Summary of PhD Thesis

DEVELOPING KM METHODOLOGIES FROM A SYSTEM PERSPECTIVE

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Preamble

Individual knowledge is the resource to any progressive organization. Knowledge Management (KM) plays a prominent role in capitalizing the individual knowledge into organizational knowledge. There are only few studies available in the literature showing the application of this idea for educational domain. Hence, majority of the issues discussed and cases taken in this research work are emphasizing upon education domain as major focus.

The goal of this research is to develop methodologies for KM from a system perspective and underlying objective has been mainly to identify the approaches for KM for business & educational domains. The system approach that is adopted in this thesis is a holistic view instead of adopting a mechanistic view of the problem. This emphasizes on the analysis of various building blocks and aspects of the system, and its sub-systems. A system approach makes possible identification of problem issues in a clear and comprehensive manner (like how KM can be helpful in achieving competitive advantage?), by considering tasks carried by various stakeholders of the system (like how to codify knowledge of processes carried by various people in an organization?) and interaction & inter-dependence between them. We visualize the KM schematically as a process required after, data gets transformed to knowledge via information, as illustrated in Fig.1(a) & Fig.1(b).

There has been tremendous growth in the area of data and information management, but, the knowledge management is still young field and is demanding great deal of attention of researchers. Moreover, due to complex nature of knowledge it is challenging also. So, the need for KM is utmost required for an individual, an organization, a society and hence for the nation for competitive advantage.
Objectives of Proposed Research

KM has been a topic of interest of various researchers from diversified fields. Domain of knowledge engineering in Artificial Intelligence is very old and is of great interest. On the same time, KM has been topic of interest for the management researchers. We have gone through several theories and thoughts pertaining to KM and made following observations:
1. KM is the field which leverages effectiveness and it gives competitive advantage to an individual, an organization and thus to the society and nation. The same has been elaborated in the previous sections.

2. Approaches to KM greatly are affected by social culture and technological awareness in the society.

3. No single approach or solution is suitable for all cases of KM. KM is a multidimensional effort, thus there is need to search and re-search new and simple solutions from both, technical and managerial perspectives.

4. KM can be carried out through knowledge management processes.

5. Instead of developing new and complicated methodologies for KM processes, it is better to use already used and tested methodologies of other domain, for this purpose. Hence so considering the spirit of KM i.e. instead of reinventing the wheels, using them.

6. KM is about converting an ordinary organization to a learning organization; this requires efforts from within the organization and needs a holistic system perspective by integrating enterprise data & information, ICTs, business processes and culture.

7. Hence, from system perspective, the goal of KM is to identify, capture, codify, transfer and uses knowledge residing in knowledge layers.

Various factors affect economical competitiveness of the country and knowledge centric activities have major share in this effect. At the first stage, KM is needed for sustainable competitive advantage and we have established this with the help of Porter’s Five Forces Model and a case of academia. After establishing the need of KM for sustainable competitive advantage, there was an issue to identify what knowledge is to manage and where it is located in a system i.e. in an organization. Knowledge layers and dimensions in context of a typical organization identified, before exploration of KM methodologies available. Then after exploration and critical analysis, we proposed our KM processes to achieve KM in an organization.

Major research challenges in this work are establishing knowledge maps as one of the methodologies for KM. Taxonomy and development model of knowledge maps has been created. Contribution is being done by suggesting innovative use of SSAD tools as knowledge maps for codifying system & process knowledge. Also, a new knowledge map for codifying dynamic knowledge has been devised. Keeping system perspective of knowledge management in focus, our research goals of this thesis are:
• How knowledge management can be as strategy for an organization (especially educational) for competing with forces from dynamic environment?
• Where does knowledge reside in the organizations? Methodologies that have been suggested by various authors for KM processes.
• How are knowledge maps useful for KM process knowledge capturing? Is there any model for developing knowledge maps?
• Which software engineering tool can be useful for capturing process knowledge as knowledge map? Can Structure Charts be used for capturing process knowledge for an organization?
• Is there any map for capturing dynamic knowledge? If no single map is useful then can hybrid map be used?

Short description of contributions made is described in the next section in sequence of chapters of this thesis.

Research Contribution
In this thesis, while considering system perspective, a holistic view of organization has been considered. KM from system perspective is a practical and proven approach to analyze various KM issues and suggest solutions of them at various levels of the organization. The system perspective focuses on interaction among all stakeholders and enables understanding and integration of technical and behavioral aspects for the fulfilling the objectives of KM.

Initially, we have established KM as a need to the society and then established KM as a one of the tool for competitive advantages. This has been shown by discussing a case of an educational Institution, by analyzing Porter’s Five Forces Model. We suggested that, apart from generic strategies suggested by Porter, KM is another very important strategy for gaining competitive advantage. We discuss in brief the contributions made.

KM for Sustainable Competitive Advantage (Chapter 1)
We have claimed that ICT facilitated KM as one of the strategies for sustainable competitive advantage against industry forces, the same can also be made applicable in education system of today.

• **Bargaining Power of Supplier** - This is an arrangement of engaging the suppliers for long term by making them realize that we are valuable customers using ICT based KM. In an example of academia, we consider educational Institutes analogous to business organization; the following are the some strategies, we suggest for locking of supplier (i.e. students, society): Deploy and promote highly interactive portal for guidance, counseling and awareness of potential new entrants by using expert knowledge, high connectivity with alumni (i.e. old knowledge sharing), usefulness of Institute to the society by research and services to industry (i.e. knowledge creation).
- **Bargaining Power of Customer** - A Portal paradigm can be developed for knowledge sharing through various groupware and similar KM technologies amongst Alumni, Faculty, Placement Officer, and Administrative staff. Repository can be created with knowledge base of past experiences with the corporate like what they need and expect from the students, feedback about syllabus apart from contact details and previous communications. The knowledge of system, competency of faculty members, qualities of students, research facilities, and strength of faculties can be made available.

- **Threat of Substitute Product/Service** - This makes available a repository of experiences with the need of corporate. Why have we developed and introduced previous courses in the academic system in context? Knowledge of old decision regarding syllabus modification gives basis for introducing or updating new courses. With competency mapping, one can know the strength of faculties so they can be trained for new programmes if the older programmes get obsolete.

- **Threat of New Entrants** - This implies resource optimization and cost saving by reducing the efforts of re-inventing the wheel i.e. by taking KM initiatives. This saving can be utilized for generating better resources. Knowing what the new Institute “know and not know,” shall help in getting competitive advantage.

- **Rivalry among Existing Firms** - There is a need to capture and share the expertise and knowledge of existing faculty members so if they leave, the system should not suffer. Repository of course materials, tutorials, assignments, educational supplements, expert and guest lecture may be created. Knowledge Maps can be developed for codifying best practices for the training of new faculty members, so they can start contributing as early as possible.

We contribute to the understanding that: ICT based KM is one of the strategies for achieving sustainable competitive advantage in an organization. This finding justified the need for KM and hence motivated for developing KM methodologies from a system approach, which are discussed next.

**Knowledge and Knowledge Management: A System Perspective (Chapter 2)**

In a dynamic environment, knowledge resides everywhere. Knowledge resides in products, people, processes, customers, suppliers, and all stakeholders. Solution of a problem becomes easy, when problem is known and properly defined. Hence, before knowing what we know, we must know where it will be found. Then the challenge of managing knowledge reduces as knowledge scattered in the organization is identified.

We have made pointers to the knowledge, scattered throughout the organization by contributing an idea of knowledge layers. Keeping system
perspective in focus, we identified knowledge layers within the system boundaries and knowledge layers between organizational system and surroundings. Another idea gives dimensions to the knowledge that is being located in various knowledge layers. One-to-one mapping of knowledge dimension and knowledge layers is the unique contribution that has been made.

So, after contributing for, identifying where knowledge is being located, we have done critical analysis of various literatures on KM. We define KM in the context of this thesis by keeping system perspective in focus as- “KM is a systematic approach by developing various methodologies and technologies with the objective to make knowledge artifacts, which are located in knowledge layers of the organization, explicit and sharable.”

Continuing the analysis of literature, we again modify the definition, which has become basis for rest of the work done in thesis. According to our modified definition- “KM is a systematic approach for managing knowledge processes by developing methodologies and applying technologies with the objective to make knowledge artifacts, which are located in knowledge layers of the organization, explicit and sharable.”

By identifying KM process, an exhaustive study has been done on methodologies and technologies facilitating these KM processes. Out of all the KM processes, we focus on the process of codification of knowledge through cartographic approach by using knowledge maps and then it has become the focus of the work in rest of the thesis.

**Knowledge Map Taxonomy & Development Model (Chapter 3)**

In threaded manner i.e. starting from justifying the need of KM, then addressing knowledge related issues, then discussing KM approaches, we focus on codifying knowledge through knowledge maps in organizational structure. We adapt a system approach, in which attention started at outer level by considering all aspects as whole, identification of several problems and then get focused on one specific problem.

We suggest definition of knowledge map first, but we have modified again by keeping system approach in mind, as- “Knowledge map is a knowledge management method, for codifying knowledge in knowledge layers for all functional areas of an organization, people expertise and assets.”

On analyzing literature, we find the need of taxonomy of knowledge maps on the basis of knowledge layers and knowledge dimensions. Taxonomy of knowledge maps is derived in which we have categorized knowledge maps on the basis of root domain, forms, knowledge layers and knowledge dimensions.

Codification of knowledge through knowledge map being an important KM method must be given formal treatment. We minutely analyze the process of
knowledge map development and then devised a unique model of knowledge map
development, which is called as B-C Model (for the name sake). This model is an
iterative model owing to continuous evolving spiral nature of knowledge. Various
phases of the B-C Model are described with the help of taking an example of a
process in an academic setup.

**Knowledge Maps for System & Process Knowledge (Chapter 4)**

To start work with, or before starting contribution, one has to understand and know
the system. In fact, knowing the structure of system is the first stage to know about
the system features, processes and behavior.

There are several approaches to represent system knowledge, also called
domain knowledge, such as textual, pictorial and diagrammatic. Hence, we
contribute with focus on diagrammatic approach of knowledge representation.
With the study and analysis of vast literature, we contribute in identifying the some
characteristics of knowledge maps. According to us, knowledge maps must be
abstract, shared & understood easily, repeatable, meaningful, and modifiable with
the ability to be validated and to be automated easily. On the basis of these
required characteristics, we identified DFD and Structure Chart useful to be used
as knowledge map.

Our main contribution shows that Context Diagram (Level 0 DFD) can be
used very easily for codifying system knowledge. With the help of two examples,
we show that representing system knowledge by using Context Diagram is very
simple. Also, being established tool of Structured System Analysis & Design
(SSAD), Context Diagram fits into the characteristics of knowledge map.
People, technology and processes are the major components of an organization, by
which they perform the business.

We use another SSAD tool, Structure Chart, which is used by software
designers to represent modules of the system, as a process knowledge map. So,
another unique contribution made by us here, which show the use of Structure
Chart for codifying process knowledge in an organization.

We argue that Structure Chart is the process knowledge map, for capturing
process knowledge along with the hierarchical representation of process execution.
Apart from codifying knowledge “what to do?”, Structure Chart also codifies
knowledge “how to do?”

**Layered Framework of Knowledge Map & Hybrid Concept Map (Chapter 5)**

We explore to the level below of system & process knowledge and found that
system and process knowledge map works at the top level, which shows “what the
system has?” or “how to do”/ “what to do?”. However, complete understanding
can come only when all the ideas and concepts related to the domain and
terminology used are explained. Knowledge of all these concepts and ideas can be represented with the help of Concept Maps.

We claim that organizational framework of knowledge maps is layered. In this layered framework, Concept Maps reside at bottom level and system knowledge maps and process knowledge maps are at top level (execution level). This argument also leads to an idea that with the use of layered arrangement, access to knowledge maps can be restricted or controlled as per the policy of an organization. While working on Concept Maps, we also point out with the limitations of Concept Maps. We find that Concept Maps do not have any feature to represent dynamic knowledge (in which decision must be taken according to the situation).

We contribute by developing a new map, called Hybrid Concept Map. In this type of map, we have added the decision-making capability of decision trees. So, with the help of examples, we show that Hybrid Concept Map is capable to capture dynamic knowledge.

Concluding Remarks (Chapter 6)

Our findings from the research carried out on KM methodologies from a system perspective have lead to the final concluding remarks (mentioned in brief):

- ICT based KM is one of the strategies to compete with competitive forces for sustainable competitive advantage.
- Knowledge has several dimensions and knowledge resides in various layers in the organization.
- KM can be achieved by managing knowledge processes.
- Knowledge Maps can be one of the significant methodologies for KM process codification from system perspective.
- Knowledge Map can be of several types on the basis of root domain, form, knowledge dimension and knowledge layer.
- B-C Model suggests systematic and formal approach for knowledge map development.
- Context Diagram (Level 0 DFD) and Structure Chart are simple, easy to use and sharable knowledge maps for coding system and process knowledge respectively.
- In organizations, knowledge map framework exists in layers.
- Hybrid Concept Map is a new map that codifies static and dynamic knowledge both in explicit manner.
Publications Arising From the Research Reported Published:
[Bansal, 2007]

[Bansal, 2010]

Communicated / Under-Communication:
- Bansal, P., Chandwani, M., “Decision Tree Based Hybrid Concept Map For Codifying Dynamic Knowledge” (Being communicated to Journal)
- Bansal, P., Chandwani, M., “Two Layer Knowledge Map Framework in Organizations from System Perspective.” (Being communicated to Journal)
- Bansal, P., Chandwani, M., “A Novel Use of SSAD Tools as Knowledge Map.” (Under preparation)

Main References
[Alavi, 2001]

[Cheng, 2009]

[Devenport, 1998]

[Nonaka, 1994]

[Porter, 1979]
[Safayeni, 2005]

[Schwab, 2009]

[Skyrme, 1998]

[Staab, 2001]

[Tiwana, 2001]

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