Developing an Intranet-based
Knowledge Management Framework in a Consulting Firm :
A Conceptual Model and its Implementation

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Abstract

Management consulting firms are considered typical examples of highly knowledge-intensive companies since they depend heavily on the expertise of their people and the nature of their assignments is knowledge-based. Hence, consulting firms have been in the forefront of thinking about how to manage knowledge However, one of the major knowledge management challenges in any organization is to develop a conceptual model to represent organizational knowledge and to use information technology for its effective implementation that would enhance right information access at right time. This paper reports our experiences in designing and developing a knowledge management framework in Management Consulting Services (MCS) of PricewaterhouseCoopers Ltd. in India (PwC India). This framework is based on a conceptual model where various knowledge sources at the content level interact to realize an integrated knowledge structure. Information technology is used here to realize an Intra-net-based framework that captures organizational structure and procedures and establishes semantic linkages among all the documents. Moreover, the framework supports sharing of informal or tacit knowledge that flows in the organization.

1. Introduction

Knowledge management refers to efforts to capture, store, and deploy organizational knowledge using a combination of information technology and business processes [1-2]. Knowledge management is a conscious strategy of getting right knowledge to right people at right time and put it into action to improve organizational performance. In recent years, knowledge management has become the terminology of many organizations in order to get competitive advantage from the efficient and effective use of their knowledge assets.

Management consulting firms are considered typical examples of highly knowledge-intensive companies since they depend heavily on the expertise of their people and the nature of their assignments is knowledge-based and mainly project-focused. They put considerable emphasis on applied creativity for solving the business problems of their clients. Their success depends on developing, selling and applying ideas to their clients. This puts heavy pressure on those firms to be innovative to meet the changing requirements of customers. Hence, consulting firms have been in the forefront of thinking about how to

manage knowledge [3, 4]. KM facility can help to improve innovative culture through availability of right knowledge at right time and through knowledge sharing among the consultants. This would also avoid duplication of work, reduce learning time and improve the speed of implementation.

However, one of the major knowledge management challenges is to develop a conceptual model to represent organizational knowledge and to use information technology for its effective implementation that would enhance right information access at right time. This paper reports our experiences in designing and developing a knowledge management framework in Management Consulting Services (MCS) of PricewaterhouseCoopers Ltd. in India (PwC India). PwC is a global consulting firm and its products and services are almost exclusively based on knowledge. Hence knowledge has been placed at the center of the PwC brand: "People, Knowledge, and Worlds" and PwC is always striving to set a new standard in managing knowledge to improve organizational performance.

2. The Background

Most current knowledge management activities rely on databases and Internet systems. However, few organizations have a systematic process for capturing knowledge, as distinct from capturing information. Thus, the approaches to knowledge management usually focus heavily on management of document collections viewed as knowledge repositories to be accessed in an appropriate way. The initial knowledge management practice of PwC India also relied on storage and retrieval of information from large volume of documents, often stored in logically disjoint databases within the organization. Information technology in this context provided efficient support for document management. However, finding information in a situation is too often equated with retrieving the information from those disjoint databases. Moreover, it had difficulties to meet the flexibilities demanded by knowledge-sharing approaches to knowledge management [5]. Existence of disjoint discussion forums or several lesson-learnt databases failed to serve their purpose. In most of the cases, the key challenge was *knowledge integratio*n—linking the various sources at the knowledge-content level.

If we view KM as a conscious strategy of getting right knowledge to right people at right time and put it into action to improve organizational performance, then this document-centered approach is truly inadequate. It only creates an over-abundance of information and data, not knowledge. The knowledge is not something that is "contained" in documents but it is something that can be generated or reproduced in the interaction with documents that needs to be viewed as "representations" rather than as "container"[6].

To address this issue, several researchers feel that current knowledge management practice significantly underutilizes knowledge-engineering technology [7,8]. The Knowledge engineering processes involves: using knowledge acquisition processes to capture structured knowledge

systematically and using knowledge representation technology to store the knowledge, preserving important relationships that are far richer than those possible in conventional databases. In [8], three facets of the knowledge management task are considered:

• *Knowledge capture*—In the group's systematic knowledge acquisition process, a conceptual business model of the company guides case and rule capture.

• *Knowledge storage*—The group uses a knowledge representation language to codify the structured knowledge in several knowledge bases, which together make up a knowledge repository.

• *Knowledge deploymen*t—Through standard Web browsers on the company intranet, group members can run the knowledge bases within a knowledge server. The server answers queries far more complex than those possible with conventional database systems.

However, it is very difficult to integrate expressive reasoning tools with intranet knowledge management environments such as Lotus Notes/Domino. Therefore, it seems reasonable to conclude that while knowledge-engineering processes are ready to bring significant benefits to knowledge management projects, the implementation is still a complex task [8]. Abecker *et al.,* [9] propose an approach to build up a KM framework from existing documents to avoid employee's resistance and work disruption.

Thus, a knowledge engineering approach is needed to develop a proper conceptual modeling of the organizational knowledge in order to structure the KM process. At the same time, a simplified implementation mechanism needs to be used to ease the process of developing and augmenting the knowledge system.

With this objective in mind, a KM framework, Knowledge Point, has been designed as a single-window access to the PwC's online resources, allowing quick access to internal and external information, including resources of different strategic business units (SBU) within the organisation, industries, clients, projects and people. This framework is not a mere repository of documents but various sources at the knowledge-content level have been integrated to realize an integrated knowledge structure. Information technology is used here to realize an Intra-net-based framework that captures organizational structure and procedures and establishes semantic linkages among all the documents. Moreover, the framework supports sharing of informal or tacit knowledge that flows in the organization. The framework supports different collaborative tools so that the people can participate in different communities of interest or special interest groups to share their views and ideas and can learn from experts within the organization in an informal way.

3. A Conceptual Model to Build the KM Framework

An appropriate model for knowledge management cannot be developed unless the organization is clear about what it wants to achieve. The objectives of a manufacturing firm may entirely differ from that of a

knowledge-based firm. As identified by American Productivity &Quality Center, a pioneer in the field of knowledge management, a general model of knowledge management should involve seven general steps, viz., creation, identification, collection, organization, sharing, adaptation and use.
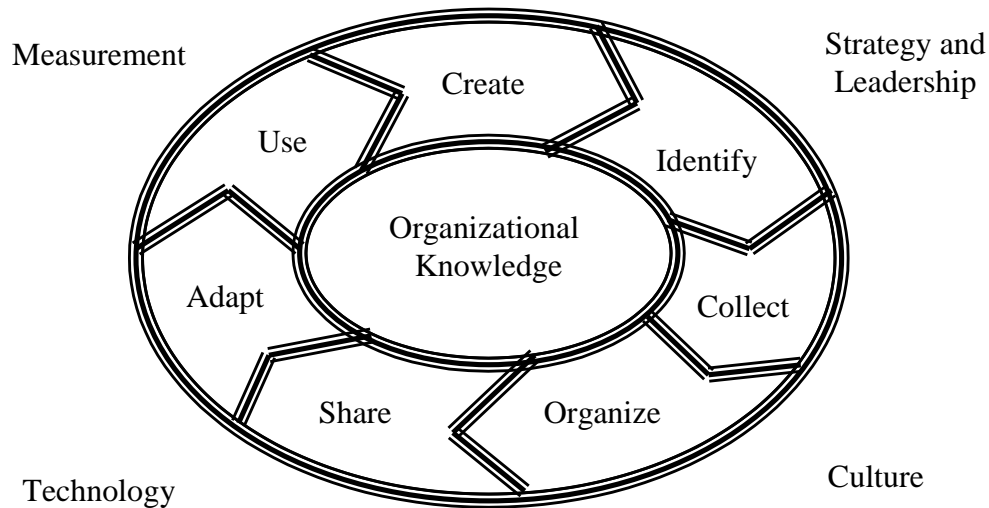
Source: American Productivity & Quality Center

Figure 1. Steps in Knowledge Management

Acquiring and structuring corporate knowledge has proven to be the bottleneck in the design of effective knowledge systems for organizations [8]. To overcome this difficulty and to ease the work of the analyst building the KM system, the choice of knowledge structuring and the type of knowledge to capture are critical. For each domain, a body of knowledge exists and is maintained in different forms (formal and informal, structured and unstructured, as books, documents, procedures, database, etc.). The issue of what knowledge should be considered as candidate for KM system can be clarified if one distinguishes the different layers of knowledge existing in an organization and their interaction pattern.

In this context, the organization can use the knowledge-engineering process to define an organizational knowledge model—a *knowledge map* [10] — which delineates the relationships that bind the multifaceted knowledge management system at the knowledge-content level. The actual software-level bindings can use hyperlinking, or any one of a host of distributed computing techniques.

We have done it as a two-level process. First, we have identified the primary entities of PwC and their interrelationship to derive a conceptual model of the organization. An explicit conceptual model of this kind is commonly called *ontolog*y. This is shown in figure 2 (a) as *enterprise ontology* [11]. At the most rudimentary level, the management consulting practice of PwC India is structured in the form of several Service Line or Strategic Business Unit (SBU), each unit specializes in providing a specific type

of service to their client. Each SBU deals with projects for their clients; however, a project may require expertise from multiple SBUs. Each SBU follows a set of methods and technologies to solve the business problem for its clients. An employee of PwC normally belongs to a particular SBU. A client belongs to a particular type of industry. So the industry-specific knowledge is also required to provide service to the client. The enterprise ontology shown in fig.2 (a) represents this description.

Based on enterprise ontology, Information Ontology [11] of PwC is defined in fig 2 (b) in the form of a *knowledge network*. As indicated earlier, in PwC, each SBU executes specific type of projects for a set of clients using a set of methodologies; each client belongs to a particular type of industry; people of PwC work in multiple projects, interact with multiple clients and have multiple expertise. So, there are documents related to different types of industries, different clients, lesson learnt from different projects and the methodologies followed, people involved in projects, their skill-sets and the practices and strategies of SBUs within the organization. All these documents are appropriately cross-linked so as to form a mesh-structured, continuously evolving knowledge-base of the whole organization. The basic idea is to enable users a meaningful and prompt navigation through this *knowledge network*. For example, a user viewing a project description in KnowledgePoint may be interested to know the following:

- Similar project descriptions;
- Detailed description of client for whom the project has been carried out;
- Other projects done for the same client;
- Details of the methodology / technologies used;
- Description of the industry-type where the client belongs;
- Other clients belonging to the same industry-type and the type of projects done for those clients;
- Details of people involved in the project and their skill-sets;
- People having expertise in handling similar projects using similar methodologies / technologies;
- People having expertise in similar industry-type;
- People worked with that particular client on different projects;

And, so on. This justifies the need for providing cross-linkage among all six entities, as shown in the figure 2(b).

The implementation of this conceptual model to realise a knowledge management framework will be discussed in section 5.
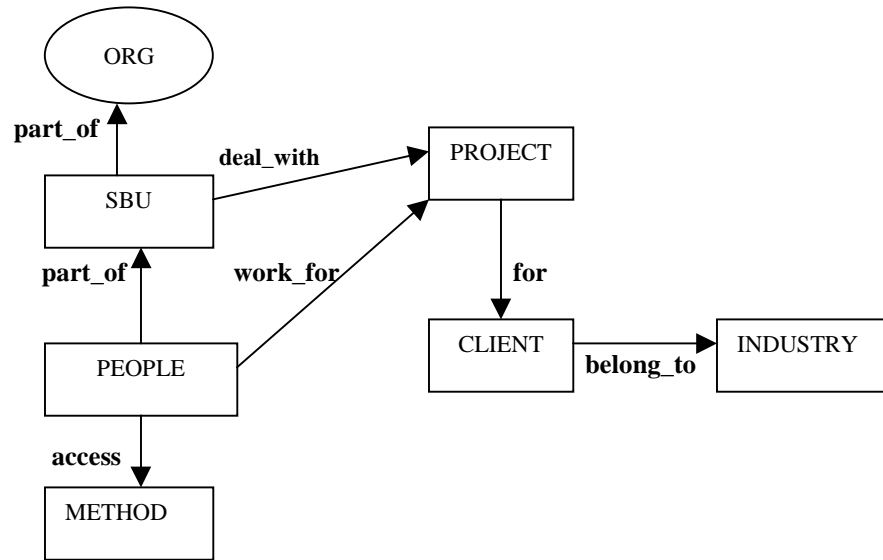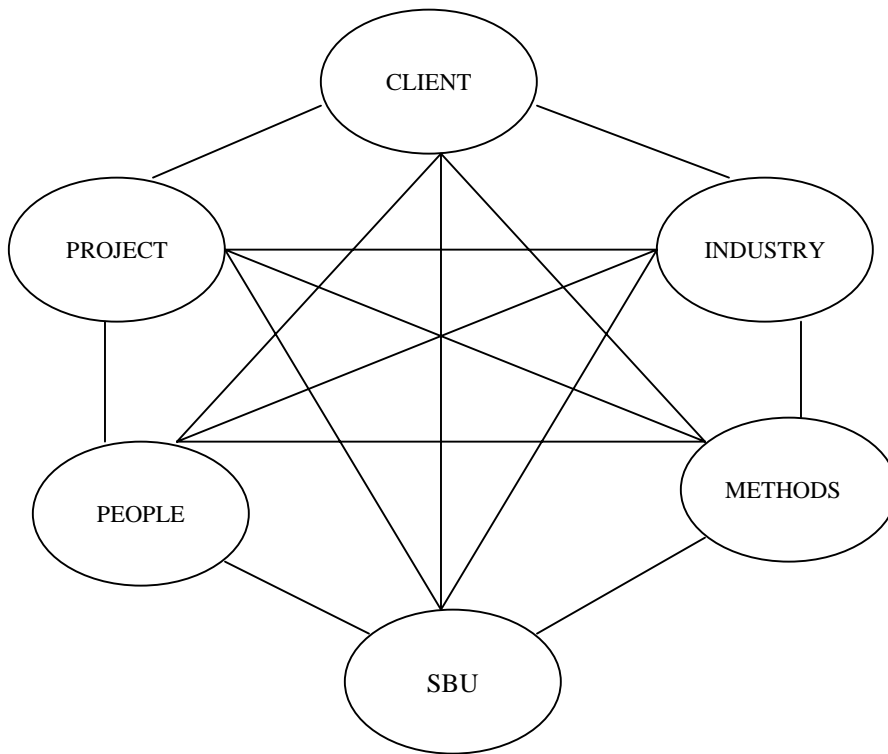
Figure 2(a) Enterprise Ontology of PwC

Figure 2(b). Information Ontology : The Knowledge Network for PwC

4. Technical Architecture

Recent advancements in information technology, especially network technology, has provided a strong infrastructure for knowledge management. It enables group members to break the bonds of time and space in communicating and sharing views, ideas and experiences. An online electronic discussion forum does not require you to wait till the other person completes expressing her views. Anonymity in expressing views can also improve the quality of discussions. Finally, these views can be structured in an organized manner to give rise to an organizational memory. Networked computers might provide the basis for a "nervous system" that could be used to implement the capacity for organizational memory [10]. The technologies that are in use to manage knowledge include the traditional GroupWare products and recent Intranet Technologies. Groupware allows the organizational record to be built in the course of everyday communication and coordination. Intranet provides the ability to organize, access and display this rich informational web.

Recent developments in web technology have enabled true platform independence at the client end. It also provides universal single window access to various new and legacy systems. Easy accessibility from anywhere is another important feature of the web technology. The open technology and standards of the web technology are not proprietary and we don't have to get locked to one vendor. Web solution providers are working towards incorporating as many GroupWare features as possible in to their products. At the same time, GroupWare vendors are also making their products web compatible. Lotus Development Corporations' Internotes 2.0 and Domino servers make the world's largest GroupWare, LotusNotes, web compatible. It converts the Notes documents to HTML format on fly to make it available to a standard browser. It enables active interaction between Notes Databases & standard web browsers and supports all Internet applications, standards & protocols. Thus, two technologies are converging to one, incorporating each other's features to gain the competitive advantage.

The technical architecture is shown in fig.3. Lotus Notes Databases store information in documents about projects, clients, industry, people and other related information. All information are appropriately cross-linked using hyper-linking to generate a mesh-structured knowledge-base. Agents perform tasks which are either manual or scheduled or are initiated form the web. ASP provides authentication for user, personalization and captures the user-count and login time.
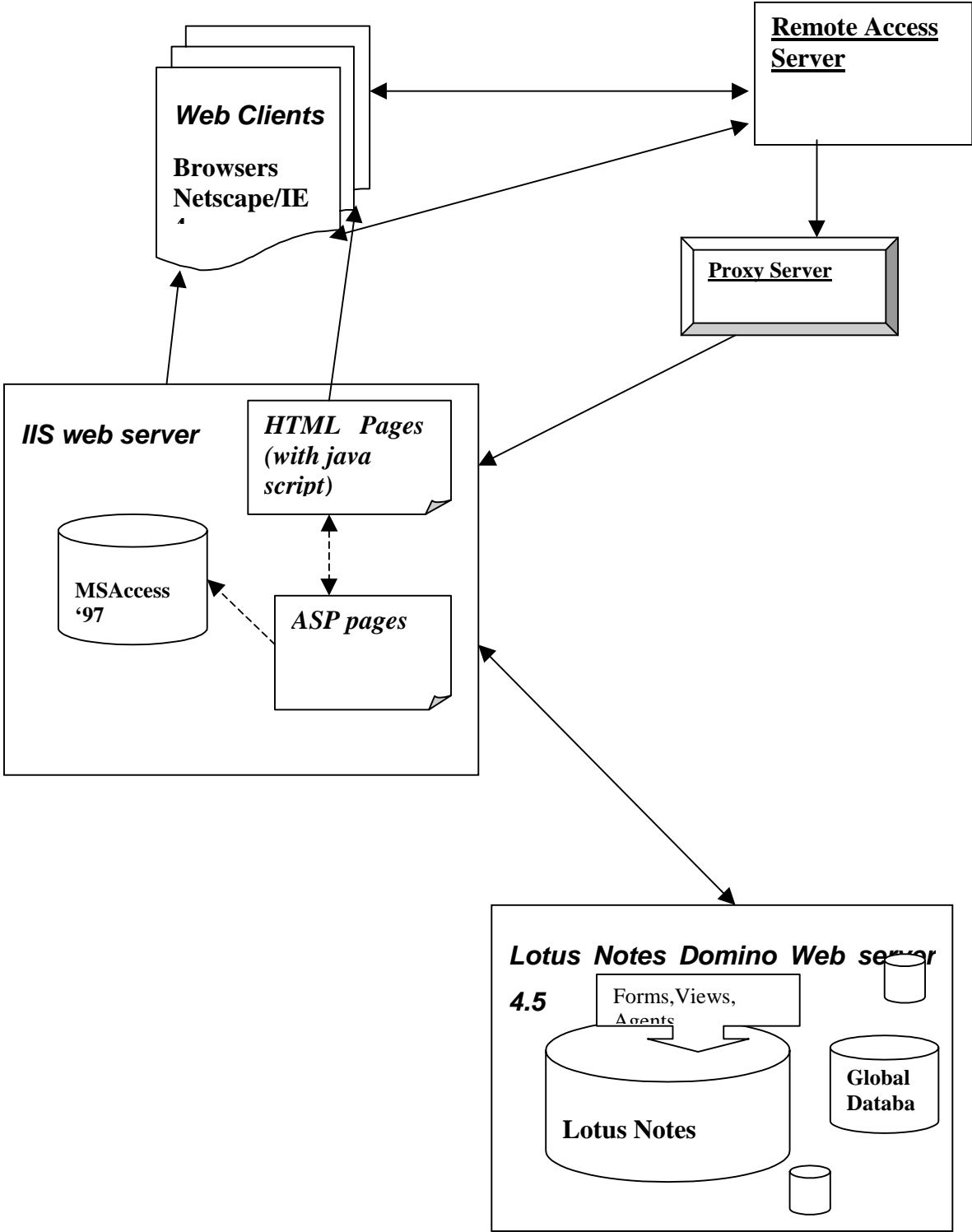
Remote Access Server

Web Clients

Browsers Netscape/IE

Proxy Server

IIS web server

HTML   Pages (with java script)

MSAccess '97

ASP pages

Lotus Notes Domino Web server 4.5

Forms,Views, Agents

Lotus Notes

Global Databa

Figure 3. The Technical Architecture of Knowledge Point

5. Knowledge Point and its Implementation

Based on the conceptual model and technical architecture described above, a knowledge management framework called Knowledge Point has been implemented in PwC India as a single-window access to its *knowledge network*. The entry-page is shown in fig. 4

Figure 4. Entry-page of Knowledge Point

The entry-level page consists of the primary entities as depicted in the knowledge network shown in figure 2 and few other related entities. The functions associated with major entities are described below:

Client:

When this is clicked, it will lead to a page containing two icons: ***Client*** and ***Project.***
When clicked on ***Client***, it gives list of clients, which can be sorted by industry-type. When a particular client name is clicked, it will lead to a page containing the detailed client information and linkages to other pages. This also serves as a template while creating a new client by clicking "create client" button. Each item described below consists of a brief description against each item and linkage to other pages, whenever needed:

- *Client* → linked to the client's external web-site
- *Parent Company* → linked to relevant external web-site, if exists
- *Turnover*
- *Industry*→ linked to the industry-page of Knowledge Point for its detailed description
- *Client's background*
- *Major product / services*
- *Office locations*
- *Services offered to the client* → linked to project page for detailed description of the project. There could be multiple projects for the same client.
  → linked to Service Line (or, SBU) page handling this client There could be multiple SBUs for the same client
- *Key client personnel*
- *PwC Personnel involved* → linked to Human Resource page for details of individuals involved
- *Client's competitors* → linked to external websites
- *External news about clients*→ linked to news database

When clicked on ***Project***, it will lead to a page containing list of projects under different service-line; they also may be sorted by clients. When a particular project is clicked, it will lead to a page containing the detailed project information and linkages to other pages. This also serves as a template while creating a new project by clicking "create project" button. Each item described below consists of a brief description against each item and linkage to other pages, whenever needed:

- *Project Name*
- *Code*
- *SBU* → linked to Service Line (or, SBU) page handling this project
- *Client*→ linked to client page for detailed description of the client
- *Industry*→ linked to industry page for detailed description of the industry-type
- *Scope of the Project*→ linked to projects with similar scope
- *Brief Description*
- *Time Scale*
- *Staffing* → linked to Human Resource page for details of individuals involved

- *Project Site*
- *Key Business Practice/ methods/technology used → linked to similar projects*
- *Solution Proposed*
- *Business Benefits*
- *Non-standard solution that has been developed*
- *Lesson learnt*
- *Technical Architecture used→ linked to similar projects*
- *Project deliverable → linked to relevant databases for details*
- *Project documents → linked to relevant databases for details*

Service Line:

When this is clicked, it will lead to a page containing icons for different Service Lines or SBUs. On clicking a particular SBU, it may lead to a page containing different sub-SBUs under that SBU. When that is clicked, it will lead to a page containing the following information:

- *About us*
- *Methodologies → linked to knowledge repositories for details*
- *Technology → linked to knowledge repositories for details*
- *Project / Client*: List of projects and clients: completed / on-going→ linked to project/client pages
- *Staff Profile*: List of employees in the SBU with their expertise / skills /current project→ linked to Human Resource page.
- *Training*: Training courses offered → linked to Training Database and E-Learning site (a web-site for Learning and Professional Development of PwC India)
- *Knowledge Repository → linked to Knowledge Resources page, Standardized document templates, methodologies, Best Practice Databases*

Without detailing further, we will explain very briefly the other items and their linkages:

Industry

This contains the description of different type of industries, categorized on the basis of strategic focus of PwC. Some examples are: Consumer and Industrial Products, Financial Services, Energy and Mining, Service Industry, Technology-Information-Communication and Entertainments, etc. Each category is linked to a set of sub-categories, which finally provides a list of clients under it and detailed description of the industry-type. Clients page can be accessed from this page.

PwC India

It contains all types of corporate information with appropriate linkages to other pages, internal communications, press releases, leadership messages, global and local announcements, organizational charts, policies, service descriptions, leadership profiles, recommended knowledge resources.

Human Resources

It provides information on staff profiles with expertise / skill-set. Each name is linked to individual description, SBU, project, client and/or industry pages, depending on his/her expertise / experience in those areas. A user can navigate through Training Database from here to see list of courses and other training-related information.

Knowledge Resources

This contains officially sanctioned and commissioned information of the enterprise including project methodologies, policy documents that support PwC's services and processes. It is also linked to library database, PwC Publication database, other knowledge repositories (internal or external).

Discussion Board

This is an area to share and capture informal knowledge. This type of informal interaction through discussion board can become a powerful stimulus for the collaborative development of new concepts and ideas. People can create special interest group or Communities of Practice [4]. Community of Practice can be formed in different ways :

- Certain topics that all practice members discuss and are interested in;
- Mutual engagement and binding to an entity: either a work-group within a SBU or a project;
- A shared repertoire of knowledge about a topic of mutual interest that all practice members have developed together.

Discussion Board enables open communication and knowledge sharing within the members of different Communities of Practices, created dynamically and spontaneously. Threaded discussions can be incorporated by integrating email and web functionality. A threaded discussion organizes what amounts to emails around subjects and discussions. The discussion is accessed using the web browser and the user generally starts by viewing an index of the contents in her web browser. Generally the index is organized by subject, with the primary statement listed first and the replies underneath organized by date and author. To view the content, the user selects the link. To add a response, a form is included with each message-type.

Help Desk

Help desk is a place where users identify experts in a specific domain and direct their queries to them. This provides a support for informal learning.

6. Security Issues

The biggest concern most executives and managers have about implementing an Intranet is security. We can make a security scheme with a lot of protection at every level, say, by means of passwords. But then we will be limiting the usage of knowledge. Security, therefore, is a continually changing balance of value, risk and practicality. The toughest part of developing a security strategy is determining what needs to be secured, and from whom. Security is not free. Every time the security level is tightened, the organization pays in terms of increased complexity of access, increased response time, and reduced communication.

Care needs to be taken that this information should not be accessible to an unauthorized user. For this purpose, login-ids have been created for all PwC employees. When he tries to login from a remote site, the proxy server asks him for a password and allow connection only for a valid user id and password.

However, not all information that is available on the content pages is for everybody. For this purpose, we have developed a privilege table. A privilege table contains a row of all the unique security classes of information and a list of all users with access to the system. The cells in the resulting table are used to record the access privileges of each user. In each cell a user either has access or does not.

Privilege tables are popular because they provide a documentation format that can be easily implemented in an automated access control program. When a user logs on, the system authenticates her. When she requests access to particular information, the software looks at the privilege table to determine if she is authorized. This type of system not only simplifies the management of who gets access, but it simplifies access for the user. Because of the privilege table, the user only has to be authenticated once, rather than at each access. The authentication and personalization system is shown in figure 5.
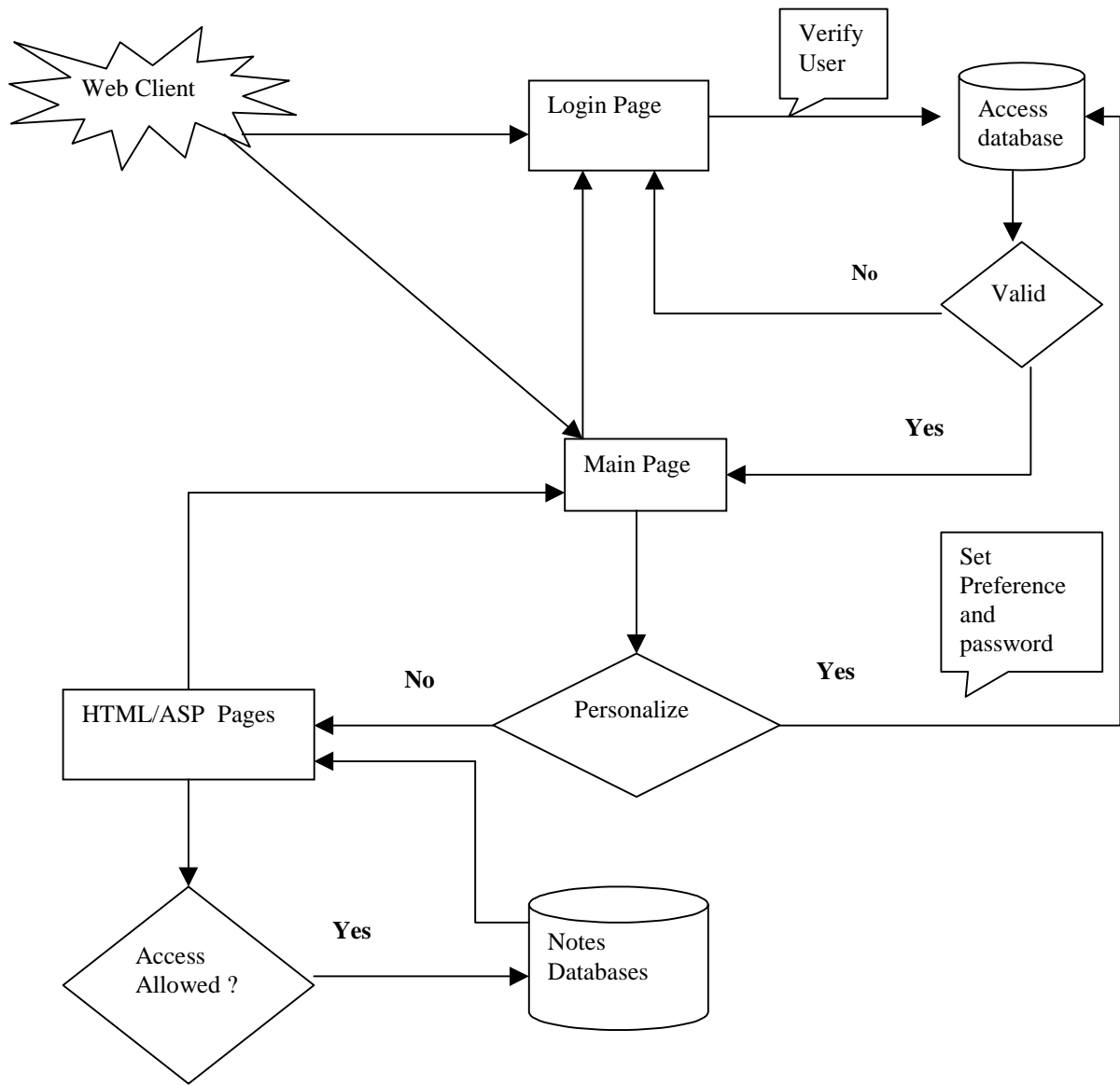
Web Client

Login Page

Verify
User

Access
database

No

Valid

Yes

Main Page

Set
Preference
and
password

Yes

No

Personalize

HTML/ASP Pages

Yes

Access
Allowed ?

Notes
Databases

Figure 5. The Authentication and Access Mechanism to Knowledge Point

7. Conclusion

We have described here the design and development of a knowledge management framework in PwC India. This framework is based on a conceptual model where various knowledge sources at the content level interact to realize an integrated knowledge network. Information technology is used here to realize an Intra-net-based framework that captures organizational structure and procedures and establishes linkages among all the documents. One of the important issues in this context is the maintenance of this knowledge network. This network resides in a dynamically changing environment and is subject to frequent changes and adaptations. The development of tools and methodologies for an efficient maintenance of this kind of network is thus a crucial research topic.

In particular, we identify two major maintenance-related questions:

- The insertion of new knowledge elements into any one of the entities in the knowledge-net requires establishment of appropriate linkage with other knowledge elements in other entities. Currently, this has been done manually by knowledge management group; however, we are investigating possible approaches to create these linkage automatically, using e.g. document analysis techniques.

- There need to be some mechanism to delete old and obsolete knowledge elements from the knowledge net. The size of the knowledge-net should not grow indefinitely.

Apart from having a good technical infrastructure, it is also important to have top management commitment, appropriate culture and measurability of improvements at every stage. Hence, knowledge management is more often a managerial issue than a technical issue. In order to sustain the effectiveness of a knowledge management framework, a culture of sharing information and knowledge needs to be developed within the organization. To ensure such a culture it is important to make people realize the importance of sharing information and helping each other. Integrating KM initiatives with the organizational processes and rewarding knowledge sharing & knowledge creation are two major steps towards this direction . Formation and development of special interest groups is also one time-tested approach to initiate such cultural change. This change is essential to ensure that individuals do not reinvent the wheel within the organization. Managerial challenge in developing special interest groups is to synchronize the objectives and goals of these groups with that of the organization.

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