

Maturity of Knowledge Management and Knowledge Enabled Business Process

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Abstract: Business today is highly knowledge intensive, be it traditional “Brick & Mortar” company or from the new economy arena like of IT organisations or financial sectors. Organisations are increasingly allocating more budgets year after year in capturing, disseminating, motivating people to reuse the experiential learning and make people collaborate & innovate in a streamlined way. Still, while organisations met with reasonably good success in capturing learning and providing sharing culture, their record on making people reuses those experiences is abysmal. This paper aims to present in the context of Larsen & Toubro Hydrocarbon Engineering Ltd, how it has overcome by enabling knowledge in the standard operating procedure (SOP) of business process. This concept demonstrates the ways to make KM non-intrusive for end user by knowledge enabling daily work of an average knowledge worker. It also minimizes the need for extra resource and management attention without compromising the knowledge competitiveness of the organisation. The paper also aims to present characteristics of various levels of KM process maturity conceptualized by authors derived out of case study and literature.

Keywords: Knowledge Worker; Knowledge Competitiveness; Knowledge Strategy; Knowledge enabled process; Knowledge Maturity

1. INTRODUCTION

Classical definition of Knowledge Management is provided by authors like (Quintas et al. 1997) that KM is the process of critically managing knowledge to meet existing needs, to identify and exploit existing and acquired knowledge assets and to develop new opportunities. (Sveiby, 2001) defines that KM is the art of creating value from an organization's intangible assets. Other definition includes (Brooking, 1997) KM is the activity which is concerned with strategy and tactics to manage human centered assets, or (Tsai, 2000) defined KM as knowledge obtaining, knowledge refining, knowledge storing and knowledge sharing. KM is the “Process of collecting, organizing, classifying and disseminating information throughout an organisation, so as to make it purposeful to those who need it (Albert, 1998). The representative classical definition in this period seems to be “Knowledge management is concerned with the exploitation and development of the knowledge assets of an organization with a view to furthering the organization's objectives. The knowledge to be managed includes both explicit, documented knowledge, and tacit, subjective knowledge.”

Later stage definition (Gunnlaugsdottir, 2003) states KM is a way to discover, collect, document and organize a knowledge base which the employee of organisation can later retrieve, distribute and use in their individual daily work and in their collaborations with their colleagues.

Evolution of the definitions of Knowledge Management over the year shows that although it started with very basic concepts of data, information, knowledge and wisdom, it slowly evolved in an interdisciplinary field covering various areas like information technology, communication technology, organizational learning, organizational development, change management, performance management, behavioral science, cognitive science etc.

Organizations over the time have gone through varied set of practices to implement KM in their organisation. Most of the organisation started with small steps, either by focusing on a very small part of whole gamut of KM or taking a pilot project in small unit of the organisation and slowly expanding the scope across the organisation to reap the benefit. The approach was mostly from “testing the water” to “exploit the potential of KM”. In this evolution, organisation followed a maturity curve explicitly or implicitly without being aware of the same.

This paper aims to study the evolution of KM practices in Larsen & Toubro Hydrocarbon Engineering Ltd from a small start focusing only on a project to finally reaching a stage whereby it has been declared as Global MAKE award (Most Admired Knowledge Enterprise) winner. The paper also aims to discuss the fitness of the journey in various maturity levels, using which author proposed the characteristics and levels of a KM process maturity model.

2. RESEARCH METHODOLOGY

A “Grounded Theory” research approach has been selected to gain insights into the topic being investigated. As in this theory, emphasis is on generation of theory from data in the process of conducting research; a qualitative real life case study of one unit of L&T has been prepared and analyzed. During the course of study, number of existing literature and case studies on this subject has been also analysed to generate a theory from ground. L&T Hydrocarbon is recognized by Teleos, (a web based global community of knowledge-driven organizations dedicated to networking, benchmarking and sharing best practices leading to superior performance), as 2010 Global MAKE winner under individual operating unit category. L&T Hydrocarbon is six times winner of MAKE awards.

3. DATA COLLECTION

A detailed literature review in the area of Knowledge Management, KM maturity models, KM measurements, Human Capital Management, and Innovation Management was done as a first step towards identifying the variables and factors of KM to be studied. Discussions with academicians and practitioners of various knowledge intensive organizations led to the classification of the objectives of the study and the selection of variables important to the knowledge management maturity.

Other than this secondary data, primary data has been collected by examining KM implementation at L&T, E&C Division (later renamed as L&T Hydrocarbon Ltd) (Abdullah et al 2009, Sinha R R 2007, Date et al. 2013).

The data analysis for the research consists of four stages:

- Acquiring different data from case and literature in the field of KM
- Developing an in-depth case history of the organisations activities from the raw data
- Coding of the in-depth case history for the characteristics during various stages of evolution of KM in the company; and
- Analysing the pattern of relationships among the conceptual categories.

This is a highly iterative procedure that involves moving between in-depth case history, existing theory and raw data (Glaser and Strauss, 1967). The data were subjected to interpretation, reinterpretation that allows patterns to emerge.

From the data of case study, the specification of research is as mentioned in Table-1.

Table 1: Specification of the Study

Methodology	Research Type	Qualitative
	Analysis Approach	Grounded Theory
	Analysis Method	Analytical Induction
Input Data	Case Study	Larsen & Toubro Hydrocarbon Engineering Ltd
Results	Framework	Maturity framework

4. CASE HISTORY – KM AT L&T HYDROCARBON

Larsen & Toubro Limited is a USD 14 billion technology, engineering & construction group with global operations. Founded in 1938, it is one of India's largest vertically integrated engineering and construction conglomerate with additional interests in IT and electrical business. It is one of the largest and most respected company in India's private sector. A strong customer-focused approach and constant quest for top class quality has enabled L&T to attain and sustain leadership position in its major lines of business for over seven decades.

L&T delivers world-class solutions in the E&C space, and helps address needs for oil and gas, petrochemicals, chemicals, power and water. Its expertise and experience encompass every phase of a project - from front end design through engineering, fabrication, project management, construction and installation & commissioning. These integrated strengths are backed by an attitude and approach that allows for flexibility of operation and agility in response.

L&T Hydrocarbon unit is structured into two verticals, Hydrocarbon – Upstream and Hydrocarbon - Mid & Downstream.

Hydrocarbon –Upstream, with in-house capabilities in engineering, project management, procurement, fabrication, installation hook-up and commissioning, provides turnkey solutions to the upstream hydrocarbon sector encompassing oil & gas production, processing and transportation. Its Product range includes Process Platforms, Wellhead Platforms, Submarine Pipelines and Platform & Pipeline Modification/ Replacement.

Hydrocarbon- Mid & Downstream focuses on Refinery Projects, Petrochemical Projects ranging from Hydrogen, Methanol & Formaldehyde Plants, Onshore Gas Processing Plants, Naphtha hydro treating, catalytic reforming and isomerization units, Sulphur recovery plant revamps, Acid gas / tail gas treatment units, Reformers & Waste Heat Recovery Systems, Cracking Furnaces & Critical Fired Heaters, Modular Engineered Systems etc.

4.1 Circa 1999 – Realizing need for KM

L&T Hydrocarbon started its KM journey in year 1999 when top management took a note on recently executed DHDS (Dehydrogenation Desulphurization) projects. At multiple locations, projects for IOCL, CRL, HPCL and BPCL (Indian client) were executed. All projects were technically similar in nature, executed simultaneously, problem faced were similar, yet the performance of the projects were different. This forced management to look for a system whereby learnings, experiences, best practices and recommendations could be shared to the benefit of all the current and future projects. This was carried forward in power projects which were being executed for HPCL and IPCL. With initial focus on capturing learnings from Power Projects and DHDS projects, the KM system has taken birth and christened as Knowledge Online (KOL).

The first prototype was launched in April 2000, which was subsequently rolled across L&T Hydrocarbon and formally launched by President (Operations) in June 2001. From that modest start to now, KOL is graduated to an integrated Knowledge Management system, which is collectively termed as “KnowNet 2.0” and encompasses KOL, Document Manager DocNet, Innovation Channel, EnCorr, Community of Practice, eVidyalaya, AskExpert and many more KM tools.

4.2 Objective

A core group was formed to work on the nitty-gritty of the KM system. After deliberations, inputs from several available sources like research papers, Gartner presentations, and Boston Consultancy group inputs etc, core group finally converged to following objectives:

- Management of those key information which are essential for effectively discharging their duties such as Contractual clauses, commissioning protocols, Engineering codes and standards, Engineering data from past projects etc
- Minimize efforts in relearning which has already happened in other projects.
- Leverage organizational knowledge in delivering business advantage to customer.
- Efficiently connect “those who know” with “those who need to know”
- Convert personal knowledge to organizational knowledge

Compression of response time, reducing and controlling cost, accelerating rate of innovation and creativity, reducing the loss of intellectual assets and its quick replacement were also looked in and it was decided to revisit on these after reaching some level of maturity.

4.3 KM Processes and Practices at L&T

To translate the KM roadmap into reality, many initiatives were taken up which were broadly classified into Hard & Soft initiatives. Hard initiatives are related to Physical systems, i.e. IT infrastructure, software programs, management systems like Organization structure, whereas Soft Initiatives are related to culture building like management support and involvement, rewards, promotional activities etc.

Company identified 3 pillars or main element for a successful KM implementation. These are:

Leadership: KM initiative is very strongly supported by the senior management. Member of Board & President (Operations) sponsors the KM efforts at L&T Hydrocarbon. He personally monitors the KM activities and this helps to get buy-in from other senior & middle management.

Infrastructure & Technology: A very robust IT infrastructure & a well-designed KM portal supported by COP sponsors & Conveners, Knowledge Coordinators from each project team, subject matter experts from various functions have helped in sustaining the KM initiative.

People Change Management: People change management i.e. the cultural aspect of KM is handled by continuous collaboration with users through KM training programs which is an integral part of induction training programs and Capability & Leadership development program. Rewards & recognition at project team level & individual level are organized where the winners are recognized by the top management in a high profile award function. A regular communication from top/senior management helps a lot in people change management.

The process to institutionalize KM was driven by various activities which could be broadly classified in four categories:

- Activities that are related to communication.
- Activities related to building a knowledge repository – this includes managing all the documents generated during the natural course of a project lifecycle.
- Activities related to promoting collaboration.
- Activities related to rewarding and recognizing knowledge sharing behavior.

Each category plays its own part in institutionalizing KM at the company and is described below.

Communication: The senior management level involvement acts as a first level of communication flowing from top to bottom. Other channels of communication are also used. While email is used extensively for dissemination of knowledge (e.g. Today’s Learning, started in year 2006), to establish a proper communication channel and convey messages to all employees across the organization in a very short span of time, the power of IT and various features of e-mail facilities were used. A daily news bulletin was designed to deliver every day communication in the e-mail box of all the employees. It is also used to disseminate key knowledge, latest happenings, management circulars etc. To add some flavor, it contains jokes, birthday lists, e-greeting cards etc. This is a very popular and powerful yet simple tool and help in disseminating information across the length and breadth of the organisation.

A monthly e-newsletter “KnowNet News” is also published by KM Cell (started in 2004) to again reinforce the communication and highlights the month’s event on KM front.

The Knowledge Repository:

A repository of past learning is a basic building block for developing KM in an organization. But, to be more focused, the tacit and explicit parts of the knowledge are treated separately. At company, two key modules – KOL (Knowledge Online) and DMS (Document Management System called DocNet) – were developed for this purpose. While KOL focuses on the tacit part of knowledge, Doc.Net is meant for explicit documents. The EPC business is a document intensive business and during any given project, documents such as contracts, plans, design specifications, detailed drawings, quality test reports and other related documents are generated.

As L&T engineers visit project sites, they entered their observations, analyses and recommendations into a common database – everything from how to prepare proposals, how the project was executed, what were the problems they encountered and so on. These details and records became part of a central repository of information on each project, accessible to any other engineer working on a similar project. A pilot was conducted and after successful experimentation, in 2001 it was decided to roll out the initiative company wide and with the help of IBM Lotus Domino; the company designed a knowledge management portal. This portal was later in year 2009 upgraded to KnowNet 2.0 under technology platform of Microsoft SharePoint

Knowledge Online (KOL) – Repository of Project / Proposal learning - KOL was developed to capture and storing of tacit knowledge and focuses on capturing key learning from the various contracts executed over the years in various industry sectors and disseminating those learning across the organisation. Other than key learning, project-specific (or proposal specific) data is also captured in the form of a project synopsis (consisting of project name, customer, licensor, consultant, description of project in terms of product, capacity, scope of work etc., key personnel with contact details and major partners), close-out reports, lost order reports, user profiles, vendors, associates and consultants information. The knowledge gained from these inputs adds value to future proposals and projects resulting in both tangible and intangible benefits. Users of KOL can review and edit content to determine relevance, potential utility and innovativeness aspects of learning. An attached search engine provides facilities for easy retrieval and access of information on projects or learning. It captures learning in structured (templatised format) as well as unstructured format.

The portal is designed in a way that it is completely centered on the project. Teams working on a project record their experiences, challenges faced solutions to frequently occurring problems etc. into this application. The application supports more than 3000 users across L&T.

One add-on module of KOL captures learning in unstructured format also. Here user can directly submit any format of learning in the repository, after approval it becomes searchable artifact.

e-Vidyalaya - eVidyalaya is repository which is meant for referring technical training material. It is an interactive learning system where various learning modules are prepared utilizing experiences of in-house experts so that any new joiner or new person in particular department can grasp the domain specific knowledge quickly.

DocNet- Document Management System – In L&T Hydrocarbon's line of business the document plays a very important role. The document is the central point of focus in a project; it spells the legal rights of both the customer and the client and lays down the guidelines for administering the project.

But for a typical project undertaken at L&T, there are hundreds of mails, faxes, and letters flowing between the

client and the company. In addition there may be many people from L&T talking to the client at any given time. That means a huge stack of paper generation and storage, retrieving which may take days if not weeks. Further documents are stored in disparate places rather than centrally, which adds time to searches for these essential production documents.

DocNet is an end to end solution for managing engineering drawings and other project documents generated during life cycle of the project. It is a web based Solution accessed over the internet/intranet using internet explorer and is built on MOSS 2007 technology. It supports capturing explicit knowledge in various phases of the project starting from Pre bid, Post award of the project, engineering, execution and final handover of the documents through various features customized over the time.

All the business processes are mapped in the DocNet. During the Pre bid stage Project specific Internet enabled websites are created through which the team members exchanges documents via internet with the vendors & client. During the Post Bid stage it acts as central document repository across Engineering & Project Management. During the engineering phase the entire progress monitoring & automated reporting is managed by Progress monitoring & reporting tool. During Execution, it summarizes the entire progress in terms of the payments, status, Look ahead & Backlog schedules etc. And finally for Project dossier submission the feature for bulk downloading the documents in a structured way is provided in the system.

Collaboration: To facilitate collaboration, a number of systems have been put in place at L&T Hydrocarbon division of the company. Company focuses on two type of collaboration. One is online collaboration between project team members as this is the business need. Project teams are geographically dispersed team. e.g. for any project related to upstream oil & gas, engineering centre is at Bangalore and Chennai, procurement centre is at Powai whereas project site will be some faraway place depending upon client. All members need to collaborate seamlessly and exchange information. Another type of collaboration is people to people to exchange ideas and share their learning. To facilitate collaboration and achieve above goals, a number of system have been put in place.

- **Community of Practice** - COP - CoP has been formed for each of the key functions, including engineering, procurement, execution, electrical and instrumentation, taxation, commissioning & troubleshooting, and contract management. Each CoP has a sponsor who is generally a Vice President or General Manager and is assisted by a convenor/co-convenor. It's the convenor who's critical to the functioning of a CoP and tasked with its day to day functioning. A small number of core members is identified and nominated for each CoP to ensure smooth functioning. Also, all others who are from the same function or are interested attend the CoP meetings and subscribe to the CoP through a dedicated web page. CoP

members interact through a dedicated portal, which is used widely by all the members, and it's where they exchange their experiences/ideas. Members meet and discuss issues once a month or fifteen days as decided by their respective CoP.

- **Sametime:** Sametime is a Lotus application that allows people in L&T to hold meetings for giving online presentations, sharing and jointly editing online documents and send instant messages or chat. This is frequently used application for quick knowledge sharing & collaborating and is considered as very effective tool of KM.
- **Project Correspondence system - EnCorr** - To fulfil the project requirement and also to keep an audit trail and log of all communications, an integrated project correspondence system was developed and has been christened, EnCorr – an acronym of Engineering and construction correspondence system. It's an intelligent blend of collaboration, workflow and information storage supported by cost efficient web-based systems. It's also a unique solution that takes care of all internal and external correspondence records such as email/letters/faxes/document transmission notes/technical query sheets and minutes of meetings generated during the lifecycle of a project. It's designed to automate the communication and simplify the task of searching for specific correspondence records based on a wide variety of search criteria. To integrate all the repositories and give users single points of entry, portals for specific projects are customized to present all the information on a single screen. With better communication and easy access to information exchanges, EnCorr provides seamless connectivity for all project team members, resulting in better collaboration. Workflow mechanisms with secure access controls enable faster response times and error free transfers of project documents and drawings.
- A dedicated websites for every Project and proposal are created and accessed by geographically distributed workforce. This provides a single interface for all IT and KM tools necessary for the project.

KM Embedded in Business Process: Moving towards further matured KM, Company mapped various business processes in KM system using Microsoft platform MOSS software for collaboration and document management in 2007. The pilot was taken for quality related documents for one division with basic Document storage facility. The first major breakthrough came by mapping engineering process in the system. Over the last 4 years two more key modules, Procurement module and Correspondence Management module was developed which mapped a number of business sub processes into KM system.

As a practice, once a project is bagged or proposal is being worked out, company creates a separate website for the project / proposals and depending upon the specific requirements, various modules are enabled on the website. At the end of the project, all the learning are compiled by Knowledge coordinators in the form of a "Close Out

Report" and after screening, it becomes part of standard operating procedures'(SOP) main document or annexure document.

4.4 Reward and Recognition

As promotional and motivational activities, company organizes annual competition around theme of KM. Winners of the competition are recognized by top management in a high profile award function. For the team award, project teams across the various units compete with each other during the event. A committee of subject matter experts (CoSME) evaluates the contributions, which are then ratified by the panel of domain experts for short-listing project teams for the final round. In the final round, short-listed project teams present their case in front of panel of judges. Honorary titles are conferred to the winning teams. For team awards, title conferred are Gyan Ratna, Gyan Vibhushan and Gyan Bhushan. It is continuing till date and is treated as most prestigious recognition in KM.

In year 2003, competition to recognize individual contribution was introduced, and the titles conferred to the winners were "KnowNet Guru" for submission of learning and "KnowNet Shishya" for best usage of the existing learning. But after one round, it didn't take off properly and management has decided to close this category of award. In hindsight, it can be concluded that as L&T Hydrocarbon business is a team based business, scope of individual recognition is limited.

Another award is for the best performing CoP, which is awarded to top performing CoPs based on a unique in-house developed index called the Intellectual Capital Unit (ICU) which measure activity level of the community of practice. Similarly, the best innovation award is also constituted to encourage idea generation.

Other than these awards, several token awards are also initiated on ad-hock basis. e.g. whenever a CoP achieves a milestone all members gather and celebrate where sponsor gives a token gift to all active members or a token award for submitting ideas in innovation channel etc.

5. DISCUSSION & FINDINGS

During the case study the data was collected and analyzed. Reviewing the literature and the L&T's case, study produced a structure of categories and subcategories. Authors have developed a KM process maturity model (KMPMM) and named it as KMPMM. Author's have of the view that the L&T Hydrocarbon has undergone through various stages of maturity over its thirteen years of KM journey and followed a path which can be generalized to develop a theory. The categories and it's characteristics at each stage is presented in Table 2. It is also concluded that organisation is displaying characteristics of early stage of Level 4 maturity, where it has started Knowledge enabling various key business processes. It is also found that, it lacks on measuring benefits of KM initiative.

Table 2. Knowledge Management Process Maturity Levels

Level of Maturity	Characteristics
Level 1	<p>KM vision is defined KM vision guides the KM initiatives in tune with business needs</p> <p>Leadership plays role model Leadership encourages knowledge sharing behaviour Leadership actively and visibly participate in KM activities Support and commitment of senior manager is visible Securing and allocating resource for KM implementation Change Management</p> <p>A well-defined KM Strategy is in place KM strategy is communicated to all stake holder Strategy are reviewed at regular interval to keep it in sync with changing business scenario</p> <p>Employees are aware about the KM initiative and it's benefit to individual and organization Communication plan are defined Employees are involved in KM processes Need of KM is established across organisation Understanding of concept of KM, different perspective and it's practical implication are communicated across organisation</p>
Level 2	<p>Organisation commits appropriate budget for KM Organisation evaluates ROI for KM</p> <p>Provides a vision of how knowledge driven organization usages IT to implement its business strategies through KM IT infrastructure (e.g. Computer hardware, software, networking) for KM are identified. Code of ethics and policies related to the IT use for KM are defined Networked virtual team without physical barrier are enabled</p> <p>Study done to an ascertain IT infrastructure requirement Ramp up plan is in place IT tools are identified and well documented Architecture of knowledge system e.g. groupware and other KM tools are in place.</p> <p>Resources (HR & IT) are identified Risk and its mitigation plan are identified KM tools are identified</p> <p>Knowledge Assets are identified and documented Tacit and Explicit knowledge source are clearly identified</p>

	Process is in place to continuously review and update the inventory of knowledge asset
Level 3	<p>Sharing of Knowledge assets is practiced Knowledge sharing is process driven Senior management sets goals for knowledge sharing KM related activities are part of normal work flow KM is embedded in business process</p> <p>People to people contact are encouraged Tacit knowledge sharing happens in a process driven manner</p> <p>Knowledge Asset (Explicit) are stored in a fashion, which can be easily retrieved across organisation Centralized repository and taxonomies exists</p> <p>Training programs are designed All new members get a hands-on about KM systems Policies and Practices of KM system are well communicated to new members Any change / modification in system are communicated to existing members of organisation Manager and staff has necessary skill and expertise to fulfil KM roles and responsibilities</p> <p>Products like Database and knowledge repositories exists for explicit knowledge sharing For explicit and tacit knowledge sharing Portals, wikis, blogs like products exists Video conferencing for collaboration Knowledge driven organisation should design, implement, use and maintain a wide range of IT supported products and services to support both explicit and tacit knowledge sharing and transfer.</p>
Level 4	<p>Reward & recognition plan is in place. Members are motivated and encouraged to use KM systems During implementation, members actively participate.</p> <p>Individual roles and responsibilities are defined and filled Staff understand their role in KM implementation and it's sustenance Introductory / specific workshop for contributors, users, facilitators, champions</p> <p>Free environment for discussion / sharing are ensured Learning culture exist or nurtured Cooperate culture are developed Knowledge oriented culture are developed Change adaptation culture are existing</p>

Level 5	Standardized processes are K-enabled so that staff carry out those functions as part of routine work to improve the process quality Staff are encouraged to come out with ideas to include more and more business processes to K-enable
	Organisation exploits the innovation potential of individuals and organisation Organization looks for acquisition of external knowledge base
	Participation from outside the “system boundary” of the organisation are ensured External knowledge are coming into system as a part of process and becoming internal knowledge Customer / vendors and other stakeholders knowledge are used in problem solving
Level 6	Organisation regularly assess and audit the KM processes and practices Improvement plans are made based on audit feedback KM performance indicator reviewed at all level of organisation

6. CONCLUSION

As importance of managing enterprise knowledge is increasing, need of a robust measurement process to take an objective stock of KM journey and its implementation status is also increasing. A standard framework can be conceptualized through the findings of the research. The framework can be used to develop an auditable practice to gauge the maturity of an organisation.

In this study, analyzing the real case study of an organisation, which is a global benchmark in implementing knowledge management, a KM process maturity model is proposed, which is as shown in Table 2 along with characteristics of each maturity level.

Further study will help in developing standard set of practices to be followed by organization during various stages of maturity, linkage between measures and corresponding maturity stage of KM, method to compare KM practices between two organizations and most

importantly a model to predict the impact of KMS on organizations competitiveness and bottom-line.

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