CHAPTER - 4

Knowledge Management and e-Governance

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Chapter – 4

Knowledge Management and e-Governance

“Today’s Knowledge Systems are isolated monoliths characterised by high internal coupling... and a lack of external coupling interfaces...”  
Tom Gruber

“Potential stakeholders usually rely upon governance elements prior to investing their time, talent, and/or money.”  
— Robert E. Davis, IT Auditing: Assuring Information Assets Protection

4.1 Introduction

Although the term e-governance is primarily used to refer to the usage of IT to improve administrative efficiency, this is argued to produce other effects that would give rise to increased transparency and accountability of University processes and reflect on the relationship between University and stakeholders and help build new spaces for stakeholders to participate in their overall development.

e-Governance plays an important role in implementing Knowledge Management in any organization. Knowledge Management techniques and issues in Students Monitoring, Administration, Examinations, Staff management, Courses management, Cafeteria approach in selecting courses by students, Project Management, Maintenance of facilities, etc. are discussed and prototypes are developed in this chapter with an objective of making the University to reflect its status at the International level.

Every University makes every effort to achieve highest standard of excellence in academics, administration and operational Endeavour with the limited financial resources. They also try to attract best students by reducing the cost of administration and providing the best facilities of learning and research.
A graphical representation of the constitution of the University is shown in the Figure 4.1.

**Figure 4.1 : Constitution of University**

The knowledge in the above mentioned sections and departments of the University lies in different places that include the minds of people, manual files, electronic databases, reports, handbook and other documents. One has to find the methods, design tools to capture this knowledge.

It is high time that the Universities should reinvent themselves by providing student centric knowledge by integrating administration across all activities and providing knowledge in various areas via the Web.

e-Governance in any University includes technology that helps to build a system that combines administrative and management functions that are necessary for smooth functioning of the organization. This process requires automation of every section of an academic institution. The system should provide real time information processing and Knowledge Management. It should be an integrated system providing a platform for processing and maintenance of large volumes of information - including faculty, staff,
students, inventory, asset management, facility management, transport, library, payroll etc., of various sections and departments of the University. e-Governance system should be a single window system that incorporates complete data and processes of an educational institution, and makes the process straightforward, efficient and error less. The system should be user-friendly, time saving, cost saving and flexible enough to adapt varying educational environment efficiently and promptly. The stakeholders of any educational system expect high level of services. The students may not prefer to stand in a long queue for filling the forms, fees and other services offered by the University. Hence the Universities all over the world are thriving to establish a well balanced e-Governance system. Secondly, having an e-governance system in the University helps a lot in Knowledge Management. The adoption of e-Governance has become simpler due to technological advancements in ICT and it is expected that e-Governance will help in transparency, faster knowledge dissemination and improved services to the stakeholders.

E-Governance provides three basic change potentials for good governance[^48^]:

(i) Automation: Replacing current human-executed processes, which involve accepting, storing, processing, outputting or transmitting information with automated processes.

(ii) Informatisation: Supporting current human-executed information processes.

(iii) Transformation: Supporting new human-executed information processes.

These change potentials, in turn can bring governance that is cheaper, governance that does more, governance that works better, governance that is innovative.

In India e-Governance is being thought of sincerely and implemented at various sectors by the government at the National Level and State Level.

### 4.2. Benefits of E-Governance

E-governance in the University increases efficiency, transparency and accountability of administrative activities. It helps in appropriate and faster
access to services, and reduced costs for administrative services. Some of the e-Governance benefits are comprehended in the following ways:

- The connectivity of management, faculty members, students and administrative staff leads to enhanced efficiency in delivering services through faster dissemination of information.
- Human errors are minimized due to increased accountability and transparency.
- Equal opportunity to access information is provided to all the stakeholders removing distance barriers.
- Inter-departmental and intra-departmental exchange of information increases, which helps in considerable reduction of transaction costs, time, space, and manpower.

The goal of e-governance is to enhance good governance which is characterized by participation, transparency and accountability.

4.3. Challenges faced in implementing e-Governance

It is a fact that new changes are always resisted by the society at large. Initiation of e-Governance forces the methods to change and also the processes of providing deliverables also change. There are some factors that are really hurdles in implementing e-Governance, they include:

- Resistance from the Faculty, Staff & Students to accept the new environment
- Resistance from the decision making authorities (both internal & external)
- Technological challenges including bandwidth issues, hardware & software issues

The challenges faced by the human capital in the organization can be minimized training the stakeholder, educating them on the benefits of the system and awarding the staff on accepting the new change. As far as the technological changes are concerned, it is difficult to keep pace with current trends as the technology changes fast as far as computer hardware and software are concerned.
4.4. e-Governance in Indian Universities

The higher education value chain is depicted in the Figure 4.2 which shows that e-governance is required at every aspect to survive in the world of competition by providing hands on knowledge to each and every stakeholder.

The challenge faced by the Universities all over the world to produce skilled manpower is pressurising them to maintain and improve the quality of education. Indian Universities also are facing the same challenge as the funding agencies like UGC, AICTE, DST, DBT and state government have become stringent in disbursing funds. These agencies also have defined standards for a University to become eligible for funding. Hence an integrated e-governance system is the need of the hour to enable fast and timely retrieval of information at the University level, State level and National level.

![Figure 4.2: Higher Education Value Chain](image-url)
This system will help the governing bodies at various levels to analyse performance of students, faculty and staff to prepare for the betterment of the Education System. The system will also help in improving the operational efficiency for the processes like procurement of various certificates, status of grants, feedback mechanism, etc. The Universities are burdened with replication of procedures required by various agencies which leads to loss of time and resources.

On the contrary, a single window system should be in place which helps the agencies in fetching required information online without the intervention of the University authorities. Funding agencies generally take a very long time for approval even after timely submission of large number of documents. This may be due to the fact that the agencies take lot of time in analysing the performance of the Universities. The delay in getting funds leads to hurried utilization of funds and at times wastage of resources purchased from grants.

The e-Governance system will help to plan a better and timely use of funds. In India, more emphasis is being given for improving the quality of education and hence the accrediting bodies like NAAC are constituted. The Universities take a long time in sending their performance report in the predefined criteria and equal time is taken by the concerned body to evaluate and approve the reports sent by the University. This process can be made faster in case an appropriate e-Governance system is in place where submission is paperless and evaluation procedures at the other end are also paperless. The stakeholders like students, funding agencies, employers will also have an up to date knowledge on the accreditation status of the Universities. The e-Governance system also helps the employers to verify the student qualification online.

The e-Governance system will also help to cope up with the strategic challenges faced by the University. They include, improving the decline in the quality of education, updation of obsolete syllabus, increasing employability
and thereby improving the quality of higher education. The colleges which are not well known will be benefited the most as their presence at the national level is shown through this system. In order to have e-Governance system at the national level in India, it is needed that such system exists in each Indian University. There are certain inputs that are required from each University to build such a system. They include detailed information about University, students, faculty, funds allocation and utilization, courses offered, research projects, details of University-Industry interactions, etc.

The advantages of having such a system at University level includes knowledge about students’ performance, teachers’ performance, comparison of performances of various faculties, utilization of funds by different departments, etc. This system will also be beneficial for the decision makers at the University. At the National level, where the knowledge about all the Universities is integrated, the system helps to formulate strategies to improve quality of education, compare the performance of different Universities in terms of employment, funds utilization and other development. The feedback system should be intelligent enough so that critical issues in the Universities can be solved tactically.

4.5 Present Scenario of e-governance in Indian Universities

At the outset, we would describe the status of e-governance in Indian Universities in general and Sardar Patel University in particular. The e-Governance in Indian Universities is in the stage of infancy. But the funding agencies like UGC have been trying hard to grant funds for implementation of e-governance at the University level.

As Sardar Patel University is taken as a model for study, we have taken the example of state of governance in the University. For this, we take one University aspect from each section of the University, discuss the present state
and derive a model of e-governance that will help in Knowledge Management at various levels.

4.5.1 Academic Section

Admission Process

The main function of this Section is to give admissions to the Post Graduate Courses in the University. This Section invites applications from the students in the prescribed form on the recommendation of the authorised committee. The admission notice is advertised in the newspapers as well as the website (www.spuvvn.edu) of the University. Since the year 2012, the University has stopped selling the application forms and the students have to download from the website. The students in turn have to submit the duly filled application form with the prescribed fees and required copies of documents of proof to the University’s Academic Section. These forms are segregated by the Academic Section and sent to the respective departments for scrutinizing as per the eligibility criteria laid down by the University. These forms are then sent to the Computer Centre for data entry. The University has an Intranet based system called University Management Information System (UMIS) which carries out this task. Some of the screens of the system are shown in the Figure 4.3.

Figure 4.3 : Screen Shots of UMIS
The checklists are then sent again to the respective departments for verification and finally merit lists are prepared which are then published on the University website with the dates of counselling.

This process is time consuming and the partial e-governance is unable to disseminate the knowledge required by different categories of users at a given instance. During the study, it was found that at many places the redundant operations also were responsible for delay and increased cost of operations.

There are several other functions of the Academic Section like issuing of Migration Certificate, Provisional Eligibility Certificate, Final Eligibility Certificate, Transcripts, etc. where student and staff interaction is more. The absence of the system where the students can directly download the required documents after fulfilling the necessary formalities creates a big rush at the University.

**Disadvantages of the Existing System**

**Some of the disadvantages of the existing system are :**

1) **Searching the required Knowledge**: Keyword based searching has its limitations which include :
   - Unnecessary and unwanted knowledge is retrieved.
   - At times no knowledge is retrieved although it exists in the database /knowledge base.
   - The knowledge retrieved is inadequate and does not cover the entire system

2) **Extracting Knowledge**: Stakeholders have to spend their time and effort to extract knowledge from the retrieved documents. There is no mechanism in the existing systems like intelligent agents which can help the stakeholders.
3) **Knowledge/Information Maintenance**: No means to remove the inconsistencies of knowledge/information and remove the obsolete information.

4) **Restricting the Information Access**: Current system does not support restricting the access of information to the stakeholders if they are registered users of the system

Improving the state of affairs between the University and the stakeholders is a major challenge through e-governance programs of the University. Advancements in ICT help to provide platform for interaction between the University and its stakeholders through knowledge exchange. ICT enables and supports services by providing technological and computational framework. The present scenario of e-governance is heterogeneous and isolated systems due to lack of communication between the University administration and stakeholders. This has resulted in duplication and inconsistent information that gives inappropriate knowledge to the users of the system. Growing size of databases is also a constraint to provide right knowledge to the users. The University administration should be able to manage the knowledge that has to be passed on to the stakeholders. Hence we propose to use the concept of Semantic Technology in e-governance of the University which would help to have better Knowledge Management in the University governance.

The value proposition of semantic technology is to enable applications and the Web to expose more intelligent behaviour. Semantic technology adds meaning to the content in such a way that it becomes machine understandable[31]. Semantic technology encodes meanings separately from data and content files, and separately from application code[18]. This enables machines as well as people to understand, share and reasoning with them at execution time. With semantic technologies, adding, changing and implementing new relationships or interconnecting programs in a different way can be just as simple as changing the external model that these programs share. In traditional
Information Technology, meanings and relationships must be predefined and “hard wired” into data formats and the application program code at design time. This means that when something changes, previous information needs to be changed, or two programs need to interoperate in a new way, the humans must get involved. Off-line, the parties must define and communicate between them the knowledge needed to make the change, and then recode the data structures and program logic to accommodate it, and then apply these changes to the database and the application.

Semantic technologies are “meaning-centred”. They include tools for:

- auto recognition of topics and concepts,
- information and meaning extraction, and
- categorization

Given a question, semantic technologies can directly search topics, concepts, associations that span a vast number of sources. They also provide an abstraction layer above existing information technologies that enables bridging and interconnection of data, content, and processes. Second, from the portal perspective, semantic technologies can be thought of as a new level of depth that provides far more intelligent, capable, relevant, and responsive interaction than with information technologies alone.

Semantic Technologies are used to:

- Create a unique access point to aggregate heterogeneous and distributed resources
- Reuse and align existing ontologies, which enables data interoperability without in-depth knowledge of application
- Easily manage multilingual and heterogeneous information. To share data between web portals
- Customise the information, i.e. the portal according to the visitor context: language, audience type, preferences. Significantly enhance and facilitate archive access
Navigation and Discovery of new, potentially interesting facts «hidden» in the repository

- Enhanced metadata representation, including multiple file formats (not only music files with flat metadata, but including pictures, links, interviews and many other resources) helping journalists to faster produce better trailers and talk-through

- Ease of integration across multiple archives and resources in the nearby future.

- Simplify the editing interface by allowing the user to interact with RDFa mark-up

- Using linked open data principles to allow linking within the linked open data cloud

- Using content negotiation principles for ease of integration to 3rd party systems

- Enabling semantic annotation of resources by instructors and students

- Exploring relationships between resources, topics, people and annotations, stored as RDF, for the purposes of building recommendation systems

Semantic Technologies extract meaning from data ranging from quantitative data & text to video, voice and images. Many of these techniques have existed for years and are based on advance Statistics, Data Mining, Machine Learning and Knowledge Management. One reason they are gaining more interest is the renewed business requirement for monetizing information as a strategic asset[12].

4.6 University’s E-Governance through Semantic Technology: A New Approach

The services and the applications of e-governance in the Universities include access to, retrieval of, integration of and delivery of relevant information to the stakeholders of the system. E-governance enables the stakeholders of the University system to take advantage of the automated administrative processes
which are accessible online. The activities of University e-governance may vary from electronic exchange of information, services, financial transactions, etc. In order to use the semantic technologies to support the existing e-governance system of the University, the user has to consider the following points:

- In order to reconstruct the system using semantic technologies, the possible solutions for supporting the information provision and consumption through the semantic web should be found.
- The transformation should be analysed and compared by the administrators of the University.

Information processing and providing knowledge is the main function of e-governance applications. Using semantic technology for e-governance of the University forces to change the way of publishing the information on web based e-governance services of the University. This will help the users to find the services of their requirement in a better way. The semantic technologies have both the informational as well as functional aspects. The information unfolds its potential when machine agents are able to find relevant information while searching on behalf of the users. The functional aspect relates to the services that allow for automated identification, activation and combination of various functional resources wrapped as services.

The stakeholders may have requirement like:

- Search for content conceptually e.g. a University looking for opening a distant education centre at another University.
- A student looking for a particular type of course in the University in detail.
- A vendor who wants to submit the tender looks for the working days and time of the University.
- Knowledge sharing by the students, teachers and the society.
We present a conceptual layered architecture of e-governance of the University using semantic technologies. This architecture named as **UniEgov** (Figure 4.4) is divided into:

1. End User Layer
2. Trouble Shooting Layer
3. Service Requester Layer
4. Core Layer
5. Service Provider Layer

The proposed architecture is built using the following principles of semantic technologies. The principles are based on service oriented architecture, distributed environments, semantic principle and problem solving principle which help in intelligent and seamless integration of services provided by the University. These principles also add value to e-governance domain of the University. The Service Oriented Principle is based on principles of service reusability, abstraction, loose coupling autonomy, composability and discoverability. Semantic principle helps in describing the information and behavioural models by means of logical reasoning. The combination of service oriented principle and semantic principle allows to define scalable, semantically rich and formal service models and ontologies that allow automation of tasks like service discovery, contracting, negotiation, mediation, composition and invocation. Problem solving principle is based on goal based discovery and invocation where the problems presented by the users are semantically presented as goals which are independent from services. This architecture will solve the goals using logical reasoning. The feature of distributed principle helps in working collaboratively across the network but the output appears as coming from a single process\textsuperscript{[42]}.

The stakeholders of the University e-governance include students, teachers and administrative staff, funding agencies, suppliers of various items, other institutions including affiliated institution, industries, etc. The consumers of the
e-governance services provided by the University include all the stakeholders as mentioned. At the same time the administrators and teachers become the domain experts who manage, create and maintain the e-governance services. The users of the system include the stakeholders and the software professionals who are responsible for making amendments in the applications of e-governance. The e-governance system consists of applications that support in transformation of problems in to required knowledge.

The troubleshooting layer is responsible to solve the requests of the stakeholders. This layer consists of the back end systems, specialized applications and development tools. In our study we consider the existing University Management System to be used as backend system with various applications related to the University. The development tools should provide an environment that support semantic technologies like creation & management of ontologies, web services, goals and mediators, mediation mappings and deployment at the core layer.

The service requester layer is the client where the requests are presented and they communicate with the services. The core layer provides the main intelligence for integration and interoperation of University e-Governance services. It provides a Semantic Execution Environment (SEE). It is the mission of the Semantic Execution Environment (SEE) unit to create an execution environment for the dynamic discovery, selection, mediation, invocation and inter-operation of Semantic Web Services.

The Semantic execution environment is suggested by OASIS Semantic Execution Environment Committee with reference\textsuperscript{29} to WSMX\textsuperscript{28}. As per OASIS SEE TC, the Semantic Execution Environment consists of three layers, namely Vertical Layer, Broker Layer and Base Layer. The vertical layer defines the framework functionality used by the broker layer and base layer. The broker layer defines the functionality required for goal-based invocation of
semantic web services. It includes discovery, orchestration, monitoring, and fault handling services, adaptation, mediation, composition, and grounding. The base layer defines functionality required by the broker layer which includes formal languages, reasoning, storage & communication.

The technology of Semantic Web services (SWSs) envisions easy access to various systems and facilitates the consumption of the functionality exposed by these systems on the web. Seamless integration, ad-hoc cooperation between various business parties or dynamic collaborations on the Web, can be achieved only if tools for handling semantically enhanced services are provided.

Figure 4.4 : UniEgov – A Conceptual Architecture

4.7 Transition from Traditional Web Based Systems to Semantic Web Step by Step :

Transition from traditional e-governance system (in our case built on Linux platform using Java tools and backend as MySql) to semantic web based system is not possible in a single step. In the semantic e-governance, the
administrators become the knowledge providers. For moving on the Semantic e-governance environment for any type of application in general and University e-governance in particular, we list out the following steps:

**4.7.1 Identify the information needs of the users which will be disseminated in the form of knowledge:**

The knowledge required by the stakeholders/consumers must be identified either from the offline transactions or the existing information systems. This will help in applying focus on the goals by the University administration. The input to this process can be forms, brochures, leaflets which can be transformed into structured table. We describe a scenario where a student wishes to take admission to an undergraduate program of science, say B.Sc. offered by around 50 affiliated colleges of the University. We convert this requirement into a structured table (Table 4.1) as follows:

<table>
<thead>
<tr>
<th>Goal : Aim of the user</th>
<th>Corresponding service</th>
</tr>
</thead>
</table>
| Get admission to an undergraduate course offered by a Science college | Name : Admission to an undergraduate course  
**Description** : Grant admission if the student fulfils the eligibility criteria  
Responsible : Concerned College office  
**Admission Fees** : Rs. 5000/- for grant-in-aid college and Rs. 50,000/- for self-financed college. |

The goals of the users and required quality of knowledge to be provided to them should be planned in advance so that they can be used for guiding and planning the evaluation of the system from the beginning. The list of goals
thus described in tables will be used to design the formal semantic structures and software components for service delivery.

4.7.2 Establish and Maintain a Common Conceptual Ground:

After identifying informational needs a common conceptual ground needs to be established. This step includes design of new standards, identify existing standards that can be reused. Here, the rules related to University e-governance are considered.

Taking the contents of Table 4.1 as input, we construct a glossary that will include all relevant topics and terms related to the service. This will help in providing the common understanding of all the actors leading to more structured and formal descriptions. This step helps in identifying the general domain concepts of a set-up. Now we create another table (Table 4.2) which contains description of terms and their relations.

Table 4.2: Category Document from University e-Governance controlled vocabulary

<table>
<thead>
<tr>
<th>Category</th>
<th>Document</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subcategory</td>
<td>Forms (admission, application, tender, examination, reassessment, etc), Certificates (migration, eligibility, results sheet, etc.), Payment Receipts (admission fees, examination fees, tender fess, etc), Notifications</td>
</tr>
<tr>
<td>Attributes</td>
<td>Title, Description of purpose</td>
</tr>
<tr>
<td>Description</td>
<td>Used for the concepts that refer to the objects such as certificates provided the University, forms to be filled in by the users (students, teachers, vendors, etc.), notifications are issued by the University to inform the users about the change in status, payment receipt which a user receives after payment</td>
</tr>
</tbody>
</table>
Table 4.2 will help us in arriving at a conceptual model (Figure 4.5) that consists of set of concepts, description of the concepts, their relationships and provide a common understanding all actors.

![Conceptual Model Diagram]

**Figure 4.5 : A Part of Conceptual Model for UniEgov System**

We have taken the concept UniEgov from the Access-eGov system\(^{47}\). This conceptual model can be then converted to semantic web representation. The standards available on the web may be reused which are explicitly defined for a specific domain.

### 4.7.3 Annotate the Services and Web Resources

Annotation is about attaching names, attributes, comments, descriptions, etc. to a document or to a selected part in a text. It provides additional information (metadata) about an existing piece of data. Semantic Annotation enriches the unstructured or semi-structured data with a context that is further linked to the
structured knowledge of a domain. It allows results that are not explicitly related to the original search. Semantic Annotation helps to bridge the ambiguity of the natural language when expressing notions and their computational representation in a formal language. By telling a computer how data items are related and how these relations can be evaluated automatically, it becomes possible to process complex filter and search operations.

Applications should be developed to annotate the existing web resources so that they are available to the users and also to the semantic agents for processing. An understanding of common conceptual ground would help the service provider/administrator to annotate the services. Semantic annotation helps to describe the web page semantically in a machine readable way. Many annotating tools are available that help for semantic annotation, e.g. Ontotext, Domeo, Cerno.

4.7.4 Process Information with Semantic Technology
For automated processing using semantic technology, some standards are already defined in the semantic web technology stack. They include:

i) A flexible data model (e.g. RDF)

ii) Schema & Ontology Language for describing concepts and relationships (e.g. RDFs & OWL)

iii) A query language (SPARQL)

iv) A language for marking up data inside web pages (RDFa)

The first step, as already discussed in previous sections is to have a common conceptual model in order to develop a domain-specific standard. The technical standards laid down by the semantic web technologies should be used to implement domain-specific standards in machine readable form. The software components built on this platform will have integration at technical and semantic level. The developers can use the already existing standards like WSMO, extend the existing standards or develop new standards. There are
various standards for developing ontologies like OWL (Web Ontology Language) but we suggest using WSMO as it has a better execution environment.

![Semantic Web Technology Standards](image)

**Figure 4.6 : Semantic Web Technology Standards**

We leave the option of choosing tools and technologies to the developers. Moreover it all depends on the type of backend the organization has in the form of applications.

**4.7.5 Create an Interface: A Portal**

One can take the advantage of semantic technologies only when maximum data and services are published using Semantic Web Standards. Semantic web search engines which are very few at present would be able to locate and process the semantically annotated information.

An attractive and user-friendly interface is essentially required to promote acceptance. We take an example of admission service that is provided by the University. We provide a personal assistant to the student that will communicate with the core layer to provide knowledge or an expert advice to
the student. This assistant should provide quality knowledge to the user and it should be in the structured form. The knowledge provided should be correct.

4.8 Challenges of using Semantic Technologies

To transform the existing information system into semantic web based system depends on the willingness of the University administrators. The first and foremost challenge is to decide a starting point of using semantic technologies. Major challenge lies in identifying the informational needs of the stakeholders. The University provides a variety of services which requires a substantial effort for annotation and restructuring of existing resources. The information providers are the administrators and faculty members who are experts in their field need to be trained on usage of IT semantic technologies. Upgrading the existing systems requires upgradation of IT infrastructure. This also is a major challenge. Moving towards semantic web is not an individual effort. It’s a challenging task to work in a heterogeneous group.

4.9 Conclusion

The main aim of our study is to manage knowledge in the University through e-governance in the heterogeneous environment. Knowledge can be disseminated in a better way if it is stored properly. The existing model of e-governance that is developed under the researchers’ guidance has several disadvantages. Hence it was decided to suggest a theoretical framework which can be implemented using Semantic Web Technologies. This framework will act as prototype architecture for building the actual system. We have suggested some tools but the developers may take up the tools of their choice.

Transforming Information Systems into Semantic Systems is a Herculean task but not an impossible one. This is a best suited technology for integrating heterogeneous environments.