The Conceptual Mechanism for Viable Organizational Learning Based on Complex System Theory and the Viable System Model

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The purpose of this research is to explore the possibility of viable learning organizations based on identifying viable organizational learning mechanisms. Two theoretical foundations, complex system theory and viable system theory, have been integrated to provide the rationale for building the sustainable organizational learning mechanism. The final research efforts to make is to propose an integrated mechanism for the living learning organization, in which it could adapt to environmental changes and create innovative knowledge continuously.

Keywords: Organizational Learning, Complex System Theory, Viable System Model

Most organizations should create and maintain innovative knowledge in order to make a competitive advantage and market leadership and to lead a continuous organizational changing process (Argyris & Schön, 1996; Dixon, 2000; Nonaka & Takeuchi, 1995). Through this knowledge-creating process, organizations could not only improve the capability of environmental adaptability, but also generate an creative management environment (Nonaka, Konno & Toyama, 2001). These organizations, which could continuously develop new products and expand market share, might take the market advantages. In order to take these advantages, the organizational learning process could be considered as one of the most critical factors for making organizations competitive, for the reason that organizations need a continuous and viable learning process in all levels of the organization (Nonaka & Takeuchi, 1995; Watkins & Marsick, 1993, 1996). In order to identify the systemic modes of the continuous and viable organizational learning process, complex system theory--CST (Anderson, 1999; Capra, 1996, 2002; Hite Jr., 1999; Holland, 1995) and viable system model -- VSM (Beer, 1981; Espejo & Gill, 1997; Espejo, Schuhmann, Schwaninger, & Bilello, 1996) has been adapted with existing organizational learning theories. The mechanism, in which an endless learning process could occur for continuous self-generating knowledge, has been proposed based on the theoretical conceptualization from the lens of CST and VSM. In more detail, the CST, which represents that the organization could be developed by a systemic self-organizing process and the VSM, which provides organization's continuous self-adaptability for environmental changes through the complex interactions among the organizational components have been integrated based on the organizational learning process.

Research Questions and Methodology

In order to develop a conceptual mechanism that facilitate continuous and self-organizational learning through the synthesized combination of CST and VSM, the following research questions were proposed:

1. What are the main principles of CST and VSM which can be applied to the organizational learning process?
2. How can the principles of CST and VSM promote the process of organizational learning?

Along with these research questions, the concept of organizational learning as a dynamic process (Crossan, Lane, & White, 1999) has been adapted as a conceptual framework for this research, and each mode of this framework has been reviewed in terms of the integrated applicability of all components of CST and the VSM. To tackle the research questions above, the qualitative case study was employed for the purpose of investigating the interdependent relationships among individual, group, and organization and their structural contextuality in the process of organizational learning. The qualitative case study has been conducted to validate the model in GS Caltex Corporation, which is gas and petrochemical businesses in Korea, considered as one of the best practices of knowledge management in Korea.

GS Caltex, which is one of the best practices in the field of knowledge management, has implemented knowledge management and made a successful story with CoP and knowledge expert's activities to support change initiatives. The major source of data in this study was collected by interviews with key men and from the internal documents of GS Caltex Corporation such as CoP (Community of Practices) casebook of best practice, training material for knowledge expert, and internal knowledge management newsletters. Interview was conducted with knowledge experts, CoP leader, and knowledge management team members. All interviews were audiotaped and transcribed.

Organizational Learning

The meaning of organizational learning could be understood as the processes of creating and sharing knowledge from the individuals to an organization toward a company wide (Argyris & Schön, 1978, 1996; Crossan, Lane, & White, 1999). According to the concept of knowledge creation (Nonaka, 1990; Nonaka & Tackeuchi, 1995; von Krogh, Ichijo, & Nonaka, 2002), individuals in an organization could generate the new knowledge based on the applications of existing knowledge, and then knowledge in the organization could be shared among all group members in order to create organizational knowledge. The knowledge created by the organization learning leads and promotes organizational change through the continuous product development, reform of organizational structure and policy, modification of workflow, and alteration of organizational culture (Garvin, 2000; Nonaka, 1990; von Krogh, Ichijo, & Nonaka, 2002).

Organizational Learning Process

The process of organizational learning has four steps: (a) intuition (b) interpretation (c) integration, and (d) institution (Crossan, Lane, & White, 1999). They categorized the levels of the organizational learning process as individual, group and organization, and described the four steps of the strategic renewal process of organizational learning. First, the intuition step is the process of acquiring information and knowledge at the individual level; secondly, the interpretation and integration steps are the process of sharing applicable knowledge through the dynamic interactions and socialization among groups; and finally, the institutionalization step is the final conformational process for sharing knowledge as a commonality at the organizational level.

All of the four steps of organizational learning processes could not only be promoted by the feedback which encourages the exploration of new external knowledge, but also be controlled by the feedback which upholds the exploitation of the internal knowledge. The new knowledge and behavioral patterns of individuals could be diffused into the organizational levels through the 'feed forward' process, and this leads to a new pattern of organizational learning process. Furthermore, all of the knowledges or behavioral patterns, which have been institutionalized by the learning process, could be intensified back into both individual and organization levels **(**Crossan, Lane, & White, 1999; Garvin, 2000).

Complex System Theory and the Viable System Model

From a system theory perspective, in order for the organization to adapt to environmental changes and to be developed continuously, organizations need to be considered as a living organism rather than a passive and complicated machinery system (Capra, 2002; De Geus, 1997; Morgan, 1997). In this regard, first, CST can be a kind of building block for a systemic process in which the organization could be innovated by the positive adaptability to the environmental changes, and several studies related to CST have been applied to the field of organization science (Anderson, 1999; Boisot, & Child, 1999; Capra, 2002). Secondly, the VSM has been focused on and utilized as a practical tool to develop a concept of a living organism, in which the organization could be developed and continuously changed through the self-adaptability to environmental variations (Beer, 1981; Espejo & Gill, 1997; Espejo, Schuhmann, Schwaninger, & Bilello, 1996).

Complex System Theory

According to Arthur (1999), the complex system can be understood the system in process, systems that constantly evolve and unfold over time based on the continuous interactions and interferences among all of organizational entities. In addition, he describes the characteristics of the complex system as the followings: (1) creating structural patterns, (2) exposing unexpected prosperities, and (3) initiating continuous change, all of which have inter-relationships with the feedback processes, which have impact on all entities of the system.

The complex system has the property that could be continuously developed through the nonlinear interaction of components. Furthermore, the complex system is an open-system, so all of the components could be integrated and interacted with not only internal but also external environments (Capra, 1996, 2002; Hite Jr., 1999; Holland, 1995). Through the continuous interaction with environmental factors, the complex system has the properties of

"emergence" through the dynamic interaction among the internal components of the complex system. Along with "emergence," the organization could reach the stage of "self organization" by support of a feedback loop, which is located inside the system itself (Capra, 1996; Hite Jr., 1999; Holland, 1995). The existing organizational system could evolve, through the revolutionary self-organization process, to the newly shaped organization, which means that the organization could be changed and developed voluntarily by the unforced interaction of microscopic components, not by externally forced intentional efforts to change it.

Through the literature review related to the theory of complex system (Anderson, 1999; Capra, 1996, 2002; Hite Jr., 1999; Holland, 1995), the following core concepts have been drawn as the critical features of CST, which could be applied to address each mode of "organizational learning as dynamic process": (a) sensitive dependency on initial conditions, (b) emergence, (c) feedback, and (d) self-organization. Systemic integration of these four concepts could result in applying the revolutionary procedures of CST to the viable organizational learning and could provide the roadmap of the organizational learning process for sustainable organization.

Sensitive dependency on initial conditions. The concept of "sensitive dependency on initial conditions," which could also be described as the concept of the "butterfly effect," stresses that a small change at the initial stage could have tremendous impact on the organizational change through the internal feedback loop in the organization (Anderson, 1999, Bloch, 2005; Hite Jr., 1999). The precondition for the organizational learning process could be considered as an individual's learning activities (Crossan, Lane & White, 1999; Kim, 1993). The problematic issues, which have been initiated by the knowledge created at the individual level could go through the "sensitive dependency on initial conditions," in turn based on the multi-interactive practices among all group members at all group entities; and finally the entire organization could have the environmental adaptability and willingness to be changed.

Emergence. The concept of emergence could be explained as the unexpected phenomenon of organizational changes or organizational structuralizing processes, which could be promoted by the nonlinear dynamics among the constitutional components of system (Anderson, 1999; Capra, 1996, 2002; Hite Jr., 1999, Holland, 1995). The emergence could occur when the system components are various and heterogeneous with each other; furthermore, the evolving processes could be accelerated by the voluntary interaction, not by intentional external interference. For those emergence phenomena, various knowledge and the individual perspectives could be re-created as the integrative knowledge through the social interactions (von Krogh, Ichijo, & Nonaka, 2000; Wenger, 1998; Wenger, MacDermott & Snyder, 2002). All these knowledge creation processes could be continuous organizational learning activities, which might not be preceded by the intended and planned plot, but occasionally and unexpectedly.

Feedback. There are two types of feedback modes in the complex system -- "a positive feedback" and "a negative feedback."(Capra, 1996; Morgan, 1997; You, 1994) The first, a positive feedback, breaks the balance of a state of existing equilibrium by creative and innovative ways to promote the organizational changes (Capra, 1996; Morgan, 1997), and the concept of negative feedback could lead to the state of stability by taking the actions from the opposite of the changing efforts (Capra, 1996; Morgan, 1997). The positive and negative feedback could be considered as the connecting link among the sub-components of the system, and they promote their continuous interactions inside the organization. The equipoise of these two contradictory types of feedback could keep the organization from making trap into the severe chaos by sustaining the basic structural regularity in the organization. Finally, the organization itself could pursue the continuous organizational changes by the support of sustained organizational equilibrium between the efforts for change and stability (Crossan, Lane & White, 1999).

Self-organization. The concept of the self-organization could be considered as the regularizing process, in which the organization could be voluntarily structured without external and intentional enforcement but only with the support of the 'emergence' mode (Anderson, 1999; Capra, 2002; Hite Jr., 1999, Holland, 1995). As mentioned previously, the interaction among the agents, which form the complex system, could lead to the stage of emergence through the process of positive feedback and negative feedback. The unstable and chaotic stage of the organization could be followed by the emergence mode. All those unbalanced situations of the complex system will go through the "critical point" and then the organization could recover the holistic regularity for the safe arrival on the stabilization (Capra, 1996). Finally, the organization could reach the self-organization mode by the emergent learning process among the sub-components, in which new knowledge is created.

Viable System Model (VSM)

From the perspective of the VSM, the organization should be considered as a living organism like the human body system (Beer, 1981; Espejo & Gill, 1997; Espejo, Schuhmann, Schwaninger, & Bilello, 1996). Based on the application of the concept of the human body system -- which includes organs, bodily tissues, muscles, the automatic nervous system, and brains -- to the organization system, the VSM proposes the structural mechanism of the organization in terms of the self-generating and self-changing process. The following five concepts could be considered as critical components of the VSM: (1) system 1: implementation; (2) system 2: co-ordination; (3)

system 3: control; (4) system 4: intelligence; and (5) system 5: policy system (Beer, 1981; Espejo & Gill, 1997; Espejo, Schuhmann, Schwaninger, & Bilello, 1996).

System 1: Implementation. As the most basic mode of the VSM, system 1 plays an essential role of sustaining and supporting for all of the organizational activities. System 1 has its own function, and continuously interacts with the external environment (Beer, 1981; Walker, 2006).

System 2: Co-Ordination. The key role of system 2 is to coordinate the system 1. The critical issue of system 2 is not only supporting for amicable process of system 1 but also controlling any types of conflicts of the first system's activities (Beer, 1981; Espejo, & Gill, 1997). In other words, the key function of system 2 is the communication channels or interface between the two systems.

System 3: Control. The meaning of system 3: Control is not a top-down, one-way type of managerial control, but is closer to the concept of 'monitoring' or 'facilitating' roles (Espejo, & Gill, 1997). The critical functions of system 3 is to maximize the role of the synergy by making a dynamic interaction among the sub-systems and promoting the sustainable condition of the organization efficiently.

System 4: Intelligence. The roles of system 4 make sense of external changes and propose innovative directions for the organization based on the current conditions. According to the changes of the external environment, system 4 provides future-oriented strategies for making the organization adaptable to and sustainable with environmental changes (Espejo & Gill, 1997; Walker, 2006).

System 5: Policy system. In this mode, the overall organizational strategies could diffuse into the whole organization, so that all entities of the organization could proceed with a common vision (Espejo & Gill, 1997; Espejo, Schuhmann, Schwaninger, & Bilello, 1996). This kind of role could be a ground rule of the sub-systems' automating functions, and a catalyst for intensification of the sustainable organization.

Viable Organizational Learning Mechanism

As we have seen above, the principles of the evolutionary complex system and structural mechanisms of the VSM were integrated into the conceptual mechanism for viable organizational learning (see Figure 1.). This mechanism is based on the organizational learning process as a dynamic process and as strategic renewal by the multileveled structures of individuals, groups, and the organization. The principles of the complex system, which has been applied to this research, suggest that how organizations could be learned as a living complex system; and System 1 to System 5, which make the organization viable are the organizational cultures, institutional systems, and organizational structures that facilitate a viable organizational learning.

Intuition. The intuiting process triggers the change of the organization as a complex system. Intuition at the individual level is a micro change in the view of the whole system, but it is the starting point of a macro change of the whole system based on the principle of *sensitive dependency on initial conditions.* Individuals as System 1, a primary unit of an organization, learn from continuous problem-solving experiences and formal learning programs. In these learning processes, individuals can create new ideas or insight through intentional questioning.

In 2006, about 500 questions were posted in Knowledge Management System (KMS) in GS Caltex Corporation. These questions were answered by CoP or "Knowledge Expert". In a CoP, the learning processes are also making start from questioning about the current job on the workplace. An interviewee said as follows:

> When somebody posted a question on the KMS, I usually searched the internet or asked somebody who had the knowledge about the question and discussed the questions in my team or community. Through these processes, different views or opinions about the question were integrated and could be the knowledge available to whole organization.

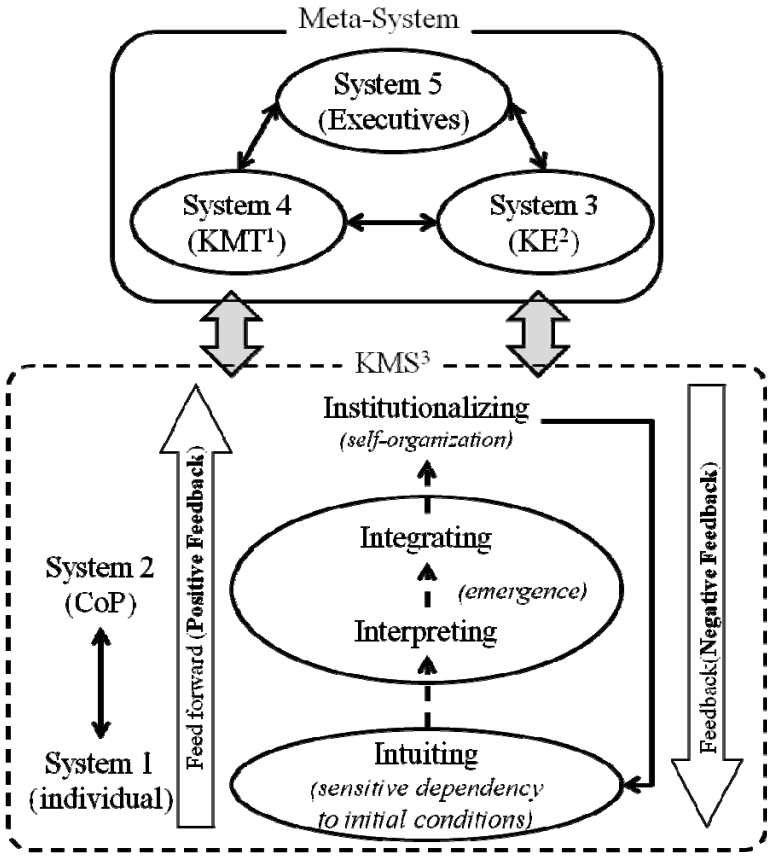
Interpretation and integration. Interpretation and integration are a social process in which individuals share problems and tacit knowledge embedded in the workplace (von Krogh, Ichijo, & Nonaka, 2000; Crossan, Lane, & White, 1999; Wenger, McDermott, & Snyder, 2002). In the process o f interpretation, individuals interact with other community members about problems that they questioned in the intuition processes, so they can create new ideas, languages, and concepts (von Krogh, Ichijo, & Nonaka, 2000; Crossan, Lane, & White, 1999). And, in the process of interpretation at the group level, individuals develop new shared understandings through conversation among members of the community (Crossan, Lane, & White, 1999). In the interpretaion/integration process, knowledge is not shared as it is, but is shared as emergent new meanings by individual's different experiences and thoughts. These emergent processes lead to self-organizing change of the organization as a complex system. System 2 facilitates the process intuition at the individual level and plays the role of the communication channel that helps the individual interact actively among others. For example, the official/unofficial community in the organization can be the System 2. Communities in the organization are considered as the places where interactions among members take place and

as the network that makes new ideas flow from individuals to the entire organization (Capra, 2002; von Krogh, Ichijo, & Nonaka, 2000).

117 CoPs that are aimed to share job-specific knowledge and skills are being cultivated in GS Caltex Corporation. 1368 people (47% of all employees) participate in CoP. CoP memebrs discuss and negotiate meanings on what is the critical business to be tackled by members. A result from the social learning process in the CoP is posted in KMS, so all employees can share the ideas and know-how with their members by accessing to KMS. In one case, CoP members established the ground rules of CoP, so called "whiteboard meeting". "Whiteboard meeting" is a way of discussion that a leader writes the topic, resulted from mutually agreed on the whiteboard and members freely discuss their opinions and make shared understandings.

Institutionalization. Institutionalization is the process of utilizing new knowledge and reinforcing new organizational routines and rules that are developed at the group level (Crossan, Lane, & White, 1999). The institutionalization process is to make the organizational change sustainable, that is, to set up the new organizational structures, policies, and rules, etc. This process, organizational change as a result of organizational learning, is a self-organizing activity in the complex system.

The explicit results of social learning in CoP called "Kit" are disseminated into whole organization thorough KMS. Every employee can download the kit and apply it to their job in the workplace. Some kits are used as learning materials. These kits disseminated company wide can be function to improve the existing organizational processes or routines.



1. KMT: Knowledge Management Team; 2. KE: Knowledge Expert; 3.KMS: Knowledge Management System

Figure 1. The viable organizational learning mechanism

Meta-system (except system 2). The meta-system consists of system 2 -5(Walker, 2006). System 3 might be an organizational unit that monitors and facilitates the emergent learning in communities. The units need to make policies that enable a variety of interactions between individuals and build the culture for the emergent learning. Third, System 4 supports integrating processes. While individuals develop shared understandings, System 4 has to monitor the external environment and to acquire new external knowledge (Beer, 1981; Espejo,& Gill, 1997; Walker,

2006). Then, individuals can combine their ideas and thoughts for shared understandings that are appropriate for coping with the external environmental changes. System 4 should make the organizational future plans, routines, and rules based on the shared understandings. System 5 is the policy-making function (Espejo, & Gill, 1997; Espejo, Schuhmann, Schwaninger, & Bilello, 1996). The policy made by System 5 could be behavioral references for individuals in the organization, for example, organizational vision, mission, and values.

In the case of GS Caltex Corporation, "Knowledge Management Team(KMT)" and "Knowledge Expert(KE)" play the role of meta-system wholly, rather than the separate system 3 - 5. First, KMT develops and manages a variety of policies to support the activities of CoPs: (1) managing CoP Support Center (on-line); (2) train leader and coordinator of CoP; (3) funding for CoP activities; and (4) managing learning event programs to share knowledge and to inform of knowledge management program. Additionally, KMT classifies various organizational knowledge into 80 domains in the KMS. KMT select KEs in each domain. One of the missions for KE is to facilitate to create and share organizational knowledge. As KMS is interconnected with every knowledge management activities including CoP, learning in each knowledge domain is cross-leveling. As a result, knowledge database in the KMS has been enriched as CoP members take participate in learning process like Wikipedia. As one interviewee stated as follows:

> …After posting an answer to the frequently asked questions, someone asked different question about the answer. If others have a different understanding about it, they added their opinions to the post…Through these organizational learning processes, CoP members' level and depth of knowledge has been becoming improved and enriched. .As a coordinator in my CoP, I asked other members to post the market trends or competitive trends. At the initial stage, a few members searched the information and posted it on the KMS board. As time goes by, more and more members participated in searching and posting the information. So, we could recognize newer insights from the information posted in the KMS and have a great potential to cope with environmental changes.

Second, Knowledge Expert plays 5 major roles: (1) knowledge filtering; (2) information distributor; (3) knowledge creator; (4) supporter of CoPs; and (5) change agent. KEs not only evaluate the knowledge that posted on KMS, but also have a dynamic interaction with individuals and CoPs, while provide necessary information about their knowledge domain to individuals and heling to solve the problem on workplace. In GS Caltex Corporation, 77 KEs are operating, as an information distributor, play a role of the hub of knowledge network. One interviewee, knowledge expert, said:

> …For example, the executives also searched for some of the information in the KMS and then, they asked to me, about what were the major obstacles for KEs to tackle in order to make KMS happen…I thought the roles KEs played were interdependent…

At last, knowledge vision and leadership facilitate *institutionalizing* process. The CEO of GS Caltex Corporation emphasizes the importance of innovation and organizational change through the knowledge management in his annual messages. He made a statement as follows:

> …through innovative activities including knowledge management and building organizational culture, we have to move toward a great company in the global society... (CEO's Annual message, 2007).

And the knowledge vision that presses strong emphasis on knowledge management activity play a key role in making the organizational change initiatives focus on one direction. The knowledge vision of GS Caltex Corporation is:

> Energy leader maximizing values of company and competence of employees through knowledge management

Members of CoP also thought that executive's strong support and interest in change initiatives are key success factors for making success story of knowledge management. The opinions extracted from GS Caltex Corporation's CoP casebook of best practice support the above statement as follows:

> …One cannot emphasize too much the importance of leadership. Strong support and interest from supervisor and team leader is the first step toward a success of CoP. The strong support from CEO, IT systems and infrastructure including KMS, and continuous monitoring of KMT are the foundational condition for making CoP successful…

Feedback. The organizational learning and strategic renewal process operates through the tension between feedback and feed-forward processes (Crossan, Lane, & White, 1999). These are visible and invisible interaction between individuals through on-/off-line. The feed-forward that transfers new ideas and insights from the individuals to the groups toward the organization is the positive feedback of the organization as a complex system. The problem questioned at the individual level is transferred to the group and organization level; then the group and the organization is continually exploring external information to tackle the problem. As a result, the organization becomes unstable and self-organized (Capra, 2002). The organization that evolved by positive feedback is reinforced by negative feedback (Capra, 1996; Crossan, Lane, & White, 1999).

Implications and Further Research

In today's complex and turbulent business environment, the organizational learning that can provide for sustainable competitive advantage and create new knowledge is becoming more and more important (Dixon, 1994, 2000; DiBella & Nevis, 1997). Thus, this research suggests the conceptual mechanism of viable organizational learning that enables an organization to create new knowledge and adapt to environmental changes constantly by itself. This mechanism applies the disciplines of a complex system that constantly evolves to an organization to provide the viable organizational learning process. This mechanism emphasizes emergent organizational learning and viable renewal process based on self-organization that is underestimated in the existing organizational learning theory in order to overcome the limitations of and problems with the previous organizational learning research.

For viable organizational learning, first of all, intuiting at the individual level must be activated. For this reason, HRD practitioners need to design/develop not only formal learning programs but also informal learning strategies through intentional questioning in the daily workplace. Furthermore, they have to cultivate and support various CoP where emergent learning can take place. Through these communities, individuals in the organization can make a strong human network and communicate with others (von Krogh, Ichijo, & Nonaka, 2000). Technological infrastructures will be an enabler to help the communicative process. In this change initiatives, the role of leadership play a significant impact on making change efforts successful. The viable organization can learn and change not through the top-down strategies of powerful leadership or external interventions, but through the bottom-up or middle-up & down learning process triggered by dynamic interactions between individuals in the organization (Capra, 2002).

Even though this research, which focuses on specific case in Korean, has a strong implication for HRD practices, further researches that makes consideration for cultural variations and differences between the western and eastern companies need to conducted. And, other researches about sub-systems constituting the VSM are needed to investigate how each sub-system is interdependently exchanging information. Especially, the role and competence of knowledge expert, as system 3 in VSM, who take part in overall processes of organizational learning and knowledge management with their tacit knowledge and experiences needs to investigate. In this respect, HRD practitioners need to develop educational programs to train a knowledge expert so that they can facilitate change efforts throughout company..

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