CHAPTER 5

TAXONOMY AND TECHNOLOGY ARCHITECTURE FOR KNOWLEDGE MANAGEMENT SOLUTION IMPLEMENTATION

5.1 INTRODUCTION

Enterprises are realizing how important it is to "know what they know" and be able to make maximum use of the knowledge. This knowledge resides in many different places such as: databases, knowledge bases, filing cabinets and peoples' heads and are distributed right across the enterprise. All too often one part of an enterprise repeats work of another part simply because it is impossible to keep track of, and make use of, knowledge in other parts. Enterprises need to know:

- What their knowledge assets are

- How to manage and make use of these assets to get maximum return.

Most traditional company policies and controls focus on the tangible assets of the company and leave unmanaged their important knowledge assets. Success in an increasingly competitive marketplace depends critically on the quality of knowledge which organizations apply to their key business processes. For example the supply chain depends on knowledge of diverse areas including raw materials, planning, manufacturing and distribution. Likewise product development requires knowledge of consumer requirements, new science, new technology, marketing etc.
Philosophically, “Knowledge is experience. Everything else is just information” - Albert Einstein. “The wise see Knowledge and Action as one” – The Bhagavad Gita. KM is not only about managing these knowledge assets but managing the processes that act upon the assets. These processes include: developing, preserving, using and sharing the knowledge. By all accounts, KM is the ability to create and use knowledge to achieve organizational objectives (Krishnan, 2001). KM is a business process through which firms create and use their institutional or collective knowledge.

Organizational learning is important for a firm’s productivity growth. It is found that information and communication technology alone do not support organizational learning and therefore do not enhance productivity. This research has demonstrated that in the case of manufacturing companies some computer-based system do support organizational learning. Taxonomy is the apex operational structure of the enterprise and it covers and categorizes all functional aspects of the enterprise under different categorizes. Taxonomy is a standardized set of terms, hierarchically organized, used to categorize information and knowledge. The taxonomy generally reflects how organizations think about the business, how the firms organize to conduct business, and/or how and what the firms deliver to their customers. The hierarchical organization is a useful way to display relationships among terms, and makes it easier to find like items at more general or more specific levels. At its most basic level, the taxonomy standardizes what we call things, making a consistent connection between an idea or concept and the words we use to describe it. This standardization makes it easier for the ultimate user to find what they are looking for. Based on semi-structured interview, expert’s opinion and Delphi study, we propose a generic framework of taxonomy architecture for a typical manufacturing Organization in this. The taxonomy should also be extensible to address non- document form of outputs as well.
An organizational structure is mainly a hierarchical concept of subordination of entities that collaborate and contribute to serve one common aim.

Taxonomy is a standardized set of terms, hierarchically organized, used to categorize information and knowledge. The taxonomy generally reflects how we think about our business, how we organize ourselves to conduct business, and/or how and what we deliver to our customers. The hierarchical organization is a useful way to display relationships among terms, and makes it easier to find like items at more general or more specific levels. At its most basic level, the taxonomy standardizes what we call things, making a consistent connection between an idea or concept and the words we use to describe it. This standardization makes it easier for the ultimate user to find what he or she is looking for. In other words, taxonomy is the apex operational structure of the enterprise and it covers and categorizes all functional aspects of the enterprise under different categories. The taxonomy should also be extensible to address non-document form of outputs as well.

5.2 RESEARCH GAP BASED ON LITERATURE

The need for having a holistic view about the taxonomy and technology architecture in organizational transformation is highlighted in literature. It is also clearly evident that taxonomy and technology architecture are the key for any organizational change like KM. From the detailed literature survey the research gap is shown in Figure 5.1.
Development of taxonomy architecture for structured and unstructured knowledge for $KM$ with navigation and content layer, development of metadata and development of technology architecture with functional requirements, administrative / operational features, architectural features, integration features, user interface and navigation features, security features and documentation and help features in an organization for the $KM$ implementation is not widely explored in the literature. This taxonomy and technology architecture is very important for a manufacturing organization before the implementation of $KM$ solution. Based on the development of taxonomy and technology architecture, organization should focus on process design and structure design for $KM$. Otherwise, implementation of $KM$
solution will not be successful for any organization. The primary intention of
taxonomy and technology architecture is to devise the backbone of KM which
will be necessary for the implementation of KM portal. The objective of this
module is to design a generic conceptual framework and generic design for
taxonomy and technology architecture for any manufacturing organization.
The factors related to taxonomy and technology architecture are derived from
the literature and those can be changed with respect to mission and vision of
the organization.

5.3 RESEARCH PROCESS AND METHODOLOGY

The research process and methodology for the development of
framework for taxonomy and technology architecture is detailed. The research
process is divided into three phases:
Phase 1: Development of taxonomy architecture for structured and
unstructured knowledge
Phase 2: Development of meta data definition for taxonomy architecture
Phase 3: Development of technology architecture with all functional
requirements, administrative / operationsl features, architectural features,
integration features, user interface and navigation features, security features
and documentation and help features
The research methodology used in the research process is detailed here:
In Phase 1, a Delphi based detailed brainstorming exercise with a pre-intended
taxonomy architecture which is derived based on business literature, research
literature, individual discussions and face validity with academic experts in the
area of KM and consultants from the consulting organization in the domain of
KM is the methodology. Delphi based detailed brainstorming exercise are
conducted with 43 executives belong to 32 manufacturing organization. For
the derivation of pre-intended taxonomy architecture, discussions with 26
academic experts from 14 different top institutions all around India and 13
consultants from 4 different consulting organizations. These pre-intended process designs can be used as a base for any manufacturing organization. The devised taxonomy architecture is presented in Section 5.4 because the generic taxonomy architecture and the taxonomy architecture derived for the case study organization are the same.

The research methodology for the phase 2 and phase 3 are similar to phase 1. The pre-intended meta data definition and pre-intended technology architecture with all functional requirements, administrative / operational features, architectural features, integration features, user interface and navigation features, security features and documentation and help features are devised based on the same methodology as indicated for phase 1.

The devised meta data definition and pre-intended technology architecture with all functional requirements, administrative / operational features, architectural features, integration features, user interface and navigation features, security features and documentation and help features are presented in Section 5.4 because the generic framework and designs and the framework and design derived for the case study organization are the same.

The diagrammatic representation of research design is detailed in Figure 5.2.
5.4 CASE STUDY DEMONSTRATION

The entire research process and methodology of taxonomy and technology architecture is demonstrated and applied through a real-life case study for Indian textile machinery manufacturing company. Thus 216 executives of this textile machinery manufacturing organization were involved
in Delph based detailed brainstorming exercise for development of all the designs of this study.

5.4.1 Taxonomy Architecture

The taxonomy architecture knowledge for case study organization was identified for both Explicit/Structured knowledge as well as tacit / unstructured knowledge.

5.4.1.1 Taxonomy architecture for structured knowledge

For the structured knowledge, the taxonomy is classified into two layers, the navigation layer and the content layer. The navigation layer provides the access path to the information category as required by the user and the content layer facilitates a structured format for the storage and access of the right information. The navigation layer for taxonomy architecture of KM is devised and detailed in Figure 5.3. The navigation layer with balanced scorecard perspective is devised and detailed in Figure 5.4. The content layer for all the navigation layer taxonomy elements are devised and detailed in Figure 5.5 to Figure 5.24. The below sections show in detail the different layers of the taxonomy as applicable for case study organization.
Figure 5.3 Navigation Layer for Taxonomy Architecture of KM
Figure 5.4 Navigation Layer with Balanced Scorecard Perspective
Figure 5.5 Content Layer for Corporate Taxonomy
Figure 5.6 Content Layer for Secretarial Taxonomy

Figure 5.7 Content Layer for Internal Audit Taxonomy
Figure 5.8 Content Layer for Quality Assurance Taxonomy

Figure 5.9 Content Layer for Finance and Accounts Taxonomy
Figure 5.10 Content Layer for Information Technology Taxonomy

Figure 5.11 Content Layer for HRD Taxonomy
Figure 5.12 Content Layer for Personnel Taxonomy

Figure 5.13 Content Layer for SCM Taxonomy
Figure 5.14 Content Layer for Foundry-Production Taxonomy

Figure 5.15 Content Layer for Foundry-Sales Taxonomy
Figure 5.16 Content Layer for MTD-Manufacturing Taxonomy

Figure 5.17 Content Layer for MTD-Sales Taxonomy
Figure 5.18 Content Layer for MTD-R&D Taxonomy

Figure 5.19 Content Layer for Planning Taxonomy
Figure 5.20 Content Layer for Manufacturing Taxonomy

Figure 5.21 Content Layer for Spare Parts Section Taxonomy
Figure 5.22 Content Layer for Sales Taxonomy

Figure 5.23 Content Layer for Customer Service Division Taxonomy
**Figure 5.24 Content Layer for R&D Taxonomy**

**5.4.1.2 Taxonomy architecture for unstructured knowledge**

Given that within case study organization there are several channels of interaction between employees that would normally contain tremendous amount of knowledge, it is important to extract and collect this knowledge in a codified form. The channels that need to be addressed currently are:

- E-mails / Chat Services
- Communities of Practices/ Interest (Organizational Learning)
- Business & Technical Review Meetings

The knowledge that we capture through these channels would be associated with at least one item in the structured taxonomy identified earlier. The unstructured knowledge would be codified to capture the following:

**Queries: Answers & Clarifications:** This describes the queries/questions related to an item and the answers or clarification made available during these
interactions on the channel.

1. Reference to other relevant structured knowledge components and industry benchmarks

2. Uniqueness of the query or situation to be highlighted

**Symptoms: Root & Cause (Problems):** These are the set of observations discussed on a knowledge item feature with respect to its operational behavior, efficiency characteristics etc. In addition this would involve identification of the root cause for these observations, if discussed during the interactions in the channel.

- Information on the surrounding environmental factors, configuration parameters and associated other happenings
- Domain specific influence and related information

**Problems & Resolutions:** Essentially these are set of issues, concerns or problem areas that get discussed on the channel for an item. Normally these are addressed to a designated organization expert or an informal area expert or a personal perceived expert. The response could normally be a resolution or a re-direction to an expert or specific knowledge center.

(i) Alternatives in different situations

(ii) Associate in different functional areas or domains if applicable

**Tips Suggestions & Feedback:** These are standard informal information floating around in the system as mails, chats etc. as tips for the knowledge items in a functional area with some other knowledge worker substantiating or refuting the tip/suggestion with appropriate feedback.

1. Support with testified data or benchmarked industry source
There are specific templates with respect to these unstructured knowledge items that can be used for any knowledge items across different service lines and vertical domains.

5.4.2 Metadata

Metadata are data that describe other data. Generally, a set of metadata describes a single set of data, called a resource. Metadata is structured, encoded data that describe characteristics of information-bearing entities to aid in the identification, discovery, assessment, and management of the described entities. Metadata is used to speed up and enrich searching for resources. Using metadata-search with parameters such as the period, the category of knowledge, author and title etc., standard query will be processed by taking context of the query into consideration. In general, search queries using metadata can save users from performing more complex filter operations manually. Table 5.1 defines the Metadata that will be applicable across the taxonomy defined in the section 5.4.1.
<table>
<thead>
<tr>
<th>S/No.</th>
<th>Attribute Name</th>
<th>Attribute Type</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Title</td>
<td>Text</td>
<td>Title of the document</td>
</tr>
<tr>
<td>2</td>
<td>Author</td>
<td>Text</td>
<td>Who wrote the document</td>
</tr>
<tr>
<td>3</td>
<td>Brief / Abstract</td>
<td>Text</td>
<td>Brief description on the document</td>
</tr>
<tr>
<td>4</td>
<td>Categories</td>
<td>Multiple Value</td>
<td>Category is the taxonomy navigation and basically will contain the elements as specified in the navigation layer of the taxonomy.</td>
</tr>
<tr>
<td>5</td>
<td>Process</td>
<td>Text</td>
<td>From which process this knowledge item was created</td>
</tr>
<tr>
<td>6</td>
<td>Corporate Strategic Objective</td>
<td>Multiple Value</td>
<td>To which Corporate Strategic Objective (CSO) this document will contribute. This is will be a drop down from the list of Corporate Strategic Objectives as specified from the BSC.</td>
</tr>
<tr>
<td>7</td>
<td>Subject</td>
<td>Multiple Value</td>
<td>List of domains like Textile Machinery, Machine Tools, Finance, HR, etc</td>
</tr>
<tr>
<td>8</td>
<td>Focus area</td>
<td>Multiple Value</td>
<td>Related focus areas like Business, Technical, Management, General, Training, etc.</td>
</tr>
<tr>
<td>9</td>
<td>Customer</td>
<td>Text</td>
<td>This property is optional. If the document is related with customer, we can specify the customer name.</td>
</tr>
<tr>
<td>No.</td>
<td>Key</td>
<td>Type</td>
<td>Description</td>
</tr>
<tr>
<td>-----</td>
<td>--------</td>
<td>---------------</td>
<td>----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>10</td>
<td>Understanding</td>
<td>Text</td>
<td>The document related to novice, expert, All, etc.,</td>
</tr>
<tr>
<td>11</td>
<td>Rating</td>
<td>Numeric</td>
<td>The weightages for the document</td>
</tr>
<tr>
<td>12</td>
<td>Keywords</td>
<td>Multiple Value</td>
<td>The search keywords for the document</td>
</tr>
<tr>
<td>13</td>
<td>Activities</td>
<td>Multiple Value</td>
<td>To which activity this knowledge item is related</td>
</tr>
<tr>
<td>14</td>
<td>Form</td>
<td>Text</td>
<td>In what form the knowledge is captured Doc, Audio, Video</td>
</tr>
<tr>
<td>15</td>
<td>Sensitivity</td>
<td>Single Select</td>
<td>To what level the document is secured for access</td>
</tr>
<tr>
<td>16</td>
<td>Type</td>
<td>Text</td>
<td>What is the type of knowledge item Ex: Report, Best Practice, Manual, etc.</td>
</tr>
<tr>
<td>17</td>
<td>Last Revised</td>
<td>Date</td>
<td>Last modified</td>
</tr>
</tbody>
</table>
5.4.3 Technology Architecture

Technology architecture for case study organization is devised and detailed in Figure 5.25. This section also discusses in detail the functional requirements and features for the KM System. The requirements are classified under the following categories as below and the same is discussed in detail.

1. Functional Features
2. Administrative / Operational Features
3. Architecture Requirements
4. Integration Requirements
5. User Interface/ Navigation Features
6. Security Requirements
7. Documentation & Help Features
5.4.3.1 Functional features

The functional features and description of functional features are detailed.

Taxonomy: Creation of multiple knowledge repositories and sub-repositories (typically, each repository would be an area of relevance to the businesses)

Option for customization of Taxonomy in order to dynamically adopt the changing requirements of the organization

Clustering Search: Quick, robust and accurate search & retrieval capability. Users should be able to drill down into relevant categories. User to be
responded with all the possible choices and ask to point which of the option he/she means. Wild & keyword guided category and menu driven search for distributed data/document or other sources.

Filtering: Active Filtering: Manually define filters and pointers to interesting content and share them across their group. Automated Filtering: Statistical algorithms make recommendations based on correlation between User's personal preference and content rating. Content rating to be generated automatically by measuring the average time all readers spent on reading the item.

Contributor of the Month: Display the Image & name of significant contributor to knowledge repository (Automated Statistical algorithms to make recommendations based on the parameters like number of contribution, quality, participation in unstructured channels etc.)

User of the Month: Display the Image & name of significant user to knowledge repository (Automated Statistical algorithms to make recommendations based on the parameters like usage of information, participation in unstructured channels etc.)

Integrative / Structured Knowledge : Shared medium for knowledge exchange for members of the same group to share, see and contribute their knowledge. Collection of distributed knowledge repositories containing explicated (databases) and explicitly captured (talk/vision) content. Structured knowledge discovery facility to transfer knowledge from structured sources to people. (If the processes around it are well established, this can prove to be a valuable addition to the corporate sensory network as a way to learn about the business from the transactional interactions with customers, partners and employees).
Interactive / Unstructured Knowledge: Interaction among people and providing basic platform for people to share the tacit knowledge through various channels like:

1. Virtual Meeting Rooms
2. Discussion Threads
3. Electronic white boards
4. Email Integration (Subject to Security Policies)
5. Video conferencing

1. Virtual Meeting Room combines several forms of real-time communication, including Voice over Internet Protocol (IP), chat, instant messaging. These forms are used to transfer knowledge from one person to another person, or within small groups. Knowledge transfer using virtual meeting room is lost, much as it is with the telephone, because the participants never place a transcript or other record of their conversation in a repository.

2. Discussion Thread: It can facilitate Brainstorming and can act as a codification point for insights and lessons learned, and they can act as the tool through which distributed teams interact. Discussion threads must focus on the inquisitive dialog. In addition, discussion threads should be seen as a component of many of the other transfer technologies. Any real-time interaction, teaching session or course should add a discussion thread that allows for asynchronous discussion to supplement the other interactions.

3. Electronic Whiteboard: It supports the transfer of knowledge by allowing an instructor or peer to work out ideas on a shared white space. All
members of the session may see the person work and in some cases, may also collaborate, thereby transferring knowledge through peer/instructor interaction.

4. E-Mail integration: It is a flexible, adaptive tool for the transfer of information and knowledge. E-mail is a private medium, however, so the learning that takes place between e-mail participants does so in a relatively private way. The only way knowledge is transferred on a larger scale is for the participants to decide to publish e-mail content or forward it to other people.

5. Videoconferencing: It has two modes, one, the speaker presentation mode, works well as a starting point for knowledge transfer in a lecture format, but if there are many participants, questions are better taken over the phone than through the video system because of the difficulties of managing windows and cameras. If the videoconferencing is also being used with video streaming, it is better for the audience and for the speaker to choose a single method of interaction, since some participants will not have cameras. The second mode is person-to-person or small group to small group interchanges where video can enhance the communication of knowledge by enhancing the overall bandwidth of the human interaction (facial expressions, body language, etc.). Videoconferencing in this mode is best when it is person-to-person and can be a very good supplement to mentoring if the mentor and student are not in the same location. It is also a good way to reduce travel when skill transfer is required because it not only allows people to communicate, but it also can establish a relationship between the parties more quickly and with higher quality than phone, e-mail or real-time chat.
Organization Learning: The system should be able to showcase Organizational learning in a structured format. Organizational learning is the process of "detection and correction of errors." Organizational Learning occurs when groups of people give the same response to different stimuli.

1. Learning from Experience
2. Learning from Success / Failure
3. Learning from external / new environment

Expert Management: Mapping the expertise of an organization is valuable for several reasons. Easy access to a map of expertise of the organization can connect people when they need guidance resulting in quicker response rates and avoid re-work. Maps can be used then to pull people in to assist on current projects or for offering training to employees who have existing good basic skills to equip them with additional skills the organization will need for future projects. Considerations include: skills, expertise, experience, and location. Some additional requirements in the same context are: capability to provide links to “Experts” in each repository / sub-repository and capability to post ideas / questions for Experts.

Best practice sharing: The system should enable identification of best practices, documentation of best practices and easy sharing of best practices.

News flash: Provide a quick idea of what is happening in the business environment internally & externally like: business interest items, industry analysis, highlights and lowlights

What’s new?: “What’s new” button that displays new content added during, say, the last 2 weeks
5.4.3.2 Administrative / Operational features

The administrative / operational features and description of administrative / operational features are detailed.

Managing the KM site: Web Master should be able to manage KM system and its repositories centrally. Admin should be able to monitor the users and prevent hacking proactively. It should be able to block the access for spurious / suspicious use. The Admin to be given rights for the following:

- Setting rules
- Giving rights
- Modifying rights
- Removing access
- Uploading
- Content reliability
- Approval

Ownership / Administration / Content Management of each repository by a different repository-owner or knowledge champion to be enabled. Ability for all employees to upload (contribute) knowledge into repositories (which will be accepted after quality-check by repository owners. Ability for all employees to download (re-use) knowledge from repositories

Network management: The network should be managed from a central place.

Workflow capabilities: The system should have a step-by-step workflow capability in terms of document submission, alert to repository-owner and editing and acceptance for publishing in repository.

Reporting: System should be able to give logs / reports for no. of contributions, no. of hits per repository / sub-repository, no. of views /
downloads per knowledge object, user-names with names and dates of visit to the site, who has read / downloaded which knowledge-object, Who is the significant contributor for a period, and what are their contributions, report on obsolete contents on regular basis, etc.

5.4.3.3 Architecture features

The architectural features and description of architectural features are detailed.
Performance: Any 300KB to 1MB files should not take more than 3 seconds to load under normal usage condition with maximum users online.

Scalability: The users are expected to grow. It should support an increasing number of users and higher load of transactions. Within acceptable limit for time delay for retrieval, query. Time for updates and inserts of new records should be min. Time delay for navigating between different parts of the interface to be min. Typically 2/3 seconds is the maximum allowed.

Interoperability: Interoperability include various factors such as

Electronic mail: SMTP. X.400, POP support
Documents: RTF, Microsoft office, PDF etc.
Data Access: SQL, ODBC
Internet: HTTP, XML, FTP

Reliability: At any point transaction on KM server should give the correct / expected output. 99.99% uptime. Time to rectify problem < 30 minutes and Standard Audio and Video Supports
5.4.3.4 Integration features

The integration features and description of integration features are detailed.
With exiting systems: Interface with existing Oracle Modules, Lotus Notes to get all structured knowledge in terms of extracting, structuring, storing and viewing in different formats. Integration is primarily sought after with respect to the following: Technical Complaints Resolution History (Lotus Notes, ‘Metalink’ - Oracle, Windows-2003), Service Request Threads (Oracle), e-mail Services (Lotus Notes) and Messenger service (‘Same-time’ – Lotus Notes)

With new systems: Interface with new systems to be developed in future to get all structured knowledge in terms of extracting, structuring, storing and viewing in different formats.

5.4.3.5 User interface and navigation features

The user interface and navigation features and description of user interface and navigation features are detailed.

Functionality: The system should be user friendly and Users should be able to accomplish their task quickly, effectively and without frustration over the systems usability. The system should take care of end user needs and requirements.

Consistency: There should be consistency across all parts of the KM system in the way in which information is presented, accessed and used like MS office.

Visual Clarity & Layout: The system should enable Users to easily find information that they need. Present all information that relates to the user's
task on one screen if possible and hide all unrelated information and control
by default. Have sufficient white space on the screen and use lowercase for
dense area. Use right font, font size. No cluttering on the screen. Hyperlinks to
provide further information on text string.

Navigation & control: Site map to be provided. The user should be able to tell
which area / tools he/she is using at a given moment.

Images: Interesting and relevant images to be used at appropriate places.

Feedback: User should be able to receive the feedback from the system so that
they know what the system is doing and what is expected next. Audible clues/
alerts to be provided.

Personalization: User should be able to configure his/her USER ID according
to one’s knowledge requirement. Individual users may subscribe to selected
repositories that are of relevance / interest to them; alerts through e-mail when
there is a new addition to the selected repositories to be enabled.

Rating: The readers should be able to rate an article / paper / resource.

Knowledge Points: Knowledge currency / points, etc. for knowledge
submission, each time somebody opens / downloads (other than the person
who has submitted).

5.4.3.6 Security features

The security features and description of security features are
detailed.

Access Control: File level access control with User groups. User groups are
classified into U1, U2 & U3 for Businesses & Functions. U1 will have access
right to all the files. U2 will not have access to certain sensitive files. U3 will have access only to limited files. KM Admin will assign the user access level for each file while uploading so that user can have access to all the files that they are authorized to view. Change of user access level should be possible at any time.

External access: Capability to provide access to stakeholders other than employees (e.g. distribution agents, customers, partners, suppliers, etc.) to selected parts of the KM portal. Capability to provide links to external content / sites, etc

5.4.3.7 Documentation and help features

The documentation and help features and description of documentation and help features are detailed.

Documentation: Complete design, development and implementation should be documented at every stage. All test results should be documented. Modifications/changes should be approved and documented.

Help: The system should have a self-help for various features and how to use it with tips, cautions etc.

5.5 SUMMARY

The generic taxonomy and technology architecture developed in this research can be directly taken as base for any manufacturing industry in building KM solution and the practice managers may concentrate on the various components. As the foundation for all activities within the corporation relating to explicit and tacit knowledge, a taxonomy can further a wide range of corporate objectives, such as enabling business processes, protecting intellectual property, and building the foundation for compliance. Each organization requires a different taxonomy because each has unique processes, organizational configurations, core competencies, and histories.