Utilization of Knowledge in Construction Projects

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Abstract

This study explores problem of utilizing knowledge in construction projects. Based on experiences and theoretical analysis, knowledge has not been fully utilized in general and project management environments. This gap in appropriate utilization of knowledge influences construction works too. The study aims to develop System Dynamics model to examine why gap in knowledge utilization is occurring and how it is influencing project performance. Empirical data has been gathered from three construction project cases that were implemented in Kosovo. At this stage of the study, only basic qualitative model has been developed. Study indicates that knowledge utilization systems in construction projects should be developed as explicit systems of rules and processes. Sole behavior of such systems is not possible without: continuous initiatives, leadership and mentoring capacity. Finally, embedding of ethical values in the overall project culture is another prerequisite for the successful utilization of knowledge in construction projects. The outcomes of this study are aiming to indicate to project managers, importance of managing projects by having in mind knowledge utilization as dynamic structured activity.

Key words: Knowledge, Knowledge Utilization, Project Management, Construction Management, System Dynamics.

1. Introduction

In construction projects knowledge is not always utilized in its full potential. Problems with quality of execution, management effectiveness, administrative behavior, conflicts and communication problems, are somehow influenced by inappropriate use of knowledge. This gap in knowledge application influences heavily performance of the projects and their results.

Based on three cases that have been analyzed as background for this study, similar pattern occurs regarding the way how project stakeholders use their knowledge. Although, knowledge is recognized as very important element in construction, it is not assumed as reproductive resource for manipulation. Mostly, actors in construction projects are utilizing knowledge spontaneously with reluctance to accept existence of any discrepancy in terms of knowledge quantities or qualities. Such behavior creates system of knowledge utilization in projects that lacks awareness about mismanagement of knowledge and indicates necessity to develop more structured and controlled system of knowledge use.

This study presents initial stage of analysis for the problem of knowledge utilization in construction projects. Task has been examined with qualitative method of Casual Loop Diagrams in two stages. First analysis presents basic behavior towards knowledge in projects. This model has basic loops of the knowledge utilization system: knowledge acquisition, lessons learning cycle, knowledge elicitation, commitment to apply knowledge, and knowledge generation. Second model is enlargement of the first one with additional elements that present mechanisms to control utilization of knowledge. These additional mechanisms are related to follow-up function; internalization of learning lessons; explicit system of knowledge needs recognition and planning; heterogenic approaches to eliciting knowledge; and taking in consideration of project strategies and external impacts.

By now, the results of the research indicate that inefficiency of knowledge utilization comes from dominant technical mentality, lack of structured systems to manage utilization of knowledge, and neglecting the impact from human attitudes and beliefs.

Modeling of knowledge utilization problem in construction projects that has been presented in this paper is in its initial stage and is continuation from the author's work presented in PhD Colloquium in 2012 SD Conference in St. Gallen (Rodiqi, 2012). Study aims to continue with more detailed conceptual and quantitative modeling in the future stages.

Research problem

Although, knowledge was very early recognized as influential factor in corporate environments (Hayek, 1945; Boulding, 1968; Machlup, 1979) and knowledge related studies in management have significant theoretical baggage accumulated (Drucker, 2008; Kogut & Zander, 1992; Cicmil & Hodgson, 2006), there is very little research done about the subjective use of knowledge in projects. Actual studies are concentrated more on other Knowledge Management (KM) functions, like: creation, transfer, enabling, sharing, and codifying. Less concentration was on analyzing knowledge utilization dynamics especially in project environments.

Intentional use of knowledge in organizations and projects looks apparent issue because people use knowledge while performing their tasks. However, the reality is not that straightforward. Theory (Boulding, 1968; Duncan, 1972; Alvesson, 1993; Brown & Duguid, 2001) as well as practical experiences (Scarbrough, 2003, Argyris, 1995) identifies problematic situations in relation to utilization of knowledge in society and organizational settings. People use knowledge spontaneously without being conscious about the application of knowledge itself (Clark, 2008). They also disintegrate utilization of knowledge in different ways, by claiming more capacity that they have: by hoarding knowledge, by performing less then they know, or by pretending that their knowledge is ultimate. In his early writings, Herbert Simon (1997) has identified problem of discrepancies in administrative knowledge. He noted limitations in knowledge capacities of the individual and identified several questions that are critical for further perception of knowledge in administrative theory:

> *"In this area, administrative theory is concerned with such fundamental questions as these: what the limits are on the mass of knowledge that human minds can accumulate and apply; how rapidly knowledge can be assimilated; how specialization in the administrative organization is to be related to the specializations of knowledge that are prevalent in the community's occupational structure; how the system of communication is to channel*

knowledge and information to the appropriate decision-points; what types of knowledge can, and what types cannot, be easily transmitted; how the need for intercommunication of information is affected by the modes of specialization in the organization." (Simon, 1997, p.46).

Another phenomenon in organizations named "knowing-doing gap" was identified by Pfeffer & Sutton (2000). These authors show that "*Organizational performance often depends more on how skilled managers are at turning knowledge into action then on knowing right thing to do*" (Pfeffer & Sutton, 2000, ch.8. p. 1). Utilitarian aspect of knowledge application was part of the historical debates as well as philosophical speculations (Russel, 1971; Wittgenstein in Anscombe & von Wright, 1975; Ryle, 1949). Applicative role of knowledge has been also acknowledged in the views toward Knowledge-based theory of the firm (Grant, 1996), within general theory of Knowledge Management (Awad & Ghaziri, 2004), and in Project Management body of knowledge (Reich, 2006, Ferrel, 2010).

As complex type of project environments, construction projects are organized in a specific supply chain through involvement of five different types of organizations: clients (project sponsor, owner), consultants (project managers; designers, engineers), contractors (including Subcontractors), suppliers, and third parties like for instance government or beneficiaries (Holti et al, 2000). These actors delegate temporarily their capacities during the project duration which creates specific inter-organizational social structure with its own rules of behavior and administration (Nicolini, 2000). Therefore, construction projects are depending on the capacities of the stakeholders and on the level these capacities are utilized because sometimes these capacities are not sufficient (lack of knowledge and skills), or they were not applied or coordinated appropriately (inappropriate use of knowledge). Besides involvement of different organizations, construction projects are characterized also with constant changes in their structure, content and environment (Morton, 2002; Bennet, 2000). Since, each new building location changes, working environment changes, structure and technology might be diverse, overall administrative support can also be totally different. These and many other situations in construction projects cause delays, rework, quality failures, thus reducing efficiency and effectiveness of the project performance. Uncertainty in construction projects is very high and such working conditions influence utilization of knowledge in many aspects.

Particularly important impact on construction performance comes from behavior of the subjects involved and from administration of the project. Behavior and administration, apart from technology, are related with human capacities, cultures both local and organizational, internal level of coordination between the parties in the project, and mutual trust. All these features have strong impact on utilization of knowledge which can be considered strongly related to social aspect of customs and cultures, competences, and level of collaboration between parties (Bresnen, 2003). Often these systems are not managed purposefully but rather spontaneously, with impact that in most construction projects formal and structured system to control utilization of knowledge is missing.

2. Research question and methodology

The purpose of this study is to explore conditions to manage construction projects from knowledge utilization perspective and investigate how these systems of knowledge utilization

relate to project performance. The research question for this study is: "*How are knowledge utilization systems influencing performance of construction project*?". Specific objectives of the research are:

1. To prove that proactive utilization of knowledge is critical issue for the construction project performance;
2. To model knowledge utilization systems that are necessary to smoothly manage construction project and to identify potential situations that can obstruct project implementation;
3. To find out how different construction project situations react on knowledge utilization.

For the purpose of research three cases has been used as sources of information. All three cases were part of author's experiences in managing construction projects. First case is Construction of Mobile Telecommunication (MT) Infrastructure, second case was Building of Vocational Training Centre and the third was Reconstruction of five bridges. All projects were constructed in Kosovo in the period from 2008 to 2012.

3. Case experiences

Based on the collected materials from observing projects, it has been realized that typically utilization of knowledge in construction projects runs in reflexive manner. Table 1. shows two basic types of KU approach: passive and active. Passive approach, which was dominant in cases that have been studied, is characterized with unaware or spontaneous use of knowledge. Project stakeholders are manipulating knowledge as inner resource and are not very keen to consider it tangibly during the project implementation. Especially, technicians are very rigid in conceptualizing knowledge problems. A respond from QC officer shows how technically oriented manager understands problem of knowledge in construction:

> "*Sole fact that when you prepare design (where you have professional designers), with that design you have defined problems! Design defines technology and with that your problems are solved because you have necessary description of methods of work in the design documentation. Therefore, with this resource, knowledge that is missing are eliminated through design solutions and documentation… because of the specifics of the project which requires accuracy…*".

As respond to these observations, in the right column, below table gives features of the active approach toward knowledge use in construction projects. These features have been partially used in MT Case. Active approach considers that KU processes should be undertaken purposefully and should encompass well established KU functions. This approach is difficult since it requires not only a procedural system but also high level of awareness and commitment to enable overall activity of knowledge utilization.

Dynamic hypothesis

Dynamics of KU could not be considered isolated from Project Dynamics (Cooper, 1998). Aim of this study is to analyze how policies and behavior behind use of knowledge are influencing project dynamics. Up to now, the case studies have indicated five different subsystems that are

influencing directly KU functionality:

1. Knowledge acquisition;
2. Knowledge elicitation;
3. Knowledge utilization follow-up;
4. Commitment to apply knowledge;
5. External impacts, including Regulatory Base, parent company policies, etc.

Table 1.

Passive Model *Commonly managed system in construction projects when knowledge has been utilized unconsciously and spontaneously without thinking on knowledge utilization processes as necessity for project performance!*	*Active Model* *Advanced system to manage construction project by undertaking systematic, purposeful and planned control of the utilization of knowledge during the project implementation!*
Features	
Knowledge is recognized as embedded, concealed value in the project!	*Knowledge is recognized as overt, explicit asset in the project!*
Knowledge utilization is not recognized at all in the project!	*Knowledge utilization is recognized as controllable function in the project!*
Project actors use knowledge on reactive basis within the limits of their personal and team capabilities!	*Project actors manage and use knowledge consciously, by plan, by overcoming the limits of their personal and team capabilities through systematic learning and mentoring!*
Results of knowledge utilization that are embedded in implemented work are not checked and followed because there is lack of specific methodology how to deal with applied knowledge during the project implementation!	*There is continuous follow-up of knowledge utilization during the implementation of the project through developed system for critical knowledge needs identification and use of mechanisms to manage application of knowledge!*
Knowledge declared by parties in the project, both tacit and explicit, was not considered matter of suspicion!	*Holders of the KU system are suspicious on the declared knowledge capacities so they rely on the facts that are coming from follow-up of knowledge application!*
Knowledge and particularly its utilization are not identified in the project as potential risk!	*Low level of possible knowledge utilization is foreseen as risk in the project!*
Mistakes are continuously repeated, utilization of knowledge is not challenged, and the process is not improving!	*Mistakes are used to improve the process of knowledge utilization to bring their occurrence in minimum.*
No discrepancies in knowledge utilization are identified!	*The discrepancies in knowledge utilization are regularly identified and interventions undertaken!*
Inner values, policies and interests of the actors in the project usually are not supporting knowledge utilization process!	*Inner interests and policies of actors in the project support knowledge utilization continually!*

Model starts with simplified project execution cycle (Figure 1.) adapted from theoretical project

models (Cooper, 1998). The cycle identifies explicitly *project demand* because this variable is retrieved from project associated documentation. Project demands can be considered explicit knowledge repository because in construction projects demands are clearly specified in: design documentation, contract documentation and regulatory base documentation. Explicit project demands are important for Knowledge Utilization system because they are source to define critical knowledge needs.

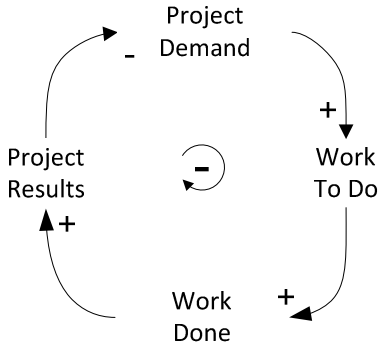

Figure 1. Basic project execution cycle

Project execution cycle continues with *work to do* and *work done* to come to another specific type of information *project results*. This last variable in the cycle is important because it collects new explicitly identified achievements in the project that can be utilized as incoming source for further actions related to knowledge flows. Enlargement of this initially defined cycle is depicted in Figure 2.

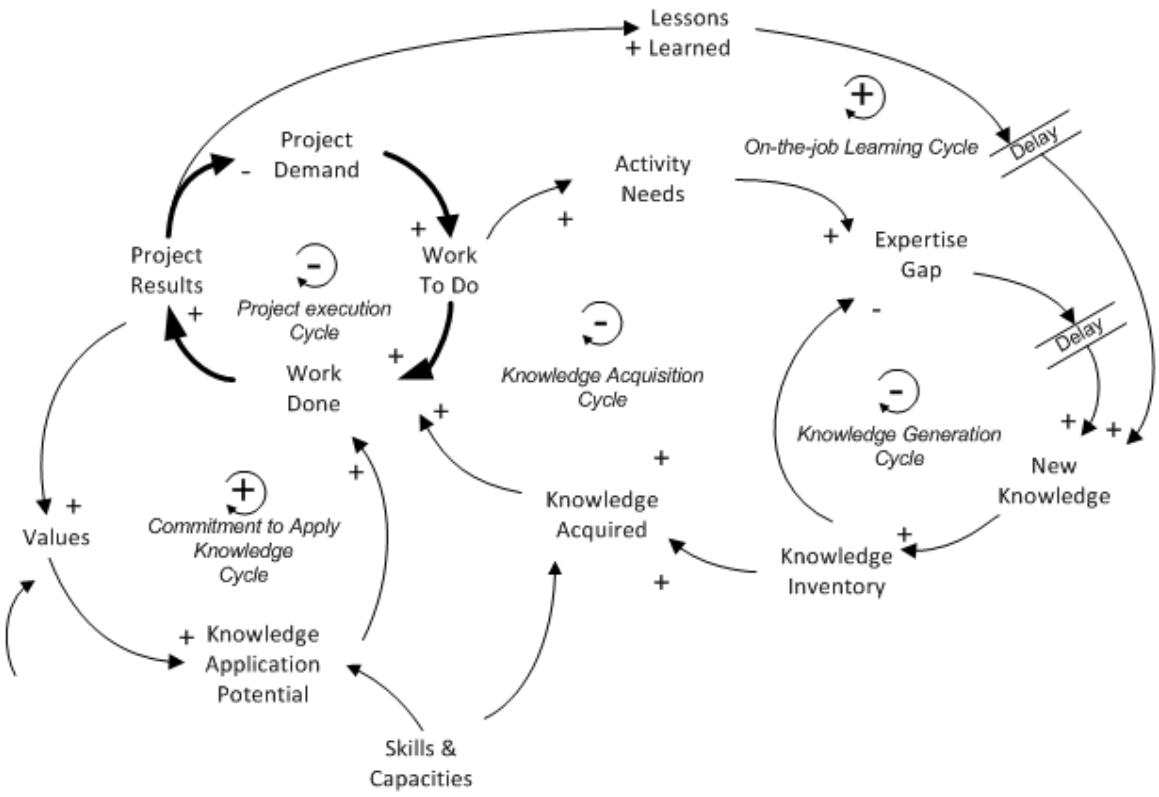

Figure 2. Modeling KU activities through passive approach

First cycle to take in consideration is 'Knowledge Acquisition'. After they identify 'work to do', project actors usually define requirements to perform activity. In this stage they check if internal capacities are sufficient through consulting actual *knowledge inventory* and if they need more expertise, project actors initiate elicitation of new knowledge. Usually this is delayed process because to elicit new knowledge covers different strategies of hiring, learning, or research which takes time. New knowledge is then used as input to knowledge inventory and closes 'Knowledge generation cycle'. Flow of knowledge continues toward *knowledge acquisition* which is stage when specific knowledge that is related to work activities has been identified. Acquisition of knowledge comes through utilizing knowledge from inventory and capacities to organize and adapt knowledge for use. This is very specific in construction when knowledge about methodologies how to perform tasks is necessary to appropriately apply tasks. This cycle runs through 'Project Execution' and becomes balancing loop because the quantity of knowledge needs is reduced proportionally to reduced project activity.

Two more specific cycles have been identified in this model. First is 'On-the-job learning' and the second is 'Commitment to apply knowledge' cycle. On-the-job learning is related to 'Lessons learned' as created experiences from the project results. Gained knowledge from this link should increase new knowledge. However, as case studies indicated, it is not very clear at which level will the actors in the project absorb that knowledge? It could be that experiences from the projects are not explicitly internalized within the company or the lessons are not utilized in next projects. There are also cases when gained experiences and knowledge remain tacitly only at experienced stuff and are not systematically used for the benefits of the parent company. Last cycle depicted in the model represent important intuitive behavior that is crucial for utilization of

knowledge. This cycle is related to a cluster of human values both individual and collective that are influencing decisions about knowledge application. Under this cycle people are declaring their ethical values, beliefs, commitment and interests to use knowledge in particular level. Therefore, besides 'knowledge acquired' variable there is also '*potential to apply knowledge*' variable that influences work done. Capacities and skills of the workers or task implementers to apply knowledge influence both knowledge acquisition and potential to apply knowledge.

This model presents basic behavior in the case of spontaneous actions to utilize knowledge. Such approach is characterized with unconscious reactions on knowledge needs, ad-hoc decisions about new knowledge elicitation, lack of follow-up of the applied knowledge, and little care about overall knowledge flows, processes and problems. This is model that presents behavioral system in managing construction projects where knowledge has not been considered as reproductive resource.

Another, more professional approach that counts for more care and discipline in utilizing knowledge in construction projects comes from the needs to reduce 'knowledge-doing gap'. If gap between knowledge utilization and results of the project implies lower level of efficiency then better utilization of knowledge should bring gains to project performance. This is argumentation for setting-up better control under knowledge flows and knowledge utilization processes. Improvements should be done through installation of particular mechanisms that are enabling better functioning of KU system. This 'active' approach is extension of the first spontaneous one (see Figure 3.). Changes that are made from the previous model are related to functional elements that enable control of knowledge flows, although the basic principles of behavior have not changed.

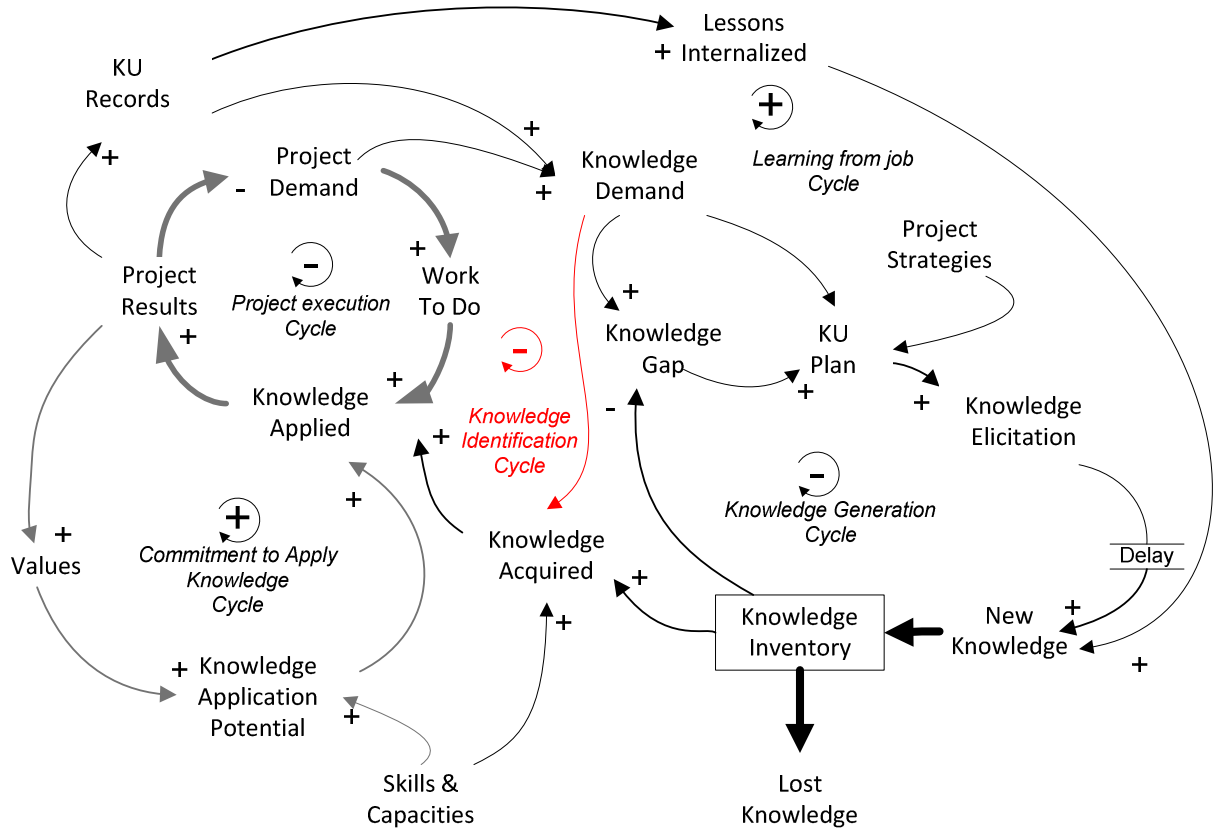

Figure 3. *Modeling KU activities through active approach*

First functional change in the model is that new system defines explicitly *knowledge demands* by utilizing information directly from *project demand* and from the records that have been collected about the results of *knowledge applied*[1]. This is somehow forerunning to define knowledge needs instead of waiting to activate '*Work to do*' activities. Definition of knowledge demand plays role in identifying *knowledge gap* by comparing actual level of knowledge in repositories with identified knowledge needs. Result from knowledge gap implies *knowledge utilization plan* instead of going directly to elicitation process (as in passive model). Plan to deal with Utilization of Knowledge is necessary not only to find solutions to reduce gap in knowledge but also to take in consideration project strategies.[2] This proactive approach enables more qualitative *knowledge*

[1] Work done is changed to knowledge applied since it is considered that knowledge is applied while work is done!

[2] MT Case shows rationality behind this kind of approach. Building second Mobile Phone network in Kosovo was critical due to the objective made from parent Company to build 100 sites in less than three months for the purpose to release the telephone signal. This objective of the newly established mobile provider was very important advertisement effect to attract consumers who were already used to have telephone numbers form the First Provider. However, in terms of building these sites there were problems to work with novel inexperienced construction companies who were not familiar with the process and to coordinate their work in such manner to achieve required productivity. Therefore, based on the Project strategy to have "frontal attack on sites", internally system of supporting Knowledge Utilization was established. Contractors were gathered in specific consultations and trainings and internal team of engineers was prepared to work through standardized procedures, forms and checklists. Furthermore, system of know-how transfer and internal knowledge sharing has been set-up with experienced foreign engineers who worked similar tasks of building mobile telephony abroad.

elicitation and reduces delay in generating 'New knowledge'. However, 'Knowledge elicitation' should be considered specific subsystem that has to be developed in the future as lower level of modeling because it is related to different types of elicitation of knowledge. Depending on the type of knowledge required, project teams can find knowledge by hiring experts or expertise, by setting up a training program, by doing research or by initiating innovative process. Furthermore, activities in obtaining new knowledge might be developed also through social systems such as Communities of Practice or group approaches.

Another change that has been made from the spontaneous model is on the variable *lessons learned*. For the purposeful model it is considered that the moment of gathering experiences in form of lessons should be internalized within the project and the parent company. Therefore it is important to develop a subsystem of on-the-job learning that will enable collection of project experiences and newly performed knowledge.

As final inquiry is that 'Knowledge identification' cycle that has been drawn up by red is considered unnecessary if the overall flow of knowledge goes through planned approach. In the first spontaneous model this cycle was envisaged as result of actors' initiative to jump into knowledge acquisition intuitively.

Further development of the model

Model is in the beginning stage of conceptual analysis. The study is still continuing and there are basically three elements that have to be undertaken in the next step:

1. To continue with detailed qualitative analysis of KU in construction projects environment;
2. To develop quantitative model; and
3. To include other perspectives to encompass situations for different type of projects rather than construction ones!

Conclusion

This study is initial effort to develop systemic environment for description of knowledge utilization in construction projects. At this stage, study concludes that actors in construction projects usually utilize knowledge spontaneously without counting of knowledge gap that is created. Therefore, appropriate and efficient utilization of knowledge in construction projects require more structured and planned approach that has well defined mechanisms to control knowledge flows. However, indications are that mechanisms are not enough but the functioning of overall knowledge utilization system depends also on: project policies, interests, characters, relations, and capacity to learn or apply knowledge, spontaneously, or purposefully! Knowledge utilization depends on effort (conscious activity) and rational capacity to develop a system to control knowledge application, where otherwise, knowledge application would have been saturated by ad hoc decision making, and inappropriate performance.

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