

KNOWLEDGE CHANNELIZATION AND INNOVATION

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This paper examines knowledge management and innovation in the Australian Construction Industry. A conceptual model is presented, based upon analysis of the literature and a series of preliminary construction industry interviews. Extensive knowledge management (KM) research has focused upon types of knowledge contained within specific organizational settings. However, we argue that a crucial missing link in KM research concerns the interface between flows of knowledge from external sources of innovations and its channelization in and out, and between organizations. This interface, regulating and facilitating knowledge from external sources of innovation into the organisation, operates under the influence of two main forces visualized as “pulling” and “pushing” forces in the model presented in this paper. The premise of the model lies in a hypothesis that as an organization changes itself into a more mature, learning organization (LO) over time, knowledge flows into it through “pull” rather than “push” forces. We conclude that a successful knowledge management initiative installs a learning and knowledge sharing culture, which is easily adaptable to new learning offering little resistance to new knowledge that flows into the organisation. The model bridges the gap between research and its application in construction practice.

Keywords: knowledge management, organizational learning, organizational culture, innovation, external sources of innovation

INTRODUCTION

Research in construction related disciplines have produced a number of innovative processes, products and technologies. Few can deny the impact of these innovations in boosting the low productivity levels of the construction industry, if adopted and diffused properly within the construction practice. Adoption and diffusion of these innovations are usually met with severe resistance in the construction organisations and ‘culture’ of the industry is usually blamed for this (Latham 1994; DETR 1998; Department of Industry Science and Resources, 1999). Most of these innovations go unnoticed by the practitioners. Only few can penetrate through the resistive culture after making successful headlines in other industries (e.g. Total Quality Management, Information Communication Technologies (ICT), Knowledge Management (KM) etc.). Even penetration does not guarantee full adoption and diffusion and chances of successful implementation remain dubious. Resistance to change, stiff culture, lack of motivation and reward systems, weak leadership, strategy and vision, absence of learning mechanisms, lack of awareness about the direction of construction research and not foreseeing the immediate benefits of adopting innovations lead to this discrepancy and gap (Gann, 2001, Santos et al., 2002; Oglesby, 1989; Bresnen and Marshall, 2001).

Construction organisations are beginning to show interest in recent successful KM initiatives in the Pharmaceuticals, Electronics, and Manufacturing industries. The increased chance of success of adopting KM principles and its diffusion into

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construction organisations is acting as an impetus for academic researchers to develop KM best practices for construction organisations and numerous initiatives have started globally in collaboration with the construction industry.

A successful KM initiative could overcome learning barriers through: instilling a learning and knowledge-sharing cultural environment; providing vision and effective leadership; and initiate knowledge-sharing reward systems (Walker, 2003; Egbu et al; 2001, Cook, 1999). This turns organisation into a learning organisation (LO) which is open to learning new techniques and continuous improvement based on its learning. Cohen and Levinthal (1989, 1990) argue that this kind of change results in an increase in the absorptive capacity of the organisation (which is actually a function of how organisations retain and distribute knowledge internally or in simple words exercise KM). Prior knowledge of particular knowledge domain tends to make it easier to understand new knowledge (Burton-Jones, 1999, Holden, 2002). It confers ability for the organisation to recognise the value of new information, assimilate it and apply it to commercial ends (Cohen and Levinthal, 1990).

Current KM research and theory has restricted itself to considering organisational knowledge contained within the organisation's boundaries. The emphasis is on knowledge capture, codification, transfer and sharing embedded in the organisation's routines and processes and residing in employees' heads in a tacit form making it explicit through the balanced use of technology and human related factors like leadership, vision, strategy, reward systems and culture.

In this paper we propose that the functionality of KM theory can be enhanced where it provides an interface between external organisations like universities or other research centres and construction organisations. This helps to merge another stream of research related to innovation adoption, diffusion and technology transfer which at this moment is being studied in parallel with KM research. This synergy, that can be realised, has the potential to facilitate lifting the productivity of the construction industry.

A new conceptual model is presented, depicting organisational transformation through learning over time demonstrating that as KM initiatives influence organisational learning, they continuously enhance absorptive capacity by pulling new knowledge in the form of innovative processes, products and technologies from outside, to readily adopt and diffuse it and provide immediate feedback. Successful KM initiatives could make LOs more open and fertile to innovative construction research ideas being developed and to adopted and diffused them quickly.

PERCEIVED KM BENEFITS

Knowledge is being recognised in the knowledge economy as a vital resource for competitive advantage in today's dynamic and changing business environment (Burton-Jones, 1999). The role of effective KM is becoming evident in producing innovation, reducing project time, improving quality and customer satisfaction (Kamara et al, 2002; Love et al., 2003). Through the process of KM, organization's intangible assets are better recognised and exploited to create value and knowledge both internally and externally is leveraged to the benefit of the organisation (Liebowitz and Megbolugbe, 2003; Davenport and Prusak, 2000; Snowden, 1999). In the project environment, KM facilitates improved communication within teams to provide informed insightful advice to project managers and project teams. KM can focus improved sharing: best practice; lessons learned; project management and system engineering methodologies; examples of review packages; and the rationale

for strategic decisions-making (Liebowitz and Megbolugbe, 2003). Failure to capture and transfer project knowledge leads to the increased risk of ‘reinventing the wheel’, wasted activity, and impaired project performance (Siemieniuch and Sinclair, 1999). These potential and perceived benefits of the KM are sufficiently convincing for construction organisations to seriously consider adopting its principles.

CURRENT STATE OF KM RESEARCH: PARADIGM SHIFTS

The quest for obtaining knowledge and effectively utilising it is not a new endeavour. Tiwana (2003) asserts that KM developed from the 1950’s from various management philosophies, improved and modified over time. For this reason Collins (2002) noted that he was struck by “an eerie sense of déjà vu” when analysing “knowledge work”. Current KM philosophies are rooted in many initiatives from the late 80’s and early 90’s under the banner of ‘Knowledge Engineering’ and ‘Artificial Intelligence’ dedicated to the development of Expert Systems and other Knowledge based systems through which knowledge capture, sharing and dissemination was supposed to occur. These initiatives failed to be fully embraced by the business community and met with failures and under-use primarily because of complexity and user-unfriendliness of these technologies so they were rendered ineffective (O’Brien, 1997).

With technological advancement in information distributing mediums and ICT, Internets and Intranets, organisations found new technological tools through which they can capture, codify, transfer and share knowledge. To their disappointment these initiatives also met with failures (Aouad et al., 1999; Davenport and Pursak, 2000; Fernie et al., 2002). Causes leading to failures have been identified (Davenport and Pursak, 2000; Fernie et al., 2002, Walker, 2003, Liebowitz and Megbolugbe, 2003, Kamara et al, 2002, Malhotra, 2000):

- High technological dependence in these initiatives;
- Inability to properly understand knowledge complexity and its esoteric nature;
- Neglect of human related factors associated with any change;
- Lack of recognition of appropriate leadership, vision, strategy and culture;
- Ignoring individual value system and notion of trust; and
- Insufficient reward system and motivation

Storey and Barnett (2000) confirming these factors in a study entitled “Knowledge management initiatives: Learning from Failures”. Such failures have generated learning and it has been argued to be 90% human activity and 10% technology (Egbu et al., 2001). Tiwana (2003) proclaimed that KM is not about building smart Intranets, digital networks, one time investment and enterprise-wide ‘Infobahn’.

Under this emerging paradigm of KM, the notion that knowledge can be readily made available from humans and made part of the machines is losing ground. Fernie et al. (2003) argued against the usual assumption on which orthodox KM is based that knowledge freely exists and can be easily captured and shared through machines. They believe knowledge is a problematic esoteric concept that doesn’t lend itself easily to codification especially the tacit knowledge, capturing of which has become a contemporary theme of KM research. Tacit knowledge is highly individualistic and concomitant with various surrounding contexts within which it is shaped and enacted. KM encourages building of communities of practice (COP) (Wenger, 1998) and

developing social networks for tacit knowledge transfer and sharing (Bresne et al., 2003; Augier and Vendelø, 1999 and Swan et al., 1999; Hearn et al., 2002).

These COP may be real and may exist in form of informal get togethers and formal conference/seminars/workshops or virtual forms of online forums or web-discussion boards, where experts can interchange ideas and leave their expertise and knowledge in the forum for others to utilise and share further (Liebowitz and Megbolugbe, 2003). Such shift in focus in KM research has generated successful initiatives and various companies in the pharmaceutical, electronics and manufacturing industries are successfully implementing KM and reaping the benefits. The KM initiatives have helped transform their organisations into LOs through which they continually innovate, maintain and enjoy competitive advantage. This strengthens the argument that 'successful' KM initiatives install an atmosphere and culture of learning and knowledge sharing, mentoring and mutual supporting.

KM IMPLICATIONS FOR CONSTRUCTION ORGANISATIONS

Rogers (1995) defined innovation as 'an idea, practice, or object that is perceived as new by an individual or other unit of adoption'. It is a decision-making process to enact change in technology, process, services rendered or other management approaches (Walker and Hampson, 2003). KM is highly associated with innovation because of its ability to convert tacit knowledge of people into explicit (Nonaka and Taguchi, 1995; von Krogh et al., 2000). It is grounded in the notion that unique tacit knowledge of individuals is of immense value to the organisation as a whole, and is the 'wellspring of innovation' (Stewart, 1997). In today's workplace the knowledge worker rather than machines possess the key resources that organisations need—the ability to creatively link disparate ideas to develop innovative solutions to complex problems and to create original and new products or services (Walker, 2003)

The above mentioned is true for the organisation whose business objectives, survival and competitive advantage depend on bringing a new innovative product into the market as early as possible and attract customers thereby. Organisations at the forefront of innovation in pharmaceutical, electronics and manufacturing industries are primarily exploiting KM to carry out such innovations. These organisations run in-house research and development (R&D) programmes and knowledge gathered or captured through KM is put together through internal in-house research projects to produce various innovations. Employees are appreciated and encouraged for producing innovative ideas.

Construction organisations near the heart of the construction process (contractors, subcontractors and specialist contractors) are different when compared with other innovative organisation in other industries. Construction is a very demanding process due to the highly competitive nature of the industry so often the construction team is highly time-starved and this diminishes creative energy to developing alternative innovative solutions to carry out tasks (even though they are capable of it). Many organisations are focussed upon 'getting work done' as early as possible to avoid the cost of liquidated damages. Experimenting with new ideas and seeking innovative alternatives are often considered as risky endeavours. People are generally encouraged to avoid risk and carry out their task efficiently using reliable approaches. Non-existent R&D functions in these organisations and absence of any formal mechanism in place that may allow capturing of such ideas for later pursuits has shaped the culture such that the people themselves dumped aside their innovative ideas or they

dissipate from their heads over time. Such culture has led to the situation where people not even bothered to think of performing innovatively.

The above mentioned is true for routine jobs but it is also seen that in when a crisis arise, and organisations have no alternative to producing innovations, latent creative energies of its people generate them to solve the crisis. In the recent project, an organisation won a project but later recognised the bid made was unrealistic and so the project was declared a 'dead duck'. Under this situation the construction team unleashed their creativity and innovative skills and generated a design method, specifications and construction process that turned the project into a profitable venture. This clearly shows how latent talents and invisible organisational assets have, in times of need that are capable of quickly reacting to and coping with the situation.

KM initiatives foster creativity and innovative effort embed them in the organisations' routine and culture. KM plays a role in facilitating internal innovation process and can introduce innovations from external source facilitating flows of innovative knowledge from these external sources of organisational innovation. This helps early adoption and diffusion of external knowledge by embedding new knowledge in organisational routines and making it part of the culture. The effect of this may be realised in improved and streamlined business processes minimizing waste and reducing unnecessary effort. For example an organisation may increase efficiencies in tendering, estimating, designing processes etc through interfacing with external sources of innovation via the KM function.

The value of KM in regard to the above may be realised in establishing an interface that would provide constant and vigilant surveillance of the research community activities and helps organisation to pull and filter knowledge to match the learning needs of organisations and to distribute it in a timely fashion.

ORGANISATIONAL LEARNING AND THE LO

Organisational learning is the set of processes used to obtain and apply new knowledge, behaviour, tools and values (Bennis and Nanus, 1985). Through this process organisational members detect error or anomalies and correct them by restructuring organisational theory in-use (Argyris and Schön, 1978) to improve action through better knowledge and understanding. It is the process of information resulting in a change in the range of potential behaviour (Huber, 1991).

LOs are organisations where people continually expand their capacity to create the results they truly desire, where new expansive patterns of thinking are nurtured, where collective aspirations is set free and where people are continually learning how to learn together. Learning is so insinuated in the fabric of life that you cannot *not* learn (Senge, 1990). Pedlar et al., (1991) added that it is an organisation that facilitates the learning of all its members continuously transform itself. Such an organisation is skilled at creating, acquiring and transferring, knowledge and modifies its behaviour to reflect new knowledge and insights (Garvin, 1993).

Love et al., (2000) attempts to resolve discrepancies between terms 'organisational learning' and 'learning organisation'. They mention that organisational learning is used mainly as a descriptive term to explain and quantify learning activities and event and 'learning organisations' tends to refer to organisations designed to enable learning by having an organisational structure with the capability to facilitate learning. Mirvis (1996) noted that LOs focus on managing chaos and indeterminacy through flattening hierarchies, decentralization, empowerment of people, team work and cross functional

teams, network relationships, adoption of new technologies and new forms of leadership and mentoring.

For learning to occur, there is need for processes and structures in place to help people create new knowledge, so that they can continuously improve themselves and the organisation (Love et al., 2000). A parent organisation poorly learns from projects because it doesn't have in place the mechanisms to capture the knowledge (Newcombe, 1999). Love et al. (2000) also noted that currently there is no defined road map for construction organisations to follow if the LO is its destination. They quoted Garvin (1993) on five activities that a construction LO should be skilled at:

- Systematic Problem Solving;
- Experimentation with new approaches;
- Learning from their own experiences and past history;
- Learning from the experiences and best practice of others; and
- Transferring knowledge quickly and efficiently through out the organisation

It can be noted that KM initiatives provide platform and structure to the organisation to carry out the above mentioned activities and proliferates learning mechanisms. This supports the assertion that KM initiatives cause organizational learning (OL) to transform the organisations into a LO. This is incorporated into the conceptual model integrating organisational learning, KM and innovations carried outside the organisation presented in the next section.

AN INTEGRATED MODEL OF INNOVATIVE KNOWLEDGE ADOPTION, DIFFUSION AND OL

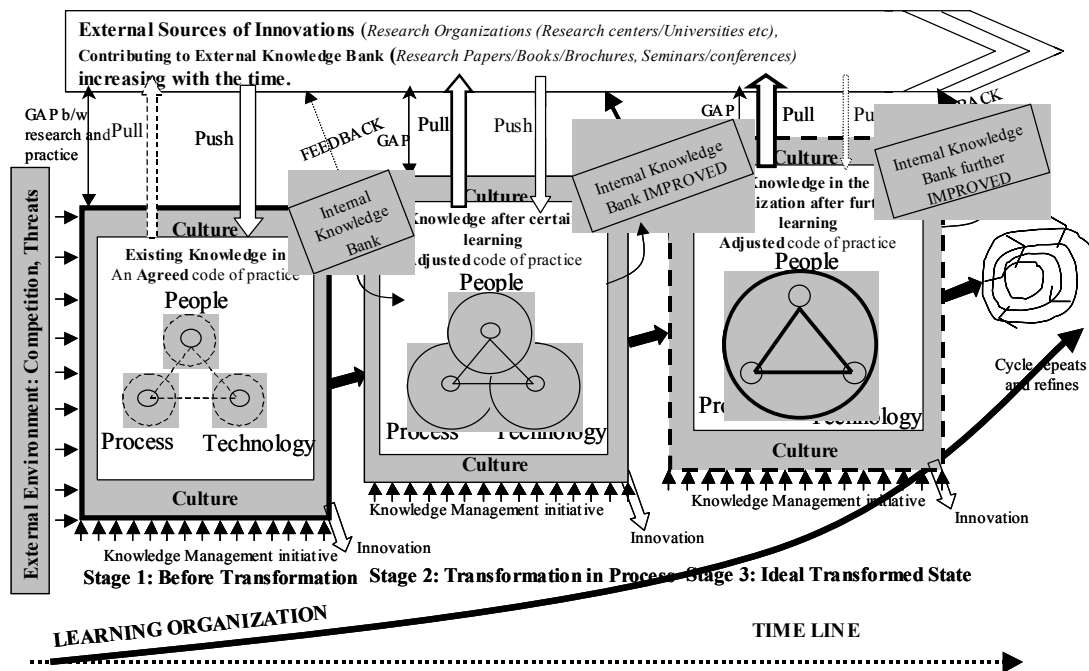


Figure 1: The model OL of interaction with external sources of innovation

The conceptual model presented in Figure 1 is based upon analysis of the literature and a series of preliminary interviews in the construction industry. It explains the

transformation of the organization over time by illustrating OL. It shows three transformation stages that are indicative of the transformation process, which is actually a continuous process. It distinctly shows a typical construction organisation and sources of external innovation referred to as an External Knowledge Bank. This knowledge bank consist of academic institutions and research centres dedicated to producing new knowledge, new innovative processes, products and technologies as well as to train and prepare people to utilize these processes. The external knowledge quantum bank increases with time.

The KM function in the organisation may act as an interface to channel and facilitate the flow of external knowledge into the organisation. In the model this interface is conceptualised to operate under the influence of two main forces visualized as “pulling” and “pushing” forces. Push is exerted from the external knowledge sources towards the organisation adopting new knowledge, whereas pull refers to the suction force exerted by the organisation to obtain the knowledge from the sources external to it. The distance between the external knowledge source and the organisations is an indication of gap that exists between academic research and actual practice. The three indicative stages of organisational transformation are explained below:

Stage 1: Before Transformation

Stage 1 depicts a state of an organisation prior to any learning mechanism or KM initiative takes place. In this state, external knowledge is strongly pushed by the innovation sources into the organisation and is shown by thickened arrows facing downwards. The arrow showing pull is dotted, depicting weakened or non-existent effort by the organisations to bring external knowledge inside their organisation. Culture is shown by a thickened borderline depicting organisation and showing how hard it is to be penetrated. A stiff and resistive culture would prevent knowledge from seeping through, even when pushed hard from outside.

Inside the organisation, it has well-defined codes of practice and organisational procedures to carry out its role (depending on its position in the supply chain). People using various processes and technologies carry out organisational duties. High segregation between people, processes and technologies is observed in this state, as depicted by the dotted lines. Each constituent of the organisation assets has its area of influence depicted by small circular dotted rings. This depicts circumstances where people in the organisation don't fully utilise the processes and technology as they could do—poor diffusion. Knowledge processes and technologies have been officially made part of the organisation but people are resistant to change and don't fully adopt and utilize available knowledge. Such phenomenon occurs regularly in construction organisation. Lack of senior management support and leadership, weak vision, absence of learning mechanisms, and lack of training and mentoring facilities segregate people from processes and technologies. A typical example in our current research indicates one example where organisations have formally adopted ICT but due to poor diffusion strategies, people hardly use it. A study by the Gottlieb Duttweiler Foundation as quoted by Brooking (1996) has endorsed this notion by finding out that only 20% of knowledge available to an organisation is actually used.

KM initiatives could instil strong leadership, vision and strategy in the organisation. It would help create a knowledge sharing culture where learning is nurtured. Under the umbrella of KM, organisations would be able to create and maintain their own internal knowledge banks. In this internal knowledge bank organisations would be able to

make people's tacit knowledge explicit—if those person should leave, their knowledge would remain. Organisations record and save the lessons learned in these repositories to avoid mistakes, redoing work and reinventing the wheel. They are then better placed to enhance productivity, improved decision-making and maintain competitive advantage. The model indicates that as the transformation starts, this internal knowledge bank would be weak and less detailed but it improves over time. This internal knowledge bank also links back to sources of innovations external to the organisation through providing feedback of issues which the research community may be interested in. This feedback process is weak, as depicted by dotted arrows, and it is very important for the organisation and the research community to reflect upon the effect of processes and technologies developed and how to further improve and refine these by introducing new innovations. The KM initiatives and internal knowledge bank or repository would help transform the organisation into the next stage.

Stage 2: Transformation in Process

This stage is where organisation has learned through KM initiatives and improved its absorptive capacity. Under this state, the organisational culture becomes less of a barrier as shown by thinner line compared to thickened line before. The quest for learning becomes stronger resulting in increased pulling forces that the organisation exerts on its external source of innovations to introduce new knowledge.

Academic institutions and research centres do not have to push much new knowledge at this stage. The organisation improves and streamlines its processes and routines after it has improved learning. People change their attitudes and become motivated under strong leadership to learn, adopt and utilise the knowledge available. The area of influence grows as shown by growing circular rings and segregation reduces as shown by thinner lines. This is indicative of the state where people are learning and trying to adopt whatever knowledge is officially deemed useful.

Strategies of pulling knowledge may take different forms. An organisation may start collaborating with academic and research centres by registering their staff in post-graduate courses. This would provide the organisation a chance to network with domain experts (academics) and unlimited access to journals where academic research is usually published. Organisations may provide their employees opportunities to attend research conferences/seminars and workshop and motivate them, through appropriate reward systems, in their pursuit of new knowledge. Organisations may also actively participate in developing communities of practice and motivating staff to develop extensive social industry and academic networks and carry out vigorous interchange of ideas within those communities. Another strategy may be emphasising its people to undertake a practice-based research with the academic institutions and advising in selection of research topics beneficial to the organisation. It would assist KM initiatives to become mature and result in the increase of internal knowledge banks. Collaboration with these sources of innovations increases through stronger feedback mechanisms, which would enable a research community to see the effect of innovation, refine it and produce more innovations.

Stage 3: Ideal Transformed State

This ideal stage represents an organisation's enhanced maturity. Culture of the organisation becomes highly adaptable and offers virtually no resistance to any flow of knowledge inside the organisation. Knowledge readily flows from outside sources into organisations through high pulling forces with an insatiable appetite for knowledge feeding OL needs and gaining momentum over time in learning. No more

segregation remains between people in organisation, processes and technologies. This state presents high levels of integration between these three organisational components. KM becomes the integral part of the organisation routines and continually assist in developing and maintaining internal knowledge repositories. The feedback mechanisms becomes solid and strong and the gap between external and internal knowledge sources decreases remarkably. Under this state, productivity levels of the organisation can profoundly improve.

We suggest that most construction organisations presently appear to fall into Stage 1, with very few at Stage 2. It is recommended that KM initiatives could help organisations travel the course outlined in the model. Currently KM theory neglects to take into account knowledge flows and channelisation from the innovation source into the organisation and feedback to the sources of innovation. By extending the theory of KM we will be in a position to bridge the gap that currently exists between academic research and business practice. This helps improve the productivity of the construction industry by timely adoption and diffusion of innovative processes and technologies

CONCLUSION

The construction industry often suffers low productivity levels—its culture, at present, resists adoption and diffusion of many innovations. This is blamed for a resulting gap between research and practice. There is a clear role for academic institutions and research centres (referred to, as ‘external sources of innovation’) to facilitate innovation. Construction research has produced various innovative processes and technologies that have the capability to address industry problems. Collaboration of external sources of innovation with construction organisations is very important so that these organisations may utilize new innovations and beneficially exploit them.

Recently, successful KM initiatives in other industries have received attention in the construction industry. Theory of KM has changed and matured despite earlier failures it met with when implemented in those industries. A balanced emphasis in the use of technology and recognition of human related factors associated with any change has enhanced KM theory. It is hoped that the construction industry could successfully adopt KM principles. KM initiatives in construction organisations could improve decision-making, generate learning from mistakes and avoid re-inventing the wheel. These initiatives could help people put their innovative and creative ideas to use, thus achieving innovation. Successful KM initiatives instil a culture of knowledge sharing and provide the organization with strong leadership, vision and strategy.

The model presented in this paper indicates that as an organisation starts to learn and transform itself into a LO (under the umbrella of KM) knowledge from external sources of innovation would start flowing in it under forces visualised as ‘pull’ rather than ‘push’. The culture of such organisations becomes highly adaptable and segregation between people processes and technology disappears. Pulled knowledge readily becomes part of the organisational routines and processes. Organisations continuously improve their internal knowledge repositories and provide stronger feedback to the external sources of innovations for further refinement and development of innovations. Most of the construction organisations fall in Stage 1 and a very few in Stage 2. KM initiatives would help lagging organisations to move through these transformation stages.

We have argued in this paper that current theory of KM may be extended to act as an external interface to take into account knowledge flows from external sources of

innovation into the organisation. At present, KM is primarily concerned with capture, codifying and transferring knowledge embedded and contained in organisational routines/process and tacit knowledge residing in the heads of its people. Extending the theory of KM, as depicted in the model, would merge it with other streams of research related with the issues such as adoption, innovation and technology diffusion, transfer and its management. Collectively, both the streams would complement each other and chances for the successful implementation would increase. A common denominator of “knowledge” in both of the streams may act as a driving force in such merger.

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