. Schütt (2003) describes the SECI model in a similar way where 'knowledge can be moved like a thing' and part of the old generation KM model. In this critique the nature of the spiral seems to be neglected too. It is also interesting to reflect this critique with critique raised earlier in the text. With Gourlay (2006) objecting to the intuitive and unstructured methodology used by Nonaka – typically a sign of a constructivist approach – it is questionable if the results are truly positivistic. A

striking point of critique of the model itself however is the non-consideration of the possibility that actors in the Ba are ‘becoming stuck in some stable dynamic’ (Griffin *et al.*, 1999). For the authors of this NUC this is the question of where does the SECI spiral get its ‘fuel’ from for the continuous knowledge creation process?

USABILITY OF THE SECI MODEL IN CM

Nonaka developed his SECI model using data mainly collected from the Japanese manufacturing sector, with the automotive industry contributing significant insights. Li and Gao (2003) point out that this data centres around observations at assembly lines in manufacturing companies and caution must be taken to use the model elsewhere. Indeed most of the core arguments and examples used by Nonaka are drawn from the manufacturing industry, yet the scenes portrayed are set away from the assembly line in the product development units (e.g. the bread making machine innovation process or the young Honda engineers (cf. Nonaka, 1991)). The authors of this paper would argue that the innovation processes as described by Nonaka are not unique to one type of industry and the efforts by elements of the CM community to adopt lessons from the field of New Product Development (e.g. Kagioglou *et al.*, 2000) support this. Similar examples of innovation can be drawn from within construction too. Learning skills through apprentice-mentor relationships (Gamble, 2001) show signs of the SECI model, and the NUCs as mentioned above are further examples of seeing the SECI model applied in construction. In CM it is used as an analytical tool as well as a foundation for modified versions thereof.

The project-based nature of construction makes the SECI model particularly interesting. Stable dynamics (Griffin *et al.*, 1999) are less likely to happen, as organisations in construction see themselves constantly interacting with the Basho – Nonaka’s term for describing the ‘greater place’ of interaction. Thus through interaction new ‘fuel’, new ideas which can be adapted through SECI, is injected in the SECI spiral and knowledge creation can thus continue. The SECI model is particularly interesting if used in the project context. Various actors with different backgrounds from different organisations interact in informal communities, which according to Nonaka (1994) can include suppliers (e.g. sub-contractors) or customers (e.g. engineers as client representatives). For the analysis of projects and organisations in developing countries in particular the SECI model appears appealing. Here through the pressure to innovate and grow learning, on an individual basis but also within organisations, plays an important role. Through interaction with others in the Basho in particular the large numbers of Small and Medium Enterprises (SMEs) are exposed to learning opportunities. In many developing countries a collection of established companies exists, yet the untapped resources of SMEs may hold the key for sustainable development (Ofori, 1991, South Africa, 2000). However in the case of South Africa many SMEs, often owner/manager centred entities, seem to fail in competitive markets and their development is hampered through a lack of knowledge. Bringing established companies and SMEs (in a South African context often labelled emerging companies) together presents obvious opportunities for learning by the latter. Project based interactions in the form of supplier-contractor, sub-contractor-contractor and Joint Ventures are just some of contact points in which Socialisation – the start of the SECI spiral – can take place. Further opportunities to start the SECI spiral could be interactions with client representatives – typically specialists in their field. Through these types of interaction knowledge creation within projects, also but not only benefiting emerging contractors, can be fostered. Interactions and learning through these can be explained using the SECI model, the Ba and the Basho. Work by authors

outside CM (e.g. Desouza and Awazu, 2006) focusing on SMEs with their owner-centred characteristics has already shown that Nonaka's work can be successfully applied here. Not only the Socialisation phase as the starting point, but also the Ba and the Basho, which form the context of the knowledge conversion processes, seem to be of particular importance. It is here where emerging contractors are exposed to the SECI conversion and thus could learn. Its suitability is of importance if learning wants to be fostered. The very notion of the Ba with its various levels including individuals, groups and organisations make the SECI model in particular suitable for investigations of learning as experienced by a small emerging contractor in any form of co-operation. The design of the SECI model is further of such a nature that all four conversion stages can also be adopted for describing and analysing activities of a particular individual only; the owner/manager of an SME is at the centre of learning. In case of these SMEs in South Africa it is the owner/manager who is the main figure interacting within the Ba's and the Basho.

CONCLUSIONS

The number of CM authors referring to Nonaka's work is a sign of the status his work holds within the CM domain. Based on the reviewed contributions one can conclude that critique from within the CM domain is low. Yet the actual appeal of the SECI model as an analytical tool or as a base for development of modified, tailor-made models has yet to be appreciated by CM authors concerned with KM or organisational learning. A wider critique of Nonaka's work from outside the CM domain exists - although this limited in numbers. This critique however is not only shown to be largely based on misinterpretations of Nonaka's work, and is almost proven immaterial through the wealth of work employing Nonaka's work successfully. The SECI model can be used in CM research. Here the strength of the SECI model, its emphasis on conversions of knowledge, can be combined with project-based the nature of the construction industry, allowing individuals and organisations to constantly entering SECI spirals. In particular the Socialisation phase appears to play an important role.

The SECI model also shows its suitability when applying it to the context of developing countries with its owner-managed small emerging contractors, in need to develop their capabilities and knowledge base. The SECI model with its Ba's can be applied here in two ways: as an analytical tool to describe SECI conversions, but also as a base for developing Ba's and Basho's fostering 'high quality' (Nonaka, 1994) learning experiences.

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