Tacit Knowledge Generation and Utilisation in the Construction Industry: from Process Perspective

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The importance of knowledge as a key determinant of organisational competitiveness and better performance is increasingly appreciated by both academics and practitioners. However, the concept of tacit knowledge still lacks sufficient attention within the construction industry, despite the fact that proper understanding and management of this resource is of immense importance for the achievement of better organisational performance. As the initial step towards the management of tacit knowledge, this paper examines the factors affecting tacit knowledge generation and utilisation in the construction industry. The study integrates theories of experiential learning, cognitive science and knowledge creation, in order to articulate the process of tacit knowledge generation and utilisation. The exploratory phase of the case study identified several factors affecting tacit knowledge generation and utilisation in an organisational context in terms of Individual level: Intra-personal drivers; Group level: Inter-personal drivers; and Organisational level: Situational drivers.

Keywords: Tacit Knowledge, Construction Industry, Generation and Utilisation

1. Background

As a consequence of increased recognition of knowledge as a valuable organisational resource within the business community, there is a growing concern in organisations' efforts to purposely manage knowledge in a systematic manner. Successful organisations are characterised by their ability to consistently create new knowledge, quickly disseminate it, and apply it in their new

products and services. Despite various definitions and classifications of knowledge, work by Polanyi (1958), Nonaka and Takeuchi (1995), divided knowledge into tacit and explicit. Although knowledge could be classified into personal, shared and public; practical and theoretical; hard and soft; internal and external; foreground and background, the classification of tacit and explicit knowledge remains the most common. As Nonaka et al., (2000) defined, tacit knowledge represents knowledge based on the experience of individuals, expressed in human actions in the form of evaluation, attitudes, points of view, commitments and motivation. Explicit knowledge, in contrast, is codifiable knowledge inherent in non-human storehouses including organisational manuals, documents and databases. Accordingly, recent discussions on knowledge reflect on two perspectives: 'knowledge as an asset' and 'knowing as a process.' When knowledge is seen as a 'thing', codification strategies, which specifically disseminate explicit knowledge through person-to-document approaches, are considered; whilst personalised strategies, which specifically disseminate tacit knowledge through person-to-person approaches, are considered when knowledge is seen as a 'flow' (Al-Ghassani et al., 2005; Hansen et al., 1999).

As Herrgard (2000) and Empson (1999, 2001) contended, organisations' knowledge resources can be described as an iceberg. The structured, explicit knowledge is the visible top of the iceberg, which is easy to find and recognise and therefore also easier to share. Beneath the surface, invisible and hard to express, is the momentous part of the iceberg. This hidden part applies to tacit knowledge resources in organisations. It cannot be managed and taught in the same manner as explicit knowledge. Even if coded knowledge is easier to diffuse, the role of tacit knowledge is often essential for being able to use coded knowledge. In the context of the knowledge economy, the generation and utilisation of tacit knowledge is considered to be the real driver for performance enhancement (Quintas, 2005). Tacit knowledge could further be classified into two dimensions knowingly: the technical and the cognitive dimension (Herrgard, 2000). The technical dimension encompasses information and expertise in relation to 'know-how' and the cognitive dimension consists of mental models, beliefs and values (Gore and Gore, 1999), in short, conception of reality. Therefore, it is imperative to examine the cognitive human process to understand better tacit knowledge, and how it is generated and utilised, before managing it.

The paper aims to explore the factors affecting tacit knowledge generation and utilisation in the construction industry, based on a study which investigated the process of tacit knowledge management in a construction organisation. Accordingly, the paper is broadly divided into four

sections. Initially, tacit knowledge and factors affecting its generation, and utilisation are discussed. Secondly, the paper introduces the research methodology followed for the research. Next, findings from the case study investigation are presented. Finally, the paper culminates with a discussion on the factors effecting tacit knowledge generation and utilisation in the construction industry.

2. Tacit knowledge generation and utilisation

Researchers like Varela et al., (1991), von Krogh & Roos (1995) and Venzin et al., (1998) have based their work on cognitive science, which has been the most influential (Koskinen, 2001) for scientists studying organisational knowledge. Accordingly, three different epistemologies are suggested i.e. Cognitivist epistemology (represented by Simon, 1982), Connectionistic epistemology (represented by Zander and Kogut, 1995) and Autopoietic epistemology (introduced by Maturana and Varela, 1980), to explain some core questions such as; what is knowledge, how does it generate, and what are the conditions for knowledge to generate? Cognitivist epistemology considers organisations as open systems which develop knowledge by formulating increasingly accurate representation of their predefined world. Data accumulation and dissemination are the major knowledge development activities, the more data that can be gathered, the closer the representation is to reality. Hence, as Koskinen (2001) asserts, this approach equates knowledge with information and data. In connectionistic epistemology, however, the rules on how to process information are not universal, but vary depending on the relationship. Organisations are seen as self-organised networks composed of relationships and driven by communication. Similar to the cognitivist, information processing is the basic activity of the system, yet relationships and communication are the most important facets of cognition. Autopoietic epistemology provides a fundamentally different understanding of the input into a system. Input is regarded as data only. Autopoietic systems are thus both closed and open. Open to data, but closed to information and knowledge, both of which have to be interpreted inside the system. These systems are self-referring and the world is thus not seen as fixed and objective; the world is constructed within the system and it is therefore not possible to 'represent' reality (Sveiby, 2001). Vicari and Troilo (1999) describe this epistemology by the following example;

"When a teacher delivers a speech, two students build different knowledge according to their own attitudes, intelligence and previous knowledge. The transmission by the teacher is the same for the two of them, but the knowledge produced is different" (p. 5).

Hence, autopoiesis epistemology claims that cognition is a creative function and knowledge is a component of the autopoietic, i.e. self-productive process (Verala et al., 1991). This closely relates to the cognitive process of tacit knowledge, thus autopoietic epistemology is embraced as the philosophical basis of understanding tacit knowledge generation. To assist organisations to generate and utilise their tacit knowledge resources, it is necessary to focus on 'how' to support the generation of tacit knowledge held by individuals who work in an organisation. The construction industry is characterised with on-the-job learning and experience (Gann & Salter, 2000; Bresnen et al., 2003). Kolb's (1984) experiential learning model describes learning through 'doing'. Hence, Kolb's four stage cognitive model (refer to Figure 1), which expounds the theory that learning is cyclical, closely resembles tacit knowledge generation and utilisation in construction employees, which has been widely used and respected for its validity and reliability.

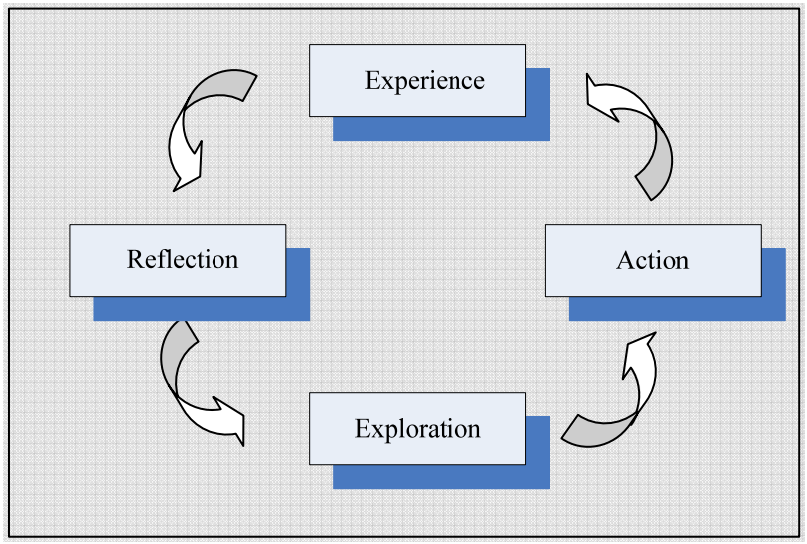

Figure 1: Kolb's Experiential Learning Model
(Adopted from Kolb, 1984)

These four stages could be described as: Experience - provides the basis or trigger for the tacit knowledge generation process e.g. active involvement, new problem etc.; Reflection - to gain an understanding of the current experience and process it in a way that makes sense of the experience; Exploration- assimilates and distils the observations and reflections into theory or concept; Action - based upon knowledge gained, develops a way to use and start to put into action. According to Kolb (1984), reflection after experience is paramount in order to learn from the past lessons and to generate tacit knowledge. This is further described by Schon (1983) who explains how practitioners reflect, based on their tacit knowing. Therefore, Kolb's experiential

learning model is embraced within this study to represent the cognitive process of the tacit knowledge generation and utilisation of construction employees. Moreover, this tacit knowledge generation and utilisation process is affected by several factors as described by Koskinen (2003) and Butcher et al. (1997).

2.1 Factors affecting tacit knowledge generation and utilisation

Koskinen (2003) categorises the factors that affect generation and utilisation of tacit knowledge in a project work context into internal and external factors. Internal factors are either possessed or under control of an individual, which influences both technical and cognitive dimensions of tacit knowledge. As suggested by Koskinen (2003) the internal factors can be further categorised into different groups which are called memory, communication, and motivational systems. Memory systems include experience, mental models, and intuition, in other words factors which function as constructs and manifestations of memory (and tacit knowledge) of an individual. Communication systems include interaction, language, and proximity, in other words factors which affect the communication of data, which is then interpreted to become knowledge. Motivational systems include commitment and trust. Commitment is a manifestation of the motivation of an individual, and the trust between the people involved motivates them to share and receive tacit knowledge (Koskinen, 2003). In a similar sense, Butcher et al. (1997), introduced the term 'Meta-Abilities' defined as personal, acquired abilities that underpin and determine how and when knowledge will be practiced within the organisation. The concept of meta-abilities was initially applied in the psychology area and then used within the organisational development area, since the organisations are developed on the basis of people. Four main meta-abilities were identified, namely; Cognitive skills: ability to notice and interpret what is happening in interpersonal situations; Self knowledge: seeing oneself through another's eyes; Emotional resilience: self control and discipline, the ability to use emotion well to cope with pressure and adversity; and Personal drive: self-motivation and determination, a willingness to take responsibility and risk. Thereby, meta-abilities, introduced by Butcher et al. (1997), in a way underpinned the similar factors suggested by Koskinen (2003) under the internal factors. However, Butcher et al. (1997) argued that meta-abilities create two humanistic elements. First, meta-abilities create an individual's influencing skills; and second, meta-abilities develop sharing attitudes. By practising these influencing skills and sharing attitudes, directly or indirectly, individuals are generating creative ideas, actions and reflection.

The external factors are called situational systems and they include leadership style and organisational culture, which define the situation in which tacit knowledge is utilised. Accordingly, this highlights that management of tacit knowledge is intrinsically concerned with both internal and external factors.

3. Research methodology

The case study approach was selected to investigate tacit knowledge management with a construction organisation. Due to the need of an in-depth, critical, longitudinal examination of the phenomenon, single holistic case study design was preferred, through which a holistic emphasis on tacit knowledge management process was placed. The study opted for a theoretical sampling strategy to select a theoretically significant and representative construction company. Selected case study was a UK company employing nearly 8,500 employees, involved with buildings and infrastructure projects, including facilities management. The overall case study investigation included two phases: an exploratory phase and an explanatory phase. However, this paper reports the findings based on the exploratory phase of the case study investigation. Eight interviews with company employees representing different levels of the staff i.e. senior level (two directors- DRT1 and 2), middle level (two managers- MGR1 and 2) and operational level (four line employees- OLE1,2,3 and 4) were carried out to explore the factors affecting tacit knowledge generation and utilisation.

Semi-structured interviews were used as the main research technique for data collection in this study. These interviews were done during the exploratory phase of the case study. Exploratory phase interviews were carried out among all three levels of the staff, representing different departments. Hence, the research deployed a triangulation of data combining more than one source of data collection; to develop converging lines of inquiry. A combination of textual analysis and mapping technique, aided by computer software, were used as the main research techniques of data analysis for data collected from semi-structured interviews. This started with qualitative content analysis, which is the main technique for analysing data under textual analysis, with the aid of NVivo software (version 2.0) to generate codes, based on related concepts from data collected. Later, cognitive mapping was done, which is the main technique for analysing data under mapping techniques, using Decision Explorer software (academic version 3.1.2) to build relationships among concepts and for better data presentation. This triangulation of data analysis techniques enabled the rigor of structuring, organising and analysing multiple sources of data, and maintenance of the richness of original data.

4. Case study findings

Key concepts were elicited from the interview participants, representing directors, managers and operational level employees, of the case study company on tacit knowledge. Figure 2 presents a synthesis of main factors affecting tacit knowledge generation and utilisation, as elicited from interview participants of the case study company. Factors have been categorised into three different levels- Individual level: Intra-personal drivers; Group level: Inter-personal drivers; and Organisational level: Situational drivers.

At individual level, two intra-personal drivers were evident: Experience and Motivation. The level and variety of past experience, and the opportunity for new experience were considered as important for the 'experience driver'. Within the case study company, several interview respondents (DRT1, MGR1) possessed extensive past experience and some respondents (OLE1, OLE3) possessed experience relating to different parts of the business. As evident from the interviewees, this had provided them with a solid and broad experience base to work within the company. As such, longer and more varied personal experiences have facilitated in more utilisation and ability to generate tacit knowledge. The opportunity to obtain new experiences is considered to be supplementary to the existing knowledge base of the workers. Interviewees from different levels revealed opportunities which could trigger new learning. In summary, challenges like weakness in the system, change in the system, complex projects, and new requests from a client provided the opportunity to trigger new learning, hence tacit knowledge generation. However, the experience of new learning i.e. tacit knowledge generation, was subjected to the level of opportunity an employee was exposed to, as not all interview participants had similar opportunities. As a result, it is concluded that the level and variety of experience, and the opportunity for new experiences are important determinants of 'experience driver' to generate and utilise tacit knowledge at an individual level. The need for recognition, a willingness to learn and support, and the nature of the subject are considered important within the 'motivational driver'. Several interview respondents (MGR1, OLE4) were disappointed due to the lack of recognition given for their knowledge within the company. One interviewee (OLE1) believed that they are not given an appropriate level of attention, to the extent that the new employees are given by the company, hence felt they are left alone. However, respondents who were satisfied with their work within the company (MGR2, OLE2) believed that their knowledge is recognised by the company.

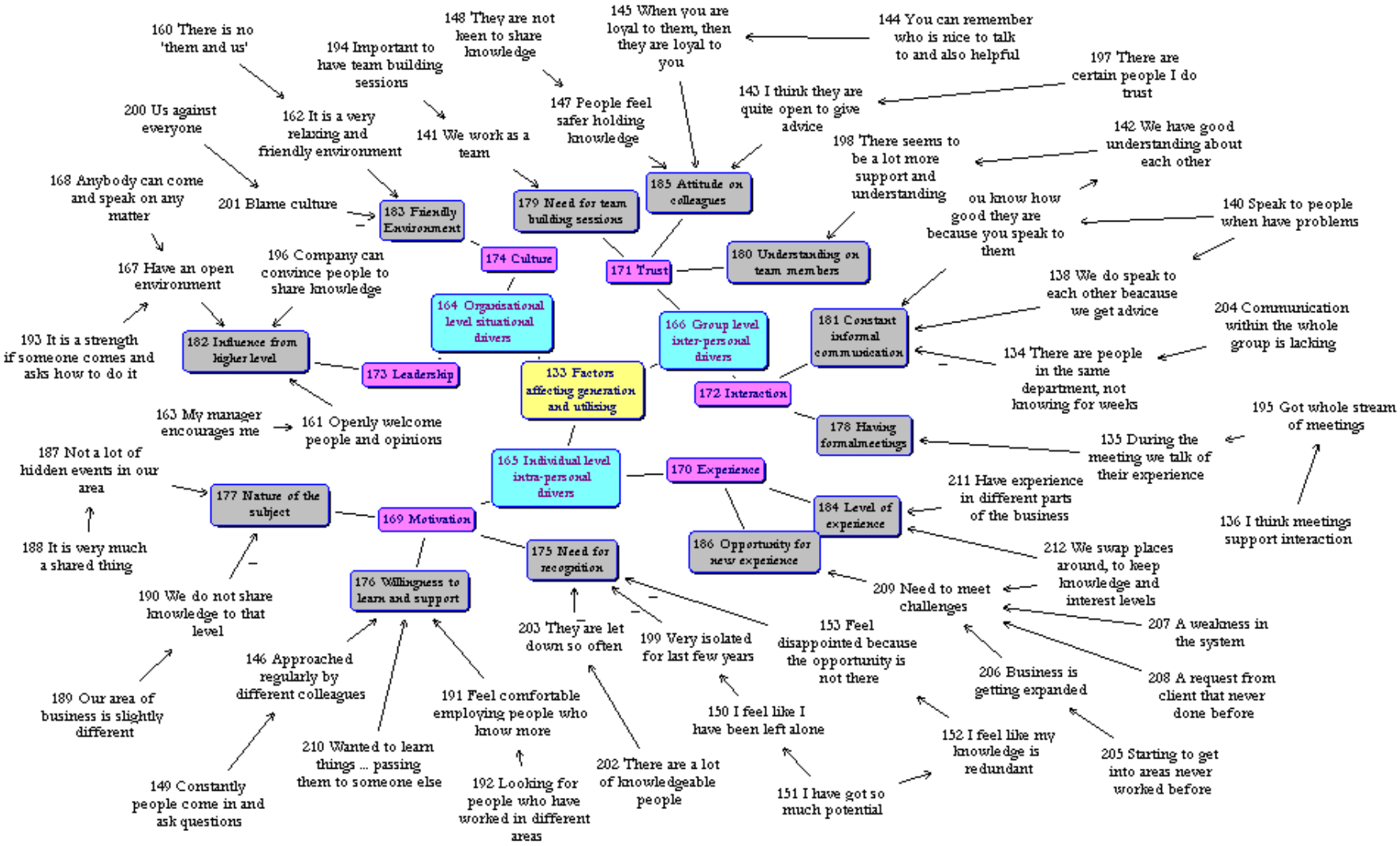

Figure 2: Factors affecting tacit knowledge generation and utilisation

It is evident that the respondent's motivation to generate and utilise tacit knowledge was largely influenced by their perception of extent to which they and their knowledge are recognised. Further, the motivation to generate and utilise tacit knowledge was evident from the respondents' willingness to learn and support others. Some interviewees (DRT1, OLE1) felt that colleagues/ sub-ordinates are frequently approaching them when faced with a problem, as they are keen to help others. Also, most of the interviewees agreed that they rely on colleagues to get advice. DRT1 felt comfortable learning from his young, talented team members. Hence, this willingness to support and learn from other people showed their motivation to utilise tacit knowledge within the company. MGR2 suggested that she wanted to learn anything new, rather than passing it to someone else, whilst OLE4 supported changes within the company, as it will bring him the opportunity to learn. As such, this willingness to learn showed their motivation to generate tacit knowledge. However, as iterated by MGR1 and DRT1 their motivation to share tacit knowledge was subject to the nature of the knowledge. Although MGR1 was willing to share tacit knowledge he had gained from working with the company, he believed that this is not done to the extent of other business parts, due to the nature of the subject. In contrast, DRT2 believed that knowledge relating to his area of work is always shared. As a result, it is concluded that the level of recognition, willingness to learn and support, and nature of knowledge are important determinants of the 'motivational driver' to generate and utilise tacit knowledge at individual level.

At group level, two inter-personal drivers were apparent: Interaction and Trust. Formal techniques and informal communication were considered important for the 'interaction driver'. Interview respondents perceived formal face-to-face meetings as a means of supporting 'professional interaction' through which they could share other colleagues' experience and knowledge. Hence, they believed that it is necessary to have such interactions, in a professional context, to promote tacit knowledge sharing among colleagues within the company. Further to formal techniques, interview findings revealed the significance of informal communications, mainly face-to-face, for tacit knowledge sharing. As suggested by several interviewees (OLE2, OLE3), they communicate often, because of advice they get from colleagues, particularly when faced with a problem. However, a few respondents (MGR1, OLE4) lamented the lack of informal communication within inter and intra groups, which they believed has hindered the ability to share knowledge. Thereby, informal face-to-face communication among colleagues is considered as an enabler for tacit knowledge sharing. As a result, it is concluded that the presence of formal techniques and the level of informal face-to-face communication are important determinants of the 'interaction driver' to enable utilisation of tacit knowledge at group level.

Understanding, attitude on colleagues, and presence of formal team building sessions are considered important within the 'trust driver'. Informal face-to-face communications among colleagues led to increased understanding of team members as iterated by interviewees. OLE3 observed that his team

members understanding of each other is very high, hence they were very supportive and readily shared their experiences. Therefore, increased trust, based on enhanced understanding among colleagues, has facilitated more tacit knowledge sharing between them. Further, this increased understanding has resulted in the development of a positive attitude in his colleagues, who believed colleagues are very open to giving advice when necessary. OLE2 believed that when she is loyal to colleagues who are helpful and supportive, they would become loyal to her. However, OLE1 had a negative attitude of her colleagues; she considered them to be holding knowledge without sharing it. She had little trust to share tacit knowledge, based on her attitude towards her colleagues. Most of the interview respondents professed the importance of formal team building sessions to enhance the understanding and attitude of team members and to cultivate trust, which could enable a tacit knowledge sharing culture within the group. As a result, it is concluded that the presence of formal team building sessions, the level of understanding and type of attitude towards colleagues are important determinants of the 'trust driver' in order to enable tacit knowledge utilisation at group level.

At organisational level, two situational drivers were apparent: Leadership and Culture. The level of influence from senior level management is considered important for the 'leadership driver'. Several interviewees (OLE2, OLE3) suggested that their managers always encourage them to come up with new ideas and opinions, which they considered very positive. DRT1 iterated that he always wanted to have an open environment for his team members, who could come to him and discuss anything. He openly recognised new ideas, even from junior members of the team. Further, operational level interviewees appreciated the 'creative freedom' given to them by their managers. Hence, such influence on subordinates encouraged them to generate and utilise tacit knowledge within the company. As a result, it is concluded that the level of influence exerted, in terms of recognising and encouraging subordinates, is an important determinant of the 'leadership driver', in order to enable tacit knowledge generation and utilisation at organisational level.

An organisational culture that creates a friendly and relaxed environment is considered important. Almost all the respondents perceived the organisational culture prevailing at the moment as strongly positive. They felt it to be a very friendly, happy and relaxed environment, which supported and encouraged tacit knowledge generation and utilisation within the company. However MGR1 believed otherwise, he wanted it to be friendlier, to encourage more knowledge sharing. As a result, it is concluded that the level of flexibility and friendliness are important determinants of the 'cultural driver', in order to enable tacit knowledge generation and utilisation at an organisational level.

Table 1: Fostering and hindering conditions for tacit knowledge generation and utilisation

	Fostering Conditions	Tacit Knowledge Generation and Utilisation	Hindering Conditions
		Factors	
Individual Level Intra-Personal Drivers	• High level and variety of experience, with higher opportunities for new experiences • High level of willingness to learn and support, with satisfied employees	**Experience** **Motivation**	• Low level and variety of experience, with lack of opportunities for new experiences • Low level of willingness to learn and support, with dissatisfied employees
Group Level Inter-Personal Drivers	• Constant informal face-to-face communication with presence of formal techniques for professional interaction • Good understanding and positive attitude towards colleagues with presence of team building techniques	**Interaction** **Trust**	• Lack of informal face-to-face communication with absence of formal techniques for professional interaction • Poor understanding and negative attitude towards colleagues with absence of team building techniques
Organisational Level Situational Drivers	• High recognition and encouragement of subordinates for new ideas • Friendly, flexible and relaxing working environment	**Leadership** **Culture**	• Lack of recognition and encouragement of subordinates for new ideas • Unfriendly, blame culture

As a summary of the above discussion, Table 1 illustrates the fostering and hindering conditions of tacit knowledge generation and utilisation in an organisation, with respect to the main factors identified.

5. Discussion

In order to articulate the process of tacit knowledge generation and utilisation, the study integrated theories of experiential learning, cognitive science and knowledge creation. The autopoietic epistemology was preferred as the philosophical basis of understanding tacit knowledge generation and utilisation; whilst Kolb's (1984) experiential learning model was considered in terms of stages followed within the cognitive process of tacit knowledge generation and utilisation. Koskinen's (2003) categorisation of internal and external factors of tacit knowledge generation and utilisation in a project work context was based on the 'level of control' of an individual. However, the exploratory phase of the case study identified several factors affecting tacit knowledge generation and utilisation in an organisational context in terms of Individual level: Intra-personal drivers; Group level: Inter-personal drivers; and Organisational level: Situational drivers.

In addition to individual, group and organisational level factors identified from case study findings, the salient features of the construction industry emphasise the importance of tacit knowledge to the industry as a whole. The importance of tacit knowledge within the construction industry can be highlighted from two facets: due to intrinsic characteristics of the construction industry, and

popularisation of the ‘knowledge worker’ concept. The unique, complex, relatively low-tech and labour intensive nature of construction projects and the limited ability to codify construction knowledge are considered as leading features of the industry, which supports tacit knowledge generation and utilisation. The importance of the ‘knowledge worker’ is highlighted by the fact that industry relies on skills, experience and capabilities of construction employees when delivering the construction products and services.

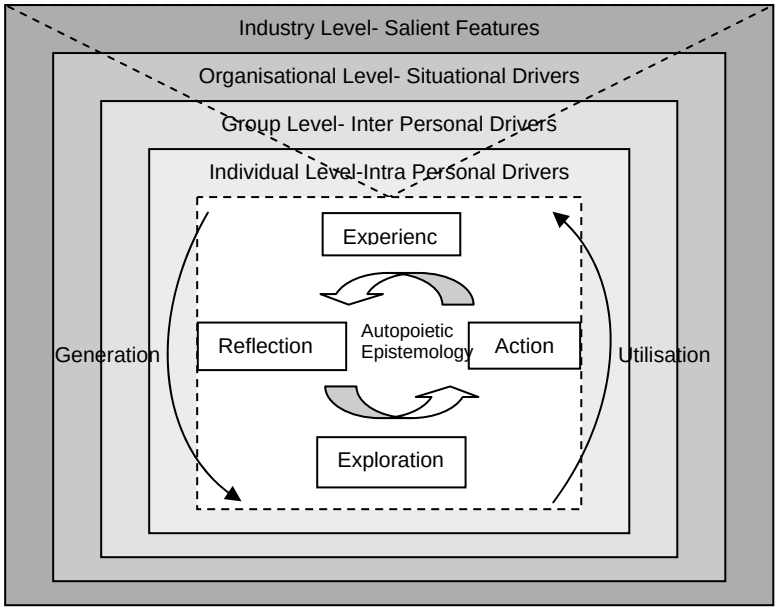

Figure 3: Tacit knowledge generation and utilisation process

Accordingly, Figure 3 summarises the sources of tacit knowledge generation and acquisition together with the individual cognitive process based on case study findings. Accordingly, the findings from the literature synthesis and exploratory phase case study outcomes lead to the following synthesis:

Tacit knowledge generation and utilisation involve internal cognitive processes of human beings, rather than an objectively definable commodity, which affected by various individual, group, organisational and industry level factors.

6. Conclusion

Different knowledge based solutions to promote knowledge sharing have been proposed in the construction industry. However, previous work on KM in the construction industry has concentrated heavily on the delivery of technological solutions, hence on KM technologies, mainly due to the increased focus on IT during the past decade. Due to intrinsic characteristics of the construction industry, tacit knowledge of the workers and their social interactions gains an increased importance

within the industry. As the construction industry is very much centred on tacit knowledge and experience of construction workers, the industry is biased towards the process-based view of knowledge. Hence, the process-based solutions, enhancing personalisation strategies and interactions between construction workers to generate and share tacit knowledge, would be much more relevant to overcome KM problems in construction organisations. Understanding what tacit knowledge is, and its generation and utilisation are central to its effective management. Accordingly, this paper explored and discussed the factors affecting tacit knowledge in the construction industry, based on a study which investigated the process of tacit knowledge management in a construction organisation.

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