Use of Virtual Communities-of-Practice for Intra-Firm Knowledge Transfer: Barriers To Dynamic Capability Formation

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ABSTRACT

Knowledge resources are critical to competitive advantage for firms and intra-firm best-practice transfer is one way in which firms seek to develop and exploit such resources. Here, we discuss the case of a multinational firm which views best-practice transfer as an on-going process of knowledge evolution and has institutionalised virtual communities of practice (CoP) in this pursuit. We contend that CoPs have the potential to generate dynamic capabilities in firms, and identify barriers that they face in generating these capabilities.

Keywords: Dynamic Capabilities, Competitive Advantage, Implementation

It is widely acknowledged that knowledge resources hold the key to superior performance and competitive advantage for many firms (Cohen and Levinthal 1990; Grant 1996). Large firms have widespread internal sources of knowledge, but the complexity that comes from their size and environment (both internal and external) makes it difficult to effectively utilise these resources as factors of production. As a consequence, intra-firm best practice (or knowledge) transfer initiatives are widely studied by management researchers (Argote 1999; Berta and Baker 2004; Emery 2002; Jarrar and Zairi 2000; Jensen and Szulanski 2007; Phene, Madhok and Liu 2005; and Szulanski 1996). These initiatives make good sense to large firms as they enable transfer of effective knowledge (both, tacit and explicit) and replication of routines from one part of the firm to another and allow them to leverage the benefits which arrive by virtue of their size (large number of subsidiaries, large head counts and thus large knowledge resources), which otherwise serves as an obstacle in managing knowledge (Kogut and Zander 1992).

Research into best practice transfer (BP) in large firms has mainly focused on the processes entailed in these initiatives. Relatively little attention has been given to the specific structures which the firm utilises in transferring knowledge from one location to another. One key reason for this is that BP transfer has mostly been viewed as a discrete, one-off (or once-in-a-while) event (Szulanski, 1996), and not as a gradual process of knowledge dissemination (Nonaka, 1994). This paper view BP transfer as a continuously evolving process of knowledge creation and dissemination, and the word ‘transfer’ portray not only the replication of high-value practices but also of small innovative ideas which can be the source of gradual and continuous performance improvement.

This view of BP transfer has two specific advantages. First, best practice is a moving target and a particular best practice may be superseded by an even better practice due to constant evolution of knowledge in space and time. BP transfer as a continuously evolving process can help firms in identifying and replicating this moving target from time-to-time. The second, and most important,
advantage comes from the routinisation and institutionalisation of the process of knowledge creation and transfer itself. A systematic and patterned approach to knowledge creation, transfer (and application) has the potential to develop an outcome described in the literature as a dynamic capability (Teece et al. 1997; Teece and Pisano 1994; Winter 2003; Zollo and Winter 2002). Dynamic capabilities facilitate changes in a firm’s internal operations and allow the firm to prudently utilise its resources (and to create new ones) by seeking congruence between its internal and external environment, and thus potentially delivering sustainable competitive advantage. Development of such capabilities is often complex and time consuming, and calls for quasi-reversible and costly investments in durable systems, structures and processes (Zollo and Winter 2002; Winter 2003).

Communities-of-Practice (CoPs) is the term coined by Lave and Wenger (1990) and refers to groups of people who share a common concern or passion, interact regularly about it and learn how to do it better. The philosophy behind CoPs is that learning occurs in social contexts that evolve when people having common goals interact and as they strive towards those goals. CoP has become associated with knowledge management as people have begun to see them as ways of developing social capital, nurturing new knowledge, and stimulating innovation by sharing existing tacit knowledge within an organisation. A CoP is different from a conventional work team in that the shared learning and interest of its members keep it together. It is defined by knowledge rather than by an individual task, and exists because participation has value to its members. CoPs are more durable than teams, as members stay together so long as they share common interest; and they are now an accepted part of organisational development (Brown and Duguid 2001; Hemmasi and Csanda 2009). In large corporations, people (and thus discrete knowledge) reside in different parts of the world and seldom have opportunities to meet and interact face-to-face and as a consequence developing and nurturing virtual CoPs makes good business sense to them. A virtual CoP is one whose members are geographically separated; who rarely or never meets face-to-face, and whose members interact and communicate via electronic media, much like a global virtual team (Gibson and Gibbs, 2006). Virtual CoPs have two distinct advantages. Firstly, as people come from culturally diverse backgrounds, with different experiences, they bring in new thinking and richer knowledge. Secondly, as people in firms ‘come and go’ these CoPs act as living repositories and locus of knowledge for firms to which people can resort to in solving their problems and issues.

In this paper, we present findings from a study conducted in a large multinational mining company, which is engaged in the development of virtual CoPs across its several important functions and processes. The purpose of developing and nurturing these CoPs is not only to create living
repositories of knowledge but also to capture and facilitate the transfer of best practices between its
geo- graphically dispersed and culturally diverse subsidiaries. The aim of our study is two-fold. First,
we seek to demonstrate the emergence of a knowledge creation capability (KCC) within these CoPs
that, at the level of the organisation as a whole, is likely to create dynamic capability (sum of parts).
To date, no research has examined these collaborative structures as manifestations of an
organisation’s dynamic capability. Second, we aim to identify some of the barriers and impediments
that exist to the development of this KCC within CoPs. Again, we know little about the factors that
facilitate and constrain the effectiveness of these increasingly popular collaborative structures.

We begin by outlining a theoretical framework for the evolution of dynamic capabilities
generated by systematic learning that occurs in virtual CoPs. Then we conduct survey-based research
to examine the extent to which the learning activities within the CoPs result in an enhanced capability,
to generate, disseminate and assimilate valuable knowledge. Lastly, we use the results of interviews
with virtual CoP members in order to identify important barriers to effective learning and knowledge
utilisation faced by virtual CoPs.

**EVOLUTION OF DYNAMIC CAPABILITIES**

A growing awareness of the importance of accumulated and shared knowledge in contributing
to a firm’s capacity for sustained success has led to the speculation that particular organisational
learning mechanisms are responsible for fuelling the creation of dynamic capabilities which, in turn,
result in the evolution of improved performance routines (Zollo and Winter 2002). Reflecting the
potential competitive advantage that arises from such adaptive capacity, researchers in the field of
strategic management have coined the term “dynamic capabilities” to a firm’s ability to be
strategically responsive to a turbulent, highly changing environment.

Following Teece et al.’s (1994, 1997) pioneering work, the potential contribution of dynamic
capabilities to growth and performance, both at firm and industry levels, has received much attention
(e.g., Iansiti and Clark 1994; Cockburn, Henderson and Stern, 2000). Much of the empirical work in
this area has taken the form of case narratives utilising historical data, that have focused on the
mapping of the evolution of dynamic capabilities either within an industry (e.g., Miyazaki 1994; Raff
2000), or within the firm (e.g., Rosenbloom 2000; Rindova and Kotha 2001). These case narratives
have resulted in insights into various industry (e.g., increase in competitive pressures, changes in technology) and organisational factors (e.g., leadership, senior management beliefs, restructuring) that have played a role in the evolution of firm capabilities over time. This line of research has also identified skill acquisition, learning and the accumulation/assimilation of knowledge as important strategic issues for competing in fast-changing environments, and led to the realisation of the need to understand more fully the role of knowledge creation and learning as sources of dynamic capability responsible for sustaining long term innovation and performance (Henderson 1994; Eisenhardt and Tabrizi 1995; Zander and Kogut 1995; Nonaka and Takeuchi 1995; Miller and Shamsie, 2001).

Zollo and Winter (2002) proposed a theoretical model of the ways in which knowledge and learning contribute to dynamic capabilities at the level of the firm. Their model, as exhibited in Figure 1, makes at least two potentially important contributions to this developing area of strategic management research.

First, a number of researchers have criticised the conceptualisation of dynamic capabilities, arguing that it is tautological, endlessly recursive and, consequently, not able to be operationalised (e.g., Mosakowski and McKelvey 1997; Williamson 1999; Priem and Butler 2001). Zollo and Winter (2002: 340) proffer a more precise and practically useful definition of the construct, as ‘a learned and stable pattern of collective activity through which the organisation systematically generates and modifies its operating routines in the pursuit of improved effectiveness’. Second, they identify three types of learning mechanism within organisations that potentially act as causal antecedents to the development of dynamic capabilities. These are experience accumulation (e.g. development of tacit knowledge), knowledge articulation (e.g. the collective sharing & discussion of experience), and knowledge codification (e.g. recording of understandings in the form of written tools). In addition to offering greater theoretical precision in the description of dynamic capabilities, Zollo and Winter’s (2002) model is practically useful as it specifies several knowledge-based mechanisms, which the organisations may seek in order to develop such capabilities.

It is apparent from this model that the output of three co-evolving learning mechanisms is ‘new organisational knowledge’ in the form of codified tools. Thus, intuitively enough, they have suggested
that dynamic capabilities will be developed when new knowledge is continuously applied in the firm’s operating routines. Here, we propose two changes in this knowledge creation framework. First, we would rename the ‘experience accumulation’ dimension as ‘knowledge accumulation’. Though the two words appear to be synonymous, there is a subtle difference in their connotation. Zollo and Winter (2002: 340) refer to experience accumulation as a ‘relatively passive experiential process’ and the processes of knowledge articulation and codification as more deliberate and cognitive exercise. The meaning they have attached to the word ‘experience’ primarily refers to ‘the things that have happened to you that influence the way you think and behave’ (Hornby 2005: 534). However, if we diagnose other meanings of the word ‘experience’ as ‘the knowledge and skill that you have gained through doing something for a period of time; the process of gaining this’ (Hornby 2005: 534) an active connotation emerges. Activities like learning and acquiring skills appears no less an active and cognitive exercise than the other two mechanisms. If new knowledge needs to be created in teams and firms on an ongoing basis ‘experience accumulation’ (accumulation of tacit knowledge) should also be a deliberate, cognitive and as active an exercise as the other two. Members of the knowledge-intensive firms have to adopt behaviours which augment their tacit knowledge (or experience) and continuously fuel the knowledge creation process. Firms have an important role to play in this individual activity by making the necessary interventions available to its members.

Second, though it is quite evident that the codified knowledge is meant to be applied somewhere in the firm, it is important that the creators (members of teams and organisations) of this knowledge closely experience the practical application of this knowledge. By doing so they broaden, extend, and reframe their own tacit knowledge. Nonaka (1991, 1994) identifies this process as ‘internalisation’, and describes it as the conversion of organisationally held explicit knowledge into individually held tacit knowledge. On similar lines and in the context of knowledge transfer in virtual teams, knowledge internalisation can be defined as a set of routines that facilitate the absorption of organisationally held know-how into individual or personal knowledge. It is closely related to ‘learning by doing’ (Zhang, Lim and Cao 2004), and its processes lay greater emphasis on ‘learning how’ as compared to ‘learning why’ (Kale 1999). It serves as the last step in the organisational knowledge creation spiral wherein members of the organisation come to understand the results of
their previous efforts in an extremely intuitive way. Internalisation occurs when the team/organisation members experience the results of the codified knowledge and feel the realism of knowledge application. The evolution of a new knowledge creation cycle rests on the strong foundations of ‘knowledge internalisation’ and the experience gained by the members in this process. Thus, we propose a fourth element in the knowledge creation process, which is ‘Knowledge Internalisation’. These four learning mechanisms should be co-evolving, systematic, iterative and patterned to be seen together as a second order group level dynamic capability (Collis, 1994; Winter 2003), which we name as the firm’s Knowledge Creation Capability (or KCC). We believe that all knowledge activities in the virtual CoPs can be categorised in terms of the four learning mechanism factors identified here. As the learning mechanisms in the virtual CoPs is in the context of best practice transfer, and as CoPs are the components of the firm; we name the generated first order dynamic capability as the firm’s best practice transfer capability, or BPTC (Gupta, Soo and Cordery 2008). The second order dynamic capability of knowledge creation (KCC) governs the rate of change in BPTC, which in turn operates on, modifies and brings in improvements in several functional processes and operating routines within the firm. Building upon Collis (1994), this concept of capability hierarchy is well explained by Winter (2003). He argued that the strategic substance of capabilities involves in patternning of activities, and by considering ordinary or ‘zero-level’ capabilities as those that allows a firm to ‘make a living’ in the short term (for e.g. firm’s production process, or marketing process such as ‘telemarketing’), dynamic capabilities can be defined as those that operate to extend, modify or create ordinary capabilities. Upon this logic and having defined the zero-level capability, he argues that there is thus an infinite regress (1st order, 2nd order….and so on) of capabilities at least in a truly mathematical sense. From a practical standpoint a higher level dynamic capability may exist (e.g. KCC in this case) if they are patterned, stable and modify the lower order capability (e.g. BPTC in this case). An adaptation of Zollo and Winter’s model is exhibited in Figure 2.

Insert Figure 2 about here

In an earlier paper, Gupta, Soo and Cordery (2008) empirically demonstrated the role of these four learning mechanisms in the development of BPTC, and the role of BPTC in generating
performance improvements. However, the study did not address whether these four learning mechanisms, collectively, represented a second-order dynamic capability (KCC). In this study, we describe the preliminary findings of a study conducted in order to demonstrate the existence of KCC, and examine a range of process impediments to its development. The empirical demonstration of KCC as a second order dynamic capability reinforces the understandings on ‘capability hierarchy’ brought forward by Collis (1994) and Winter (2003).

THE SETTING

The setting for our study is a large multinational mining and mineral processing company with refining operations in 4 continents around the world. Having observed varying levels of subsidiary performance, they began developing and institutionalising virtual CoPs to share operational knowledge, with a view towards improving their practices and processes. Each CoP has a common operational focus and its membership spans across several geographical locations. Members of CoPs interact in a technologically enabled virtual environment with a view to share their operational knowledge and experience. They discuss practices and technologies being used at their sites, and in the process, help each other to solve their issues. As the communities mature they work towards analysing each unit’s practices, identifying the best ones, improving upon them, codifying them in the organisational repositories and trying to standardise them across the wider organisation. In a virtual environment, they make use of technologies such as teleconferences, videoconferences, NetMeetings, and WebEx for meeting and interacting as a community. They have also developed a community portal (on the company intranet) as their virtual office for communication (through e-mails and discussion boards), and for storing and retrieving shared documentation. In their interactions they undergo collective brainstorming, presentations, debriefing sessions, review past work and actions and engage in collective problem solving. Through such activities members not only develop their own knowledge and skills, but also contribute to the effectiveness of the firm. At current standing, the company has set up around 80 virtual CoPs (across several administrative, production, process maintenance and R&D functions).

Virtual CoPs which were related to strategically important operations and functions came earlier into existence. The CoPs also differed in their methods of formation. While some originated...
from the pre-existing groups in the company, others of high strategic importance were formed as the result of an executive decision of senior management. Other communities emerged naturally, as a result of the collaborative effort of some enthusiastic and energetic professionals. Virtual CoPs also differ in their membership structure and level of virtuality. The variation in the structure is on account of total number of members in a CoP and also in terms of numbers of members from one particular location. All the members in most communities are employees of the firm and rarely, a community may have members who are representatives of external stakeholders such as customers and suppliers.

Each community comprises a set of core members and other interested members, has a leader who is responsible for the coordination of community meetings and activities, and accountable for its operations and performance; and a sponsor whose primary role is to seek alignment of community activities with business needs and to represent community in its dealings with the senior management. Some professionals (on the basis of their knowledge and expertise) are members of multiple CoPs. Some of the communities, because of their high level of task specialisation and high division of labour requirement, are broken down into various sub-communities by their leaders. All the CoPs are at varying levels of maturity (in terms of their development) and at different performance levels across key performance indicators designated by the company. Most of the communities have their first member interaction over a teleconference, while few were lucky to have their first interaction over a videoconference or in a face-to-face meeting. Members also vary in their level of experience – from fresh graduates to company veterans.

METHODS

A web-based survey questionnaire was administered to 678 community members distributed across 62 virtual CoPs. The total number of valid responses was 243, representing members from 42 communities, a net response rate of approximately 36%. We also conducted 32 semi-structured interviews of leaders and members of 18 virtual CoPs within the firm, examined company archives and personally attended numerous meetings of virtual CoPs.

All the survey items were subjected to exploratory factor analysis, using Alpha-factoring as the factor extraction method and direct-oblimin factor rotation. Four factors explained 61% of variance in the items, with knowledge codification activities loading on the strongest factor and explaining 33%
of the total variance explained. All the factors showed satisfactory interitem consistency ($\alpha > .70$).

Next, we carried out confirmatory factor analysis by assessing the congenericity of each of the four learning mechanisms, using AMOS 17.0 structural equation modelling software. We entered the theoretically derived items that have survived from the item-reduction stage as observed (endogenous) variables in each model. In order to test for the existence of a higher-order factor representing KCC, it was entered as a higher order exogenous variable and all four learning mechanisms were correlated (through KCC). We determined the model fit by examining the root-mean-square error of approximation, the goodness-of-fit index, and the chi-square: degrees of freedom ratio.

**RESULTS**

All the indicators of goodness of fit (GOF) were excellent and all the standardised loadings of indicators on four factors were quite good (between .5 and .9). Except for Knowledge Accumulation factor, all the learning mechanism factors had high loadings ($> .70$) on KCC construct. High levels ($> .5$) of variance-extracted measures shows good construct validity (convergent). However, knowledge codification and knowledge internalisation factors had weak discriminant validity due to high correlation among themselves (.75). This seems to be data specific and spurious in light of the strong theoretical understandings and arguments. Key results from the CFA and the representative items of learning mechanisms are shown in Figure 3. These findings reveal the coevolving nature of learning mechanisms and provide support for the view that KCC exists as a second-order factor defined by the four learning mechanisms.

**BARRIERS TO DYNAMIC CAPABILITY DEVELOPMENT USING VIRTUAL COPs**

In this case, virtual CoPs share and transfer knowledge with the ultimate goal of identifying and transferring best practices and ideas. In the process, they manifest a second-order dynamic capability (KCC) which has the potential to generate a first-order dynamic capability (BPTC), which was demonstrated, in our earlier paper (Gupta, Soo and Cordery, 2008). Thus it makes good sense to become familiar with the barriers they might face in their pursuit. Using the results of our interviews,
we now identify several key barriers to the development of KCC in such entities (a summary of the key problems is outlined in Table 1 with the corresponding implications provided in Table 2).

Barriers to Knowledge Accumulation

Virtual CoP members learn as individuals and groups, and contribute to the community’s knowledge pool. A significant bottleneck in the process is the add-on nature of community-based learning. Learning activities in these communities are essentially an add-on to the members’ main job. Thus, members who are very busy in their primary area of functional responsibility find it difficult to take time-out to attend community meetings, visit the community website and to keep themselves abreast of new developments. The situation seems to become exacerbated when communities have not identified specific goals, objectives and deliverables that are aligned with members operational goals. The interviewees were quite frank in their opinions:

“One real challenge in this pursuit is that these community activities are an add-on to members normal jobs…this is a sort of side-work for them.”

“Discussions in the community have often no relevance to me. It’s better if they look at the issues of specific sites and than collaboratively solves them in the community.”

“I can’t do the community work because I have certain objectives to meet. My personal evaluation depends on meeting these work objectives.”

Barriers to Knowledge Articulation

The options available for collective learning in CoPs include teleconferences, videoconferences, NetMeetings, WebEx, and the discussion board on their community web-portal. One of the key challenges, which restrain knowledge articulation, is the complete absence of any face-to-face interaction in most virtual CoPs. It is very difficult to understand feelings, emotions, reactions, likes and dislikes when the people have never met before. The group interaction is further restricted in the absence of body language and gets exacerbated when people have different accents and dialects.

“Without seeing people, it is very difficult for me to judge whether somebody is just sitting back with his arms crossed, or they are angry, or are leaning forward and are enthusiastic.”

“There are people who just sit and listen. It’s hard to get that level of engagement when you can’t see faces. It’s hard to know whether they are concentrating, or interested in what the conversation is about.”

“Because of the accent aspect it is very hard to tell whether people’s tone is positive and enthusiastic about participation, or there is some irritation.”

~ 10 ~
While technology is widely been touted as an enabler of information transfer, knowledge creation and innovation, it can be a curse in the same pursuit if organisations and its members are poorly resourced. Countries vary in terms of the quality of available infrastructure and people in organisations are not evenly resourced in terms of their access to the available means. This restricts the use of more effective communication tools as observed in following statements:

“We used NetMeetings as well, but problem is that at some sites there are only dialup internets and NetMeetings doesn’t work on dialups.”

“As a regular communication tool videoconferences are more a trouble than they are worth. For a one-hour meeting we have to spend 3 hours in the office. Also lot of time is absorbed in setting up the systems…..and than returning back at night time. It is very troublesome…..not practical.”

**Barriers to Knowledge Codification**

The biggest challenge to knowledge codification activities again comes from the add-on nature of community activities and lack of resources in most communities. In a virtual, multicultural and multilingual environment it becomes imperative that most of the knowledge and information is well codified in digitised form. To carry out these activities extra resources are required.

“Ultimately we are planning to digitise all the relevant knowledge in our department so that it is fairly accessible. At the moment all of these documents are in hard copies and lying in boxes……..but now we have an admin person to manage this library. ”

Further challenge in this regards seem to arrive from the improper filing of documents and folders on the web-portal. This makes it difficult for people to extract knowledge from the web resources if they are not actively involved in the community activities at a micro level. However, this difficulty again seems to be a function of lack of human and temporal resources.

“In the past six months, I would say, I have pulled around 10-15 document from the community site, which I could not locate on my system. I think this would be hard to do for someone who is not involved with communities much.”

**Barriers to Knowledge Internalisation**

The most significant challenge in this process percolates from the lack of authority and recognition to many of the virtual CoPs in the company. As said earlier, the company has established around 80 virtual CoPs across key functions and processes. These functions are on a continuum with respect to their strategic importance in the eyes of the management, which is derived by the quantum of resources each function draws. Some functions are quite large in terms of number of headcounts, raw material consumption and their contribution in the value chain, while most are relatively small.
The CoPs which are on the low end of the strategic importance continuum receive relatively lower levels of management support, and frequently struggle to obtain the recognition, resources and authority. However, proper management support alone shall not be able to alleviate the situation. Poor knowledge internalisation also occurs from lack of leadership and risk taking abilities of leaders and sponsors in virtual CoPs. Following quotes captures these issues:

“Until recently, we were a kind of community for sharing ideas, whereas we could see several areas for improvement. We were always operating at an arms length with the locations, which have the final say whether something needs to be implemented or not.”

“The people who sanction best practices are generally reluctant to issue them, as this brings in lot of responsibility. They do not feel that much authority to speak on behalf of different refineries if something goes wrong.”

**DISCUSSION AND CONCLUSIONS**

In this paper, we have discussed how firms can develop knowledge transfer and application mechanisms using virtual CoPs. We have also proposed that these learning mechanisms evolve to create an overarching dynamic capability. Our study established the existence of four learning mechanisms within CoPs that had been formed expressly to improve the development and transfer of best practices within a firm, and also uncovered evidence that these coalesce to create a higher order dynamic capability. Specifically, confirmatory factor analyses indicated that knowledge accumulation, articulation, codification and internalisation processes contributed to a higher-order factor, which we termed the knowledge creation capability (KCC). A number of key impediments to the development of this capability were also identified. These included a lack of formal job descriptions and responsibilities that cover community activities, a lack of alignment between learning and job-related goals, inability of members to meet face-to-face due to budget constraints, a lack of infrastructure that facilitates rich, technology-enabled interactions, and a lack of management support in terms of authority and resources to carry out community activities.

Dynamic capabilities constitute resources which are internally accrued over a long period of time and thus seem to meet the condition of inimitability. They seem to be valuable and immune to the threats of substitution. Therefore they meet, at least in principle, the criteria of resources that provide sustainable competitive advantage within the purview of the resource based view of firms.
APPENDIX 1 (Figures)

Figure 1

Learning Mechanisms  
- Experience accumulation  
- Knowledge articulation  
- Knowledge codification  

Dynamic Capabilities  
- Process R&D  
- Restructuring, re-engineering  
- Post-acquisition Integration  

Evolution of Operating Routines  
- Improvements in current operating routines  
- Development of new operating routines  

Fig 1. Model of Learning Mechanisms, Dynamic Capabilities and Operating Routines  
Organisational Science, 13 (3), 340.)

Figure 2

Knowledge Creation Capability (KCC)  
- Knowledge accumulation  
- Knowledge articulation  
- Knowledge codification  
- Knowledge internalisation  

Best Practice Transfer Capability (BPTC)  

Community/group Performance  
- Longevity, stability, and viability measures  
- Productivity measures  

Team/group level constructs  

Fig 2. KCC, Best Practice Transfer Capability, and Community Performance  
Figure 3

Knowledge Creation Capability (KCC)

Knowledge Accumulation (KA)

Knowledge Articulation (KR)

Knowledge Codification (KA)

Knowledge Internalisation (KA)

Goodness-of-Fit Statistics

<table>
<thead>
<tr>
<th>Value</th>
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<tbody>
<tr>
<td>Degrees of Freedom</td>
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<tr>
<td>Minimum Fit Function Chi-Square</td>
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<td>Root Mean Square Error of Approximation (RMSEA)</td>
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<td>90 Percent Confidence Interval for RMSEA</td>
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<td>P-Value for Test of Close Fit (RMSEA &lt; .05)</td>
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<tr>
<td>Goodness of Fit Index (GFI)</td>
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<td>Adjusted Goodness of Fit Index</td>
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**Fig 3.** Results of confirmatory factor analysis (standardised path coefficients). Unless noted otherwise, All coefficients are significant (*p<.05). KA1 to KI4 are item variables, e = error.

**Item Description**

**KA1** I always welcome new responsibilities and initiatives in my community.

**KA2** I read all community documents and member correspondences.

**KA3** I always read a work-related article (in newspaper, magazines or on the internet), if I come across one.

**KR1** Members provide suggestions and feedbacks to each other on problems and developments at their respective sites/locations.

**KR2** Members discuss and analyse the work practices and technologies at each others' sites/locations.

**KR3** The leader of my community encourages all members in the meeting to contribute to discussions.

**KR4** Members discuss/review similar practices and technologies being used by other departments/processes in the company.

**KC1** My community maintain records (in the form of a memo, note or report) of important community discussions, actions and outcomes.

**KC2** Members of my community regularly develop the community website to make it more informative and useful.

**KC3** Members of my community regularly put queries, solutions, suggestions and ideas on the discussion board for use of other members.
KC4 My community has clear goals and objectives written down on the community website.

KI1 Members of my community ensure that a sanctioned best practice is implemented at their sites.

KI2 Community members personally observe the implementation of generated best practices, briefs and ideas at their respective sites.

KI3 My community learns from mistakes and failures in the company.

KI4 My community always experiment with new ideas and practices.
## APPENDIX 2 (Tables)

<table>
<thead>
<tr>
<th>TABLE 1</th>
<th>BARRIERS TO DYNAMIC CAPABILITY BUILDING USING VIRTUAL CoPs</th>
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<tbody>
<tr>
<td>Barrier</td>
<td>Specific Problems Identified</td>
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</table>
| 1. Barriers to Knowledge Accumulation          | • Learning is a sort of side work, or part-time job. People do not take it seriously.  
                                          | • Learning outcomes are not aligned with business objectives  
                                          | • Learning is not aligned with the job objectives.  
                                          | • Lack of drivers for learning. |
| 2. Barriers to Knowledge Articulation          | • Most of the communities have never met face-to-face. Without any face-to-face interaction it is difficult to understand people’s emotions and needs.  
                                          | • It is difficult to seek participation and engage people in teleconference meetings.  
                                          | • Meetings over teleconferences can be fairly disorganised and spontaneous due to lack of video aspect.  
                                          | • Many people are from non-English speaking background. Though they speak English, and the lingo (technical and company specific stuff) is same, it is hard to understand the accents, emotions and sentiments.  
                                          | • Community members are from different countries, culture and language backgrounds. They have different attitudes towards group communication in a multicultural/multilingual setting.  
                                          | • Some locations don’t have broadband internet and NetMeetings doesn’t work well on dialup internet.  
                                          | • Videoconferences cannot be attended from home. Members have to come to office in the odd hours, setup the systems and then return home in odd hours, which is quite cumbersome.  
                                          | • Turnover of members in some communities is quite high. When members leave there is a break in continuity, loss of knowledge and disruption in workflow. The cycle starts again with the new member. |
| 3. Barriers to Knowledge Codification          | • People are very busy with their main jobs and do not find time for community activities. Codification activities absorb lot of time.  
                                          | • Communities vary in terms of their potential to add value to company profits and revenue. High potential communities attract better resources, management focus and attention. Most communities do not have enough manpower to digitise documents and manage web-portals.  
                                          | • People lack language skills for codification work. |
| 4. Barriers to Knowledge Internalisation       | • The importance of learning has not been adequately emphasized organization wide. Learning is seen as a waste of time by many.  
                                          | • Learning does not complete unless you apply it. People lack authority to apply and experiment, which restrains further learning.  
                                          | • It is not always possible to demonstrate benefits (from knowledge activities) upfront as the implications could be quite long term in nature. Compliance to establish a business case in knowledge transactions sometimes restricts learning.  
<pre><code>                                      | • Lack of leadership and initiative taking. People do not want to be held responsible if something goes wrong |
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<table>
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<tr>
<th>Implication</th>
<th>Specific Actions</th>
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</table>
| 1. Implications for knowledge accumulation | • Set community objectives in consultation with people in the refineries.  
   • Tie learning activities with people’s job objectives.  
   • Provide temporal resources. This may even result in more hiring.  
   • Render appropriate recognition for people efforts. |
| 2. Implications for knowledge articulation | • Organize face-to-face meetings, at least, once a year. Let people meet in dyads and triads whenever possible. This will help people in building understanding and trust. First community meeting should be face-to-face, if possible.  
   • If not all, let few community meetings across the year should be videoconferences or web meetings. A well setup videoconference will make the meeting more interactive. It will also help improving communication as people can observe non-verbal cues and body language.  
   • Involve people in the preparation for the periodical meetings. Set agenda which interests all.  
   • Impart communication skills coaching and cross-cultural training.  
   • Control member turnover and ensure smooth transition of people.  
   • Move gradually towards more structured and formal meetings. Set goals, objectives, deliverables and timelines. |
| 3. Implications for knowledge codification | • The incumbent leader should have ample time to manage and perform codification activities.  
   • Provide manpower to communities for admin and secretarial work.  
   • Impart language skills, especially for written English.  
   • Document all important discussions in the form of memos and reports and publish it on the community portal. This will help non-English speakers to clearly understand the developments in communities. |
| 4. Implications for knowledge internalisation | • Keep learning and knowledge transfer initiative in high esteem. Project communities as club of elites and make the membership look attractive and competitive. Attract enthusiastic and energetic people for membership.  
   • Support by words and deeds both. Seek direct participation of senior people and render necessary resources to communities.  
   • Relax strict compliance of business case (cost-benefit analysis) for learning activities; and leave a margin for errors, mistakes and losses.  
   • Endow communities with authority, set expectations and make them accountable.  
   • Go slow and expect benefits in the long run. |
REFERENCES


Iansiti M & Clark KB (1994) Integration and dynamic capability: evidence from product development in automobiles and mainframe computers, Industrial and Corporate


