Knowledge management in project phases

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Abstract: Many organizations choose project work as flexible and reliable structures for the development and production of their goods and services. Knowledge such as other tangible resources needs management. Knowledge management functions have to handle the knowledge and experiences in projects for more productive results. In this article we discuss the kinds of necessary knowledge, knowledge management stages and policies and important factors during three phases of a project: Planning, designing and implementation.

Key-words: knowledge management- Project management- knowledge- knowledge creation

1 Introduction

Because of the inherent instability in the business environment today, organizations often find themselves facing the need to change their mode of operation and structure [1]. In order to compete in increasingly complex environment, the firms must create, share and manage knowledge that will give them a competitive advantage. One method of knowledge creation that has been used by organizations for many years is focus groups (teams) [2]. Creating knowledge at the team level is essential for long-term team effectiveness, innovation and productivity [3]. In addition, a team can be viewed as a socially constructed phenomenon or linking mechanism that integrates individuals and organizations [4]. Organizations may change their structure to project team to be more flexible and innovative [5]. Projects are especially suitable for learning [6]. Organizing by projects is on a strong increase for flexibility and innovation and intensive learning [7]. In project management process intra project learning takes place too when project team members discuss approaches for completing a task or overcoming a problem [8]. Such learning creates a body of local knowledge [9]. Inter project learning is combining and sharing of lessons learned across project to develop new knowledge [8]. It leads to more global knowledge that can be transferred laterally across contexts and then applied locally [9].

In project management process also tacit and explicit knowledge should be managed. Explicit knowledge can be codified and, therefore, easy to transfer. Tacit knowledge can not be transferred easily, because it is not expressed in explicit form [10]. It may be argued that tacit knowledge is a more valuable asset in the regional context. However, local knowledge infrastructures also contain 'sticky' knowledge in projects. There is kernel knowledge and ephemeral knowledge too [11]. Kernel knowledge is generic project knowledge, but ephemeral knowledge is specific project knowledge.

Different kinds of knowledge need different policies and resources and technologies to transfer and share and develop between groups' members. Providing better conditions for more productive results is one duty of knowledge management.

The paper comprises the following sections: section 2 explains the project phases. Section 3 explains the types of knowledge which are necessary in each phase of project. Section 4 discusses the involved human resources in each phase. Section 5 discusses the information they need and the information technology they can use for gathering information. Section 6 discusses the knowledge management policies and tasks according to necessary type of knowledge in each phase. Section 7 integrates the results of sections 2-6. And finally the section 8 concludes our discussions.

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2   Project phases

We consider three phases for projects: planning, designing and implementation. At the end of planning phase we have a program for action. Planning phase starts with project pre planning and then feasibility analysis and requirement definition [12]. These three phases make "planning phase". Project planning usually is described as a process of activities that starts by breaking the project work into activities [13].Each activity is then assigned to the organizational unit or team responsible for its execution.

The planning phase is greatly impacted by questions like: what, where, how, time and cost [14]. Answering these questions provide plans for action. The necessary data to answer these questions can be gathered from sources such as: project statistical information; general environmental information; technical information; financial information; and statutory authority's information [15].

In design phase each group/individual should do the planned duties. Technical design in each part should be done in this phase. The calculation and analysis, use of information technology, i.e. AutoCAD and software programming can be done. At the end of this stage we have project plans and schedules for implementation.

In the implementation phase translation of ideas into action is carried out. Subsequently monitoring of progress is done with established dead-lines and designated responsibilities. Different parts of designed responsibilities integrate to complete the whole project.

3   Types of knowledge

The most famous types of knowledge are tacit and explicit knowledge. Explicit knowledge can be expressed in formal and systematic language and shared in the form of data, scientific formulae, specifications, manuals and such like. It can be processed, transmitted and stored relatively easily. In contrast, tacit knowledge is highly personal and hard to formalize. Subjective insights, intuitions and hunches fall into this category of knowledge. Tacit knowledge is deeply rooted in action, procedures, routines, commitment, ideals, values and emotions [17]. Tacit knowledge is in personnel's minds and explicit knowledge can be found in different organization's documents [16]. During project phases both types of knowledge exist. An organization creates knowledge through the interactions between explicit knowledge and tacit knowledge [17]. There

are four modes of knowledge conversion. They are: socialization (from tacit knowledge to tacit knowledge); externalization (from tacit knowledge to explicit knowledge); combination (from explicit knowledge to explicit knowledge) and internalization (from explicit knowledge to tacit knowledge).

Socialization is the process of converting new tacit knowledge through shared experiences. Since tacit knowledge is difficult to formalize and often time- and space-specific, tacit knowledge can be acquired only through shared experience, such as spending time together or living in the same environment. Socialization typically occurs in a traditional apprenticeship, where apprentices learn the tacit knowledge needed in their craft through hands-on experience, rather than from written manuals or textbooks. Socialization may also occur in informal social meetings outside of the workplace, where tacit knowledge such as world views, mental models and mutual trust can be created and shared. Socialization also occurs beyond organizational boundaries. Firms often acquire and take advantage of the tacit knowledge embedded in customers or suppliers by interacting with them [17].

Externalization is the process of articulating tacit knowledge into explicit knowledge. When tacit knowledge is made explicit, knowledge is crystallized, thus allowing it to be shared by others, and it becomes the basis of new knowledge. Concept creation in new product development is an example of this conversion process. Another example is a quality control circle, which allows employees to make improvements on the manufacturing process by articulating the tacit knowledge accumulated on the shop floor over years on the job. The successful conversion of tacit knowledge into explicit knowledge depends on the sequential use of metaphor, analogy and model [17].

Combination is the process of converting explicit knowledge into more complex and systematic sets of explicit knowledge. Explicit knowledge is collected from inside or outside the organization and then combined, edited or processed to form new knowledge. Creative use of computerized communication networks and large-scale databases can facilitate this mode of knowledge conversion. When the comptroller of a company collects information from throughout the organization and puts it together in a context to make a financial report, that report is new knowledge in the sense that it synthesizes knowledge from many different sources in one context. The combination mode of knowledge conversion can also include the `breakdown' of concepts. Breaking down a concept

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such as a corporate vision into operational business or product concepts also creates systemic, explicit knowledge [17].

Internalization is the process of embodying explicit knowledge into tacit knowledge. Through internalization, explicit knowledge created is shared throughout an organization and converted into tacit knowledge by individuals. Internalization is closely related to `learning by doing'. Explicit knowledge, such as the product concepts or the manufacturing procedures, has to be actualized through action and practice. For example, training programs can help trainees to understand an organization and themselves. By reading documents or manuals about their jobs and the organization, and by reflecting upon them, trainees can internalize the explicit knowledge written in such documents to enrich their tacit knowledge base. Explicit knowledge can be also embodied through simulations or experiments that trigger learning by doing. When knowledge is internalized to become part of individuals' tacit knowledge bases in the form of shared mental models or technical know-how, it becomes a valuable asset. This tacit knowledge accumulated at the individual level can then set off a new spiral of knowledge creation when it is shared with others through socialization [17].

It is important to note that the movement through the four modes of knowledge conversion forms a spiral, not a circle. In the spiral of knowledge creation, the interaction between tacit and explicit knowledge is amplified through the four modes of knowledge conversion. The spiral becomes larger in scale as it moves up through the ontological levels. Knowledge created through the SECI process can trigger a new spiral of knowledge creation, expanding horizontally and vertically across organizations. It is a dynamic process, starting at the individual level and expanding as it moves through communities of interaction that transcend sectional, departmental, divisional and even organizational boundaries. It has been shown in figure 1.

Other types of knowledge are kernel knowledge and ephemeral knowledge. Kernel knowledge, include forms of knowledge that need to remain within a company in order to sustain high project performance in the long term. It is a form of generic knowledge like knowledge of machine design [11]. In designing phase we can see this type of knowledge more. Knowledge in designing phase is more global. New methods in designing and new advanced soft wares in many engineering projects can be used in similar fields.

In planning phase kernel knowledge for financial and technical analysis is necessary, but different

information from many suppliers and customers should be gathered and analyzed especially for one project. Ephemeral knowledge use and produce in this stage. This knowledge can be used during the lifetime a project. In planning phase especial analysis is necessary according to the conditions in the project. In planning phase ephemeral knowledge uses and produces more.
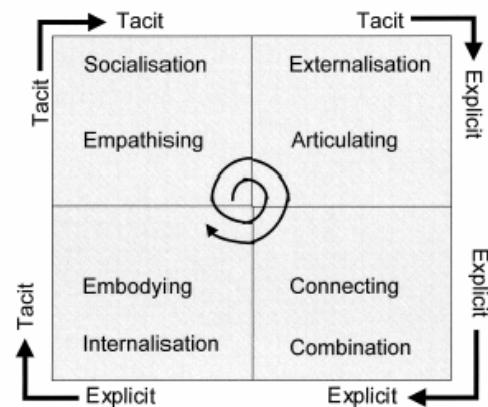

Fig. 1 The SECI process [17]

In implementation phase we need both kernel and ephemeral knowledge. For example human resource management knowledge can be   necessary kernel knowledge in implementation phase. Especial decision should be made that needs creation of ephemeral knowledge in this phase.

Knowledge creation in planning and implementation phases can be local and depends on especial situation in each project and if doesn't record doesn't remain. Part of produced knowledge during these phases is tacit and by postmortem reports or direct communication can be saved and shared to others.

4 Involved people

Having emphasized on three main issues in organizations: human, structure and information and communication technology, knowledge management tries to achieve organization's strategies and goals through establishing proper structures and processes for exploiting knowledge resources based on focusing in human asset as the main value of firms [18]. In planning phase much different information from suppliers, team members, customers and organization abilities and resources should be analyzed. This analysis can be done by experts. They may use knowledge from other projects too.

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Sometimes they participated in them and sometimes use postmortems reports. Postmortems can be used to capture tacit experiences in projects [19]. Statistical information from other projects can be used too. Sometimes direct communication to experts is necessary to get needed information. In planning phase we can see the application of tacit knowledge more. The ability to analyze situation and environment needs tacit knowledge and experiences. For this analysis olds experts who have more tacit knowledge may be better.

Reading postmortem reports and using them in recent project is internalization. Experts can transfer their knowledge by working with trainee during this phase and trainee can capture tacit knowledge and create tacit knowledge by direct communication (socialization).

In designing phase we need kernel knowledge more that can be found in academic places and young people who update their knowledge and methods can participate in this phase also. They have explicit knowledge more that can be captured from new knowledge bases.

In implementation phase many manual workers and contractors and suppliers may participate in project. Technical knowledge to control the processes and matching to designed maps is necessary.

The diverse and huge volume of information should be analyzed according to actions and reactions of many people. Many documents and plans exist from pervious two phases and should be combined to create necessary knowledge (combination). Many new decisions for implementation plans according to especial information should be made. In this situation experts with their tacit knowledge can act better. They can add to their experiences too. Such experiences can be saved as traditional reports or stories for other projects.

5 Information management

Different information needs different policies to be managed. In planning phase we consider two types of information according to their sources: Information from organization and information about the environment. Information about market situation, statutory authority, the price of necessary material, good suppliers and competitors and customer's needs should be considered. They are environmental or external information. This information should be first hand and valid. Yellow pages and newspaper and sometimes interview and direct communication can be suggested for gathering them.

Information about organization abilities and resources (tangible and intangible) and organizational

culture and policies are internal or organizational information. If the analyzer is not a member of organization we strongly suggest consulting with an expert from the organization. There are many intangible resources and subcultures that only members can understand and recognize during their works in the organization. Interview and reviewing of organization documents can be used for gathering information.

In designing phase knowledge maps can guide us to suitable experts and databases. Knowledge bases can be useful for capturing new methods and needed knowledge. The information about culture can help to find better ways to encourage people for accepting these new knowledge and methods during knowledge transfer.

In implementation phase first hand and new information about market and suppliers is necessary. Information about workers' culture especially when the project are implementing in a foreign country is necessary too.

6 Knowledge management cycle

The knowledge management cycle includes the following steps: knowledge identification and capture, knowledge sharing, knowledge application, and knowledge creation [20].

Once the critical knowledge is identified and captured, it is typically shared with others. Those individuals then apply this knowledge and internalize it to their situation, which in turn creates new knowledge. This new knowledge is then captured, shared and applied and the cycle continues [20].

In planning phase identification and application and creation take place more. We have feasibility analysis that needs technical information. Financial analysis should be done in this that needs financial information. And then requirement analysis should be done that needs information about existence abilities and facilities inside and outside the company. The diverse and large volume of information should be analyzed in order to create necessary knowledge. Experts should apply their tacit knowledge to create necessary knowledge. In this stage necessary knowledge from different fields identifies, applies and creates.

In designing phase the technical knowledge uses more. New knowledge should be identified, captured and shared between team's members if they need. The captured knowledge internalizes to apply during project. So knowledge identification, capturing and creation can be seen more during this phase.

In implementation phase knowledge application and creation can be seen more. Experts should apply

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their tacit knowledge and create necessary knowledge. The experts who have expanded their knowledge base and experiences should apply them to create necessary knowledge.

7 Project knowledge management

In this section we show results from section 2-6 in table 1. In this table for the three project phases the relationships between types of knowledge and information and their sources and effective factors in successful knowledge management have been shown. This table can be used for better planning and resource allocation in each phase according to knowledge management theories for more productive results.

This table can be used for project managers to expand their vision for better programming and management by considering knowledge like other resources.

Phases \\ Knowledge factors	Planning	designing	implementation
Types of knowledge (used more)	Tacit – Ephemeral	Explicit - Kernel	Tacit, Explicit – kernel, Ephemeral
Interaction with	Suppliers- Markets- Customers- Competitors	Knowledge Bases	Contractors- workers- Markets- Suppliers
Information	From Suppliers, customer, market and Inside the organization	From Experts through knowledge Maps- Databases	From Suppliers, , Market and Worker cultures
Knowledge management cycle	Knowledge identification, Application and Creation	Knowledge identification and capture, knowledge Sharing and Creation	Knowledge Application and Creation
Important factors in knowledge creation	Experiment, First hand and correct information	Knowledge sharing culture and knowledge Transfer equipments	Good human resource management, Information and Experiments

Table 1: knowledge management in project phases

8 Conclusion

In such a changing environment modern organizations have to react fast and be flexible, so organizing by projects is on a strong increase. They need to use knowledge management in their projects to manage knowledge such as other tangible resources. In different phases of projects, types of knowledge and involved people and varieties and amount of information need especial policies and tasks for management. Knowledge creation can be seen in all phases.

The pattern of capturing necessary information in each phase can be a future research. This pattern depends on the sources of information and the type of knowledge used more in each phase. It depends on the type of projects and final production in each project too. Choosing suitable IT systems or direct communication can be studied in different fields.

Maximizing each kind of knowledge that uses and produces in each phase needs especial policy and mechanism. Project managers can consider kinds of necessary knowledge for better planning. These mechanisms change according to the projects and final products. Comparing these mechanisms and policies in each type of projects can be future studies.

Knowledge increases during a project. This knowledge can feed back as an enhanced resource to other projects. Knowing about sources and types of knowledge and people who create it in each phase of project can guide for better feedback system. This feedback system affected from final product too.

Mechanisms of recording and retrieving them in each phase should be studied. Designing a feed back system to save the results of project can be future study.

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