Achieving Excellence through Knowledge Mapping in Higher Education Institution

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ABSTRACT
Knowledge Management is widely used for developing strategic alliances in an organization. This leads to effective use of resources and infrastructure so that the organization can reap more benefits from the investments with respect to both people and technology. Further this helps to maintain the overall quality of the organization. In order to build a robust and thriving knowledge environment in higher education institutions there also is a need to collaborate technology and people for developing an overall culture of accessing, sharing and managing knowledge. The advantage of visual representations as Knowledge maps in the field of knowledge management has being widely discussed and justified. It provides a better overview, faster access, more efficient and memorable representation of knowledge assets. In particular it is useful in eliciting or referencing implicit knowledge and identification of knowledge gaps. Thus to design a DSS for education sector there is a need to design Knowledge maps that identify various components of higher education and a flow of information among them. In the paper this has been achieved through a knowledge process map and a knowledge flow map. A knowledge mapping matrix has also been proposed to overcome the gap identified in these maps.

General Terms
Knowledge Management (KM), Knowledge Representation

Keywords
Knowledge Map (K-Map), Knowledge Process Map (KPM), Decision Support System (DSS), Knowledge Management system (KMS)

1. INTRODUCTION
The role of business intelligence and knowledge economy especially in industries such as software, pharmacy, media and financial services have proved its worth in today's rapidly changing business landscape. The survival and success of any organization depends entirely on the organization's ability to adjust to the dynamics of the business and its working environment. It has proved its advantage even in the service sector like education, research, health [1, 2, 3]. Use of appropriate instruments for converting data into knowledge and further exercising control over knowledge is the need of the hour. For developing an actionable scenario knowledge mapping is a technique, which is applied to facilitate the changes in dynamic environment of various systems. The terms knowledge map (K-map) or knowledge mapping have been used to designate a wide variety of approaches to organize and structure knowledge sources, to map best practices, to develop insightful concepts and to create expert networks. This is done by mapping best practices and by identifying the gaps in processes.

The importance of higher education for the development of excellence and expertise, in developing innovative technology and knowledge, leading to overall development in economy cannot be undermined. Today all higher education institutes are designing the Total Quality Management (TQM) strategies to attain academic excellence and to satisfy various stakeholders including internal stakeholders like students, faculty, management (primary) or external stakeholder like parents, industry, research community (secondary), society and country (tertiary) as a whole. Thus designing of a Knowledge based knowledge management system which can attain these objectives is required. With advent of ICT a large amount of data is available that needs to be mined to be converted into knowledge that can be shared between different stakeholders both internal and external to organization. This can be explored and evaluated for the holistic growth of organization. Lot of researchers have proposed the principles needed to develop KMS for higher education institutes [4-8].

2. CONVERTION OF DATA TO KNOWLEDGE THROUGH KNOWLEDGE MAP
Knowledge builds upon information extracted from data. Data can be termed as the property of things but knowledge is property of agents defining their actions in particular circumstances, whereas information is that subset of data that stimulates an agent to act accordingly [9]. Michael Polanyi had classified knowledge as of two types, explicit and tacit [10] where explicit knowledge can be spoken and codified in words, figures or symbols, typically in documents or databases, tacit knowledge is embedded in individuals' minds and is hard to express and communicate to others. Another division of knowledge was described by cognitive psychologists [11, 12] as descriptive (know-what) , procedural (know-how) knowledge and strategic knowledge (know-why, know-when). Descriptive knowledge is also referred to as declarative and is more comparable with the explicit than with the tacit dimension. Descriptive knowledge defines a description of an object, situation, facts or methods and procedures. Procedural knowledge specifies actions or manipulations, for example, steps to fulfill a task, process to gain a skill. Instead of facts, it describes a method or behavior. Strategic knowledge is rarely measured and is invoked when other knowledge types are used. An individual benefits from using strategic knowledge in a decision process. It can be considered as a subset of declarative knowledge. Human intentions related to know-why type of knowledge also belong to the group of strategic knowledge.

Knowledge Mapping is a process of surveying, assessing and linking the information, knowledge, competencies and proficiencies held by individuals and groups within an organization. Vail et.al [13] defined a knowledge map as a visual display of captured information and relationships, its an association of items of information such that association itself create actionable information. These maps enable efficient and

effective communication of knowledge at multiple levels of detail, by observers with different backgrounds. According to Ong et al [14] a knowledge map is a knowledge representation technique that reveals the underlying relationships of the knowledge sources using a map metaphor for visualization, thus it is a technique that can be used by organizations to identify their intellectual assets of the knowledge domain. The process of building knowledge maps entails creation of ontology, identification of processes and extracting the instances of a process. Different types of knowledge is then extracted and represented as knowledge maps. The knowledge maps are subsets of the ontology and can be used as an analytical tool in the decision-making process. Large research has been done on designing of knowledge map and different researchers had characterized them on different criteria. Eppler [15] categorized knowledge maps as source maps, knowledge asset maps, knowledge structure maps, knowledge application maps and knowledge development maps. Besides these five types of knowledge maps, one can also imagine knowledge map that combines some of the above types into a single map, typically, a knowledge application map and a partial source map. Implementation of popular knowledge mapping tools and techniques like Concept map, Mind Map /Idea map, Concept circle diagram, Semantic map, Cognitive map, Process map, Social mess map / Cross boundary causality map, Conceptual map, Knowledge flow map, Causal map, Cluster Venn diagram, Thesauri, Topic map, Perceptual map for higher education is discussed[16].

Advantages of Knowledge mapping

- Knowledge mapping explores personal and group competencies and illustrates how knowledge flows throughout an organization
- It is helpful in properly categorizing the knowledge assets among people, processes, content and technology. The Knowledge Mapping is used for representing the participants' views and their interrelationships as well as learning dependencies.
- It helps decision makers to identify knowledge areas that are strategic or critical.

3. MAPPING KNOWLEDGE IN HIGHER EDUCATION INSTITUTE

K-maps play a crucial role in designing a Decision Support System for business domains. The basic steps involved in designing a DSS are:

- Identification of the core and contextual knowledge inside any organization.
- Identification of various components (actor) and their role in the system processes.
- Establishment of a relationship between them through a Knowledge Process Map (KPM).
- Identification of gaps and their potential causes.
- Use of Knowledge mapping matrix to map the categories of accumulated knowledge with respect to what, how, who and where
- Identification of information and knowledge flow between various processes.
- Development and audit of a decision support system (DSS).

3.1 Identification of Various Components

Information and communication technology plays a crucial role in organizing knowledge for any organization [17]. Information is generated through different processes in any organization. The important processes that exist in any educational institute are like admission, examination, teaching, research and many more. For smooth functioning of these processes various automated systems are used. The database of these systems can be exploited using data mining techniques which acts as a seed for developing a DSS[18-20]. DSS extracts information through these systems and converts them into knowledge that can be reused to create new knowledge.

Academics Administration System (AAS) covers all aspects related to class conduction where the actual knowledge will be dissipated to the students by the faculties.

Student Administration System (SAS) covers all student administration related information like admission, registration, attendance and examination, placement and training etc.

Quality and Academic Monitoring System (QAMS) monitors the performance of faculty, course development and deployment, feedback analysis. It also monitors the student performance in evaluation system and placement. The main objective is to observe that the performance of overall system is as per the quality guidelines framed by the organization.

Administration and Staff Management System (ASM) cover overall administration and issues related to staff members, their attendance, payroll management system, inventory control system etc.

Placement System (PS): It is almost mandatory for the technical institutes to carry out efforts for student's placements in the industry. Moreover conduction of various events such as seminars, workshop, industrial interaction sessions and training for the students is also important which is handled by a strong Corporate Resource cell (CRC).Extra and co-curricular activities pertaining to students can be managed by the Event management system working in collaboration with CRC and the placement cell. Faculty development programs conducted for updating faculty with latest technology, pedagogy techniques and research development is also to be looked after.

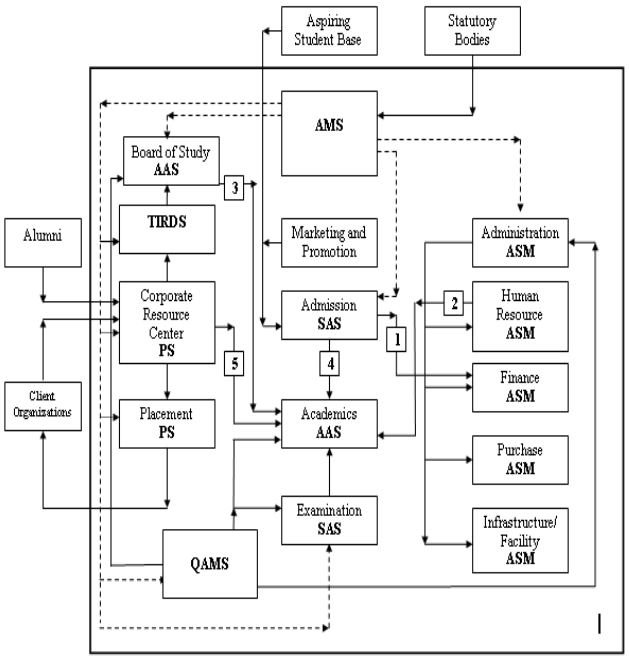
Apex Management system (AMS) deals with administrative system which designs the rules and policies for students, faculty and staff. The working of this system is basically governed by tacit knowledge. For designing suitable rule the management apart from anticipating the effect of any new designed policy should be sure that it comply the guidelines laid by the statutory body and mission of the institute.

Technology Innovation and research development System (TIRDS) The quality of any organization is much rated by the research activities that are conducted and technology that are being developed. Also patents, consultancy for various industries and research publications etc are important. Research is a source of tacit and explicit knowledge .Apart from all these activities trainings and consultancy work undertaken by the faculty members which in turn strengthen the overall quality of teaching learning process helps to generate huge amount of tacit knowledge.

3.2 Knowledge Process Map (KPM)

A Process Knowledge Map (Figure 1) has been constructed for a higher education institute which depicts the various processes and establishes relationship among them. It can easily be seen that output of one process is input to other, like the Corporate Research Cell on the basis of their interaction with the industry provides input to the Research and Development System which later provides intellectual inputs to the Board of Studies for incorporating changes in the existing curriculum. These changes on regularization can be incorporated in the existing academic system. Being a dynamic system KPM helps

management body to identify the gap between the required skills and current skill.



1. Student's Academic Fees
2. Faculties and Staff
3. Course Curriculum
4. Students
5. CRC strengthens academics from the inputs of industry

Figure 1: KPM depicting relation between different systems and processes in Higher Education

3.3 Process Knowledge Mapping

After developing KPM there is a need to identify which process generates what type of knowledge. To accomplish this task process knowledge mapping can be carried out. Development of a KPM leads to another dimension to work upon knowledge.KPM creates a need to identify core and contextual knowledge inside any organization. Moreover it is important enough to identify which process generates what type of knowledge? Who need it? Who has it? What issues does it address etc. To compile all these facts and to fill in the gaps in KPM, process knowledge mapping can be carried out. Process knowledge mapping analyzes a business process or method to identify:

- Decision milestones (where knowledge is needed)
- Knowledge requirements (what knowledge is needed)
- Routes for access and retrieval of knowledge (through people and technology)
- Gaps between required skills and current skills.

3.4 The Identified Gaps

- How can academic institute better meet the needs of our student and attain higher student satisfaction coefficient?
- How can academic institute improve overall performance?
- What student interventions are most effective?
- How to seek greater administrative efficiency?
- How the curriculum and academic environment affect the students learning ability?
- Which are the programs having greater demand and what new programs or courses should be introduced?
- How technology and other resources are utilized in cost effective and environment friendly manner?
- How innovative research and technology development can take place?
- Which value added course should be conducted for overall development of student?
- Which student and faculty welfare schemes should be introduced to attract both student and qualified staff?

3.5 Knowledge Matrix

Mapping the knowledge against the processes can be done by combining the facts in form of a knowledge matrix which has been proposed in Table 1. It identifies what knowledge is needed, how can it be created and disseminated, is it tacit or explicit, what issues does it address etc all pertaining to a technical education institution.

3.6 Knowledge Flow Map (KFM)

The KFM is a High-level knowledge models in a transparent graphical form which is designed to know how the knowledge should flow among these processes to develop a DSS.

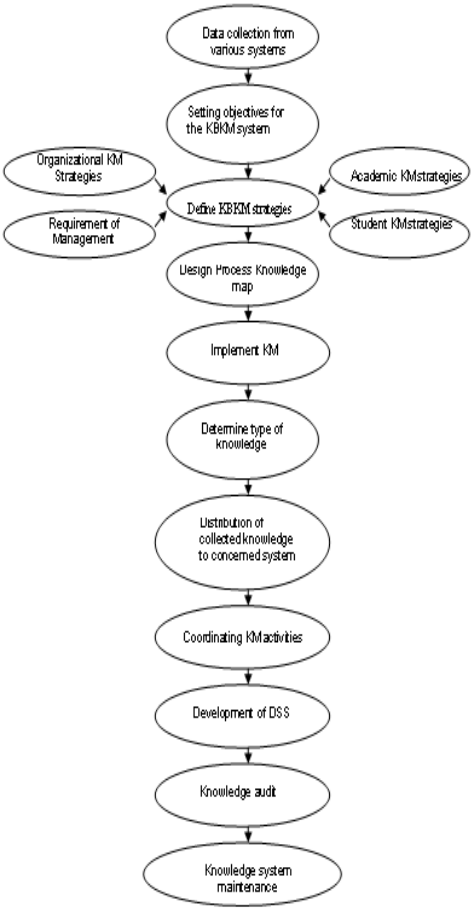


Figure 2: Knowledge Flow Map for developing a DSS

Table 1. Knowledge mapping matrix for Higher Education Institution

Sr.No.	What knowledge is needed?	How can it be created/ shared?	Who has it?	Who needs it?	Where is it?	tacit or explicit	routine or non-routine	What issue(s) does it address?	Type of Knowledge	Knowledge Quality
1	Knowledge regarding governance of a technical institution	By abiding by the rules and policies laid by the statutory bodies related to technical education	Apex bodies related to technical education	Management	External to organization	Tacit	Routine	Formulation of the policies and rules to govern the institution	Conceptual	Structured
2.	Knowledge about administrative maintenance	Inventory control Book keeping	Admin Staff	Management	Internal to organization	Tacit and explicit	Routine	Administrative	Conceptual	Complied
3	Knowledge about the Information about every student	Maintaining records during the admission of the students and its regular updates	Student	Management	External to organization	Explicit	Routine	Admission and other policy making admission	Conceptual	Compiled
4	Knowledge related to academic issues, Refreshing the base knowledge and benchmarking it	Competency matching, Knowledge sharing Series through web technology and Video conferencing, Faculty exchange program, guest lectures , Refresher courses, Certification courses	The Faculties and the Technical staff, Guest speakers, Industry people	The students, The faculties	Internal and external to organization	Tacit	Routine	Enhancement of knowledge which can help in introduction of new courses. Understanding the current developments in various fields, Generation of new Ideas and knowledge	Procedural	Domain Specific
5	Knowledge generated from innovative technology development ,enhancement and Applications	By research experiments in labs, by creating a knowledge hub by undertaking research activities, filing patents, by printing journals at institution level which can be further circulated	The students, Faculties, research Scholars	Management ,The faculties, the students	Internal and External to organization	Tacit and Explicit	Non routine	Will help to develop and strengthen the innovative skills, Enhancement of knowledge base, initiation of Research activity	Strategic	Domain Specific
6	Knowledge how to train student to implement Technology learned	By conducting Industrial visits, Industrial training	Industry People	students	Industry,	Tacit	Non routine	Helps to observe the application of the technologies and learn new technology	Strategic	Domain Specific
7	Knowledge gained from outcome of collaborative research	By doing collaborative research intra as well as inter departmental projects	Research scholars from different fields	Research scholars and faculties	Research People and faculties	Tacit	Non Routine	Collaborative research and knowledge sharing	Strategic	Domain Specific
8	Knowledge gathered from Information, News, Notices, Tutorials and subject notes	Through Intranets, Web portals	The management and the faculties	The students and other people seeking information	Internal to organization	Explicit	Routine	To reach out to people in a fast manner	Situational	General
9	Knowledge from result analysis	By analyzing examination results and identifying trends	Examination cell	Management, Faculties, Students	Internal to organization	Explicit and tacit	Routine	Academic excellence and student performance	Strategic	General
10	Knowledge about quality maintenance and attainment of mission and objectives of organization	By conducting quality audit and feedback analysis	Quality assurance cell	Management	Internal to organization	Explicit	Routine	For Total Quality Management	Strategic	General
11	Knowledge regarding usage of ICT tools	By analyzing Log files of the servers	Technical IT Staff	Management	Log Files	Explicit	Routine	Security Issues, Usage Issues	Procedural	Compiled
12	Knowledge generated due to value addition courses, basket courses	Feedback of student, performance of student in placement	Faculty	Students	Internal to organization	Tacit	Routine	Addition to learning	Procedural	General
13	Knowledge regarding the current market scenario, qualities a fresh graduate should posses.	Interacting with alumni working with various organizations	Alumni, industry experts	The management. Faculties and the Students	Corporate	Tacit	Non routine	Placements of the students, To create competent and market ready graduates	Strategic	General

4. CONCLUSION AND FUTURE SCOPE

Achieving excellence is an ever evolving process which needs continuous auditing of the current system, identification of the gaps and implementation of the strategies that can overcome these gaps. Recent studies have shown the importance of Knowledge Mapping in identifying the knowledge gaps in various industries and service sectors.

For implementing DSS as per the required standards we need to implement knowledge management by capturing, storing, distributing and analyzing information.ICT tools can be used to convert information into explicit knowledge, depending upon relevance associated with it. A knowledge map can then be used as a knowledge representation technique that reveals the underlying relationships of the knowledge sources and identifies the gaps in the generated knowledge. Chen et.al. [21] proposed knowledge representation through parameter flow chart that efficiently combines parameter information, flow chart technology, and visualization technology for the manufacturing industry. B. Karimi [22] proposed heuristics knowledge map for R&D centre. Velardi et. al[23] describes the architecture of the K-Map and provides a qualitative and quantitative evaluation of the advantages of a semantically indexed knowledge base as a means to improve information accessibility and network analysis.

Designing a Knowledge management system for technical higher education institute is a very complex and heuristic task. It contains multiple stakeholders both internal like student, faculty, management and external like industry and society. In this paper we had identified that for creating a self learning DSS each process should generate its own knowledge and identify the relationships and dependencies with the other processes. For making the knowledge available in the most effective manner to those people who need it, and for continuous improvement we need to audit the system and identify the knowledge gaps. The proposed KPM for a higher education institute can be very useful in identifying the current knowledge needs and also the future knowledge need of the institute. KFM is a most effective technique to locate the critical and sensitive domain not only in developing a KMS but also in deploying and maintenance of KMS. Moreover, the Knowledge mapping matrix proposed in this paper identifies which process generates what type of knowledge? Who needs it? Who has it? What issues does it address etc., thus filling the gap introduced in KPM and KFM. Overall the key idea in the paper is to stress on the importance of organizational knowledge for creating activities rather than individual knowledge pool by collaborating knowledge generated by all the processes and all individuals in the organization.

Further the work can be enhanced by quantifying the knowledge maps and designing a concept-weight annotated K-map which concertizes and visualizes the importance of process and their relationship. These associated weights can be evaluated using multidimensional scaling algorithms [24, 25].

Moreover an educational system is a dynamic system and the importance of any particular process will change as per the prevailing conditions. Fuzzy cognitive map [26] can be used to assess the dynamic behavior that can translate between different states depending upon the changing conditions in the organization. Incorporating dynamism in knowledge map creation is the key issue especially in technical higher education. The notion of being able to filter out irrelevant knowledge assets is central to the dynamism of a knowledge map and its usability. The customizing of the map according to people's preferences increases its use and reuse. Further the users can drill down into the different levels of detail that are available and bring another dimension that allows them to interactively change the map's perspective. As a future endeavor dynamic knowledge mapping can be incorporated while designing DSS for a technical higher education scenario.

Thus to achieve excellence and develop an actionable scenario in educational organization the importance of knowledge embedded within the system and the relationships and gaps in knowledge sources are to be identified and explored through knowledge mapping technique.

5. REFERENCES

[1] Ebner, S., Khan, A., Shademani, R., Compernoll, L., Beltram, M., Lansang, M. A., and Lippman, M. 2006. Knowledge mapping as a technique to support Knowledge Translation. In Bulletin of World Health Organization.

[2] Krbálek, P., and Vacek, M. 2011. Collaborative Knowledge Mapping , In Proceedings of the 11th International Conference on Knowledge Management and Knowledge Technologies

[3] Tomato, T., Akakura, T., Sugie, S., Nishihori, Y., and Nagaoka, K. 2011. Collaborative Knowledge Construction Using Concept Maps for Cross-cultural Communication. In Proceedings of the Fifth International Conference on Mobile Ubiquitous Computing, Systems, Services and Technologies.

[4] A. Rusli, M.H. Selamat, S. Shahibudin, R.A. Alias, "A Framework for Knowledge Management System Implementation in Collaborative Environment for Higher Learning Institution", Journal of Knowledge Management Practice, 2005.

[5] A. Rusli, M.H. Selamat, A. Jaafar, S. Abdullah, S. Sura, "An Empirical Study of Knowledge Management System Implementation in Public Higher Learning Institution", International Journal of Computer Science and Network Security, 2008.

[6] D.J. Cranfield, J. Taylor, "Knowledge Management and Higher Education: a UK Case Study", Electronic Journal of Knowledge Management, 2008.

[7] M. Sagsan, "Knowledge Management Discipline: Test for an Undergraduate Program in Turkey", Electronic Journal of Knowledge Management, 2009.

[8] H. Wright, "Tacit Knowledge and Pedagogy at UK Universities; challenges for Effective Management", Electronic Journal of Knowledge Management, 2008.

[9] Boisot, M. H. 2006. Knowledge Assets Securing Competitive Advantage in the Information Economy. OUP Oxford New Ed.

[10] Polanyi, M. 1966. The Tacit Dimension. Routledge and Kegan Paul, London

[11] Nickols, F. W. 2000. The knowledge in knowledge management. The knowledge management yearbook

[12] Jong, T. D., and Ferguson Hesler, M.G.M. 1996. Types and quality of knowledge

[13] Vail, E.F. 2002. Mapping Organizational Knowledge. In Knowledge Management Review

[14] T.H. Ong, H. Chen, W. Sung, B. Zhu, "Newsmap: a knowledge map for online news", In Science Direct. Decision Support Systems, 2005.

[15] Eppler, M.J. 2001. Making Knowledge Visible Through Intranet Knowledge Maps: Concepts, Elements, Cases. In Proceeding of the 34th Hawaii International Conference on System Sciences

[16] Gupta, P., and Mehrotra, D. 2011. Mapping Knowledge for sustainable Academic Environment. In Proceedings of National Conference on Data Management & Security, Amity University Rajasthan

[17] Mathew, V. 2009. Virtual Knowledge sharing and collaborative learning in organization. In Virtual Conference on Business Management

[18] Luan, J. 2002. Data mining and knowledge management in higher education –potential applications. In Proceedings of AIR Forum, Toronto, Canada.

[19] Minaei-Bidgoli, B., Kortmeyer, G., and Punch, W. 2004. Enhancing online learning performance: An application of data mining methods. In Proceedings of International Conference on Computers and Advanced Technology in Education.

[20] Superby, J.F., Vandamme, J.P., and Meskens, N. 2006. Determination of factors influencing the achievement of the first-year university students using data mining methods. In Proceedings of the 8th international conference on intelligent tutoring systems, Educational Data Mining Workshop,Taiwan

[21] W.L. Chen, S. Xie, F.F.Zeng, B.M. Li, "A new process knowledge representation approach using parameter flowchart", sciencedirect, 2011

[22] B. Karimi, M. Saeedikia, "Building a Knowledge Map Based on Process Mapping for R&D Centers", Australian Journal of Basic and Applied Sciences , 2009

[23] Velardi, P., Alessandro Cucchiarelli, A., and D'Antonio, F. 2009. Monitoring the status of a research community through a Knowledge Map, Web Intelligence and Agent Systems

[24] C.Y. Su, T.I. Wang, "Construction and analysis of educational assessments using knowledge maps with weight appraisal of concepts", Journal of Computers & Education, 2010.

[25] Wingyan, C.W., Chen, H., Jay, F., Nunamaker, Jr. 2003. Business Intelligence Explorer: A Knowledge Map Framework for Discovering Business Intelligence on the Web. In Proceedings of the 36th Hawaii International Conference on System Sciences

[26] H. Zhuge, X.F. Leo, "Knowledge map: Mathematical model and dynamic behavior", Journal of Computer Science and Technology, 2005.