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Dimensions of Interoperability for an Effective Portal

Rakhi Tripathi^{1*}, M.P. Gupta¹ and Jaijit Bhattacharya¹

ABSTRACT

As the level of e-government maturity in India is increasing the need for interoperability is also increasing. Currently, few departments of the government of India are working on integration and are in the process of adopting the technology of interoperability. A model is proposed to evaluate the position of Government portal of India in a technology adoption space by evaluating its current level of integration sophistication. The model identifies critical factors necessary for the successful adoption of interoperability technology along three dimensions of integration—process integration, technological integration and data integration. To get to the integration sophistication a questionnaire has been developed that includes all the three dimensions. A survey on this questionnaire will be further conducted.

1. Introduction

The corporate portal provides companies with competitive advantage, since it is able to unlock valuable and strategic information, for a long time hidden in the enterprise systems Shilakes and Tylman (1998). Having this integrated information system, companies become more proactive, agile, competitive and capable of executing better performance analysis, market segmentation studies, forecasting, etc. In the same way a Government portal is required so that the connection with citizens become stronger. And for this interoperability is essential.

The adoption of a new technology such as Interoperability involves a proper assessment of the status of integration (process integration, data integration and technical integration) within the government. Therefore, identifying the factors relevant to the adoption of interoperability by the government and provide an estimate of the potential resources that would be needed by the adoption. The higher the level of integration of an organization, the lesser the resources needed to adopt the interoperability technology.

This paper now talks about the factors that will help in finding the sophistication level of integration and hence will give the interoperability point.

2. Factors coming in its way to effective one-stop-portal

There are certain factors due to which it becomes hard for any organization to achieve an effective portal.

Lack of financial resources: One of the most critical factors is financial factor. Without a proper financial backup even a good plan will fail. To come up with an effective portal a strong financial support is required

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whether it's for manpower, machinery or connection speed.

Lack of qualified manpower: There is an issue in finding certified, specialised and talented manpower. For the development of portal the organization/ department requires manpower with Information Technology background and also good managerial skills. A skilled person with an experience in developing portal can easily understand the requirements of the portal and also can help in adopting new technologies.

Lack of clarity of the strategic goals: Every organization should be clear with its goals. Lack of clarity will lead to an improper infrastructure which will further lead to unsatisfactory results. Development of portal has various stages (Layne and Lee, 2001) and hence, the organization should know at what stage their portal is at and where next it needs to go and finally where the portal has to reach. This requires a proper strategic plan.

Lack of top level management support: Many authors suggest that leadership commitment is a key challenge for the success of any knowledge management initiative (Nonaka & Takeuchi, 1995). If management spends a significant amount of resources on either purchasing or developing and implementing such technology, employees could interpret this as a sign of management's support for this ideal, and act accordingly. However, as Martinsons (1991) acknowledges, if employees perceive that management is not very committed to implementing this new technology, then the initiative to promote a strong knowledge sharing culture is not likely to be successful.

Lack of efforts to promote the utility of portal among users: If the users are unaware of the services provided by the portal then the portal will not be fully utilized. Efforts should be applied to promote the portal's utility among its respective users.

Lack of motivation among different departments: To achieve one-stop portal, vertical as well as horizontal integration among departments is required so that the information can flow from one department to other. For this not only technical details are needed but also a full support from various departments is essential.

Poor design: Frequently, technology is not designed for the work people actually do but rather for the work technologies think they should do (Hickins, 1999). In a portal's perspective the main focus of the portal should be to serve the citizens. Therefore it should be designed in such a way that the citizens are able to understand it, they are not misled and it should save citizens time.

Low level of IT maturity: If the level of IT maturity is high then fewer efforts are required to achieve a one-stop portal as high IT maturity means higher user awareness, good IT planning, good IT usage history etc. (Banbasat et. al, 1980). And if the level of IT maturity is low then more efforts are required to achieve one-stop portal.

Security apprehensions: For any portal security is one of the biggest concerns. Portal can be attacked from outside i.e. intruders and also can be misused by the authorized users. To handle both the situations good security systems should be available. At each level security should be given a priority whether the portal is providing only information or is providing services to the citizens.

Lack of flexibility in the existing technology: Flexibility is defined as the degree to which an organization possesses a variety of actual and potential procedures, and the rapidity by which it can implement these procedures to increase the control capability of the management and improve the controllability of the organization over its environment (Leeuw & Volberda, 1996). Therefore, high flexibility corresponds to high control of an organization with respect to its environment. The technology used in the portal should be flexible i.e. it should be compatible with the other existing technologies, should be easily upgraded as and

when needed, should be compatible with open standards etc.

Poor usability: People will only use technology if it provides: an easy way to locate the information they need; effective interfaces; and quality service delivery (Griffiths, 1999). Hence, the portal should provide appropriate information to the citizens/users. It should not confuse the users by linking or opening many windows. The citizens/users must be able to use the services easily provided by the portal. It should be possible for customers to access public services via a single entry point even if these services are actually provided by different departments or authorities. Customers should be able to access these services in terms of “life-events” and without knowledge of the functional fragmentation of the respective public authorities. (Wimmer and Krenner, 2001)

Social Issue: The level of trust that exists between the organization, its sub-units, and its employees greatly influences the amount of knowledge that flows both between individuals and from individuals into the firm’s portal (DeLong & Fahey, 2000). Therefore, attention should be paid to the supporting norms and behavioural practices that manifest trust as an important organizational value. In an organization with a positive social interaction culture, in which both management and employees socialize and interact frequently with each other, people would share their knowledge; while in an organization that promotes individualistic behaviours people will be more reluctant to give away their most valuable knowledge because they will feel it too risky.

Integration: The ability to present a unified view of corporate information that integrates information from different organizational repositories instead of having corporate information spread across many sources within the organization (Benbya et. al (2004)).

3. Data Integration

A proper data centre is in plan: In Government there are multiple diverse data sources: Unstructured data that lies in the form of rules, procedures and concepts, guidelines etc; Data referring to facts and figures treated as operational idea; and Structured data which is derived from information that can be stored in computerized form database and further be used for decision making (Gupta et. al, 2005). To handle this proper data centre is required.

A proper architecture to combine data residing at different sources and providing the user with a unified view of that data: As mentioned earlier, in government there are multiple data sources. Once a proper data centre is planned then there is a need to integrate all the data so that the user can have a unified view. For this, architecture is required where all the different databases from different departments are well connected and are interoperable.

A regular update of the data which is stored and connected with different databases: The data in Government departments keeps on changing. For example: number of births, deaths, change in addresses etc. To maintain this change a regular update of the database is required. Updating requires both personnel as well as technology (software etc.).

New technology (software, versions) is compatible with the all the existing different data bases: Every department (which maintains databases) uses technology that may not be the same of other department. For example: one department is using windows XP (operating system) with some database and other department is using MAC (Operation system) with database of other format. Then there should be compatibility in the technologies so that these departments can integrate their databases easily. If the technologies are not compatible then it will not only cost but will consume time.

Once the user enters a query to the portal the information reaches the back office instantly: When a user visits a one-stop portal and enters a query/information then that query should reach the back office where all the various departments are integrated and user should get the information instantly. For example: If a citizen submits change of address then this information should instantly go to the back office where the departments of passport, ration card etc. are integrated and hence, the citizen's information is updated at each department at once.

Ontology is used to effectively combine data/information from multiple heterogeneous sources: Ontology is made capable to 'describe metadata' in order to build one complete glossary that will clearly define the data found in the World Wide Web (Weng and Tsai, 2006). The reason ontologies are becoming so popular is largely due to what they promise: a shared and common understanding of some domain that can be communicated between people and application systems (Ding et. al, 2001). The aim of ontology is categorizing knowledge in domain and its development is often a cooperative process involving different people, possibly at different locations topic investigated by several technological research communities.

Adequate measures are taken for data security in the data centre: For security purposes, the portal must support cryptography, authentication, firewalls, etc. to safeguard corporate information and prevent unauthorized access. The ability to secure access to diverse range of resources with incompatible security controls is an enormous challenge for corporate portals.

Open standards are being used to reduce the risk of vendor lock-in and also help to guarantee data preservation: Three key characteristics of open standards identified by Coyle (2002) are 1) that anyone can use the standards to develop software, 2) anyone can acquire the standards for free or without a significant cost, and 3) the standard has been developed in a way in which anyone can participate. When a standard has the first two of these characteristics (the ability to use the standard and to obtain it with out a significant cost) it can be said to be an open standard in an utility sense. That is to say that an open standard is a standard that is not encumbered by a patent, does not require proprietary software, and can be utilized by anyone without cost. Proprietary standards can sometimes be expensive and it may be cost prohibited to purchase access to a proprietary standard if it is ever needed. The use of open standards can help assure interoperability of diverse systems. There are various software packages that are being used to create digital libraries, online library catalogs, and other resources that libraries relay on. These various systems need to be able to interact in order to provide the best possible service to patrons. The way to make certain that these diverse systems, and any future systems, can communicate with each other is by using open standards to help achieve the "free flow of information through interoperability" (The Open Group 2005).

Uses Message Formatting Language (format of data messages and business documents that can be exchanged between applications): The Message Formatting Language is used to define the format of data messages and business documents that can be exchanged between applications. This includes defining the standards for the data exchange between the parties. The involved parties can be the internal Government agencies as well as outside agencies.

Data Replication: Data replication is a process of maintaining a defined set of data in more than one location. It involves copying designated changes from one location (a source) to another (a target), and synchronizing the data in both locations. Data replication provides support for automated real time data synchronization enabling locality of access for data access regardless of source implementation. Earlier Data replication was used to exchange data between homogeneous data management system. Now the new standards are emerging to facilitate the Data replication between heterogeneous systems. Some of the approaches and standards used are ANSI SQL based interface, In addition messaging middleware based solution is being used for data replication using XML interface for the data exchange.

Data Transformation: Both structured and unstructured data must often undergo considerable transformation before it can be used by applications. Data transformation enables the translation of data information to support data cleansing and metadata interchange through leveraging industry standards. Some of the open standards that facilitate data transformation are: ANSI SQL, XML. EDI standards: UN/EDIFACT, including ANSI X.12

Message Formatting Language: The Message Formatting Language is used to define the format of data messages and business documents that can be exchanged between applications. This includes defining the standards for the data exchange between the parties. The involved parties can be the internal Government agencies as well as outside agencies.

Data Modelling: Data Modelling defines the conventions to be used for representation of system and data models among all the internal government departments. Data modelling is used to provide the conceptual design primarily for human interpretation. UML (Unified Modelling Language) is the most widely used standard for defining and exchanging the data schema and data model. UML has been supported by lots of case tools, designing tools and software testing products.

Data Resource Description: Data Resource Description defines the language for representing metadata. Metadata commonly defined as data about data, relates to a set of attributes that will capture the semantics of individual data items. Each element contains information related to a particular aspect of the information resource and metadata describes the technical aspects of information resources. Use of the IFEG metadata standards is essential if data is to be truly interoperable. The Resource Description Framework (RDF) is an evolving metadata framework that provides a degree of semantic interoperability among applications that exchange machine-understandable metadata on the Web. RDF allows multiple metadata schemes to be read by humans as well as parsed by machines. It uses XML to express structure thereby allowing metadata communities to define the actual semantics.

4. Process Integration

Proper set of efficient processes are formed for the portal: Processes in Government have played an important role in enabling application integration and collaboration across multiple organizations. The integration can be categorized into two types: internal integration and external integration. Internal integration includes all the integration aspects within one organization. Enterprise application integration (EAI) is a typical example of internal integration. External integration covers all the possible integration patterns across multiple enterprises. All these processes need to be formed and organized.

The processes are connected with the back office and the front desk: Integration of all the processes whether internal or external involved in a portal is required. When the citizen enters portal he should get a single view and the desired information. For this all the processes should be integrated both at back office as well as front office.

The processes are being upgraded regularly and new technology is being applied to do so: Once the processes are formed and further integrated, there is a need for updating the processes. Like data, the processes also keep on changing in Government and so updating of processes is required. For an example: In a department information was flowing vertically and then later the information also started to flow horizontally (the department got integrated with another department). Therefore, the process has changed.

Reusable Software Components: Software reuse is the process of implementing or updating software systems using existing software assets (DoD, 1996). A good software reuse process facilitates the increase of productivity, quality, and reliability, and the decrease of costs and implementation time. An initial

investment is required to start a software reuse process, but that investment pays for itself in a few reuses. In short, the development of a reuse process and repository produces a base of knowledge that improves in quality after every reuse, minimizing the amount of development work required for future projects, and ultimately reducing the risk of new projects that are based on repository knowledge.

The architecture for combining different processes has a middleware: Middleware allows the semantic description, publishing and updating of life events in order to provide citizens with an up-to-date and personalized list of available services; allows the description, identification, instantiation and invocation of services (Gugliotta et. al, 2005). It is not necessary to have a middleware as there are other programs also available that have both middleware and back office integration altogether.

Message-oriented Middleware (MOM) Brokering software that facilitates inter-application communication: Relies on asynchronous message passing between applications to facilitate inter-application communication. Message-oriented middleware enables applications to package their business information as messages, which are handled by the message-oriented middleware. MOM takes care of distributing messages to where they are needed, thus removing the need to write complex networking code. Brokering software can further enhance the flow and distribution of information by enabling the transformation and intelligent routing of messages without the need to change either the applications that are generating the messages or the applications that are consuming them.

5. Communication Integration

Powerful network architecture for the portal: Network architecture is the design of a computer network. It includes the design principles, physical configuration, functional organization, operational procedures, and data formats used as the bases for the design, construction, modification, and operation of a communications network. It outlines the products and services required in data communication networks. For a one-stop portal that needs to be interoperable, must have strong network architecture.

A good speed of connectivity (bandwidth): Bandwidth is a rate of data transfer, or bit rate, measured in bits per second. In government where there is enormous data which not only needs to be stored but also needs to be shared. For a portal to handle such huge data requires a high speed of connectivity so that the information can flow very effectively and reaches the user on time. For example: if a department wants to download/upload a form from another department and the connection is very slow then it will waste a lot of time.

Quality of services (delay and loss of packets) is being provided: A communications network transport a multitude of applications and data, including high-quality video and delay-sensitive data such as real-time voice. Networks must provide secure, predictable, measurable, and sometimes guaranteed services. Achieving the required Quality of Service (QoS) by managing the delay, delay variation (jitter), bandwidth, and packet loss parameters on a network becomes essential. Thus, QoS is the set of techniques to manage network resources (CISCO).

Deployment of web and internet technologies in all departments of the Government: Governments worldwide are increasingly using the Internet to provide public services to their constituents (Layne & Lee, 2001). Much of the research has focused on practical and technical dimensions while research on how to improve e-government for users remains scarce (Bertot & Jaeger, 2006). Web-based technologies offer governments more efficient and effective means than traditional physical channels to better serve their citizens (Evans & Yen, 2006).

Compatibility of the existing technologies: Technical compatibility corresponds to the extent of fit of the

new technology with existing data and telecommunications infrastructure (Lin and Lin, 2008). Kwon and Zmud (1987) concluded that incompatibility of new technologies with existing values and work practices is one of the greatest inhibitors in IS implementation. Thus, when firms perceive e-business as compatible with existing beliefs and work practices, they are more likely to be positively predisposed to promoting its successful diffusion.

Private lease lines for the portal are provided: Private lease lines not only increases the speed of the network but also are more secured. The confidential information can be shared in a better way. On the other hand it is expensive.

Backup of main server(s) is provided where all the information is being stored: A backbone network for the Government requires all kinds of servers (mail servers etc.) that contain most of the information. Backup of these servers is required as if one of the servers fail due to any reason (power failure, hardware crashed etc.) then immediately the information can be saved. Especially in case of a one-stop portal backup is essential as it is a 24 hour connection with the users.

Security of the main server(s) is being taken care of: Another concern for the servers involved with the portals is their security. According to Straub and Nance (1990), people frequently misuse hardware, programs, data, and computer services. Each has specific risks that involves the *vulnerability* of IS assets to attacks from *IS threats*, where a “vulnerability” can affect an IS asset negatively (Rainer et. al., 1991).

Adopted XML as the primary standard for data integration and presentation tools for all public domain information systems: The UK's e-Government Interoperability Framework (e-GIF) "sets out the government's technical policies and standards for achieving interoperability and information systems coherence across the public sector. The e-GIF defines the essential pre-requisite for joined-up and web enabled government. It is a cornerstone policy in the overall e-government strategy." One of the three key policy decisions in the UK 'e-GIF' program is identified as the "adoption of XML as the primary standard for data integration and presentation on all public sector systems...the adoption of XML (Extensible Markup Language) and XSL (Extensible Stylesheet Language) form the cornerstone of the government data interoperability and integration strategy."

Uses standard protocol to allow a CORBA-based program to interoperate with the same or another vendor, on almost any other computer, operating system, programming language, and network: The Common Object Request Broker Architecture (CORBA) has been proposed as a standard by the Object Management Group (OMG) (Geraghty et. al, 1999) and (Henning and Vinoski, 2001). CORBA is middleware that enables interoperability and supports distributed object computing.

Supporting applications are designed intelligent enough to convert the contents to a format understandable by the multiple access devices/channel (Mobile etc.) by users: These days internet is not limited to computers only. One can access the internet through mobiles, PDAs etc also. Therefore, applications that can support all the formats are becoming essential. This will not only make the portal flexible but also reachable to most of the citizens.

Network Layer Security: Network layer security standards deal with the security at the network level. These standards are relevant when for implementing virtual private network (VPN) and secure remote access. The most common standard used for this is Internet Protocol Security (IP sec), which provides a mechanism for securing IP. It is the security standard at the network layer for communication.

6. Interoperability

Klischewski and Scholl define integration as “the forming of a (temporary or permanent) larger unit of government entities for the purpose of merging processes [and systems,] and/or sharing information” [1]. The European Commission has defined interoperability as “the means by which the inter-linking of systems, information and ways of working, whether within or between administrations, nationally or across Europe, or with the enterprise sector, occurs” [2]. Klischewski and Scholl further stress that systems and applications that interoperate are characterized by the following aspects: independency, heterogeneity, and control by different jurisdictions/administrations or by external actors; yet also cooperation in a predefined and agreed upon fashion [1]. Likewise, Wimmer et al stress that interoperation can only be reached by means of open standards [3], whereby interoperation needs to be addressed on technical, semantic and organizational level alike (cf.[2] and [3]). Therefore, following questions are formed to know the status of interoperability in India:

Coherent exchange of information and services between departments of the Government: There are departments in the Government that are not inter-related and hence no interoperability between them is required between them. But for the departments that are related (example: Land Department and Revenue Department, Transport Department and Traffic Court, etc.) require interoperability i.e. the information and services need to be exchanged.

Back office interoperability is available: If a portal is one-stop then information from a citizen will go at the back office and be updated. At the back office all the inter-related departments will be vertically and horizontally integrated and hence the information will be interoperable.

A query for one department can be answered by another department from back office: If there is back office interoperability then is it possible that if a query entered by a citizen for department A can be answered by department B? For example: A citizen enters ‘change in address’ at the passport office. Then at the back office where all the other departments (like transport department, ration etc.) are integrated automatically update the change of address of the citizen and hence, the citizen need not go to all the departments to change the address.

Follows legal compliance required to adopt interoperability: There are legal compliances that need to be followed to adopt interoperability. The legal compliance certification is a five-step process, each following the other. The first step is to define the key responsibility area and mapping the flow of compliance activities between departments and thereby determine the key responsibility area. This mapping removes any ambiguity in compliance. Training the company officials by domain experts, normally a third party service provider, follows this. The third step is to install controls for compliance and assessment of the same through third parties. The management's commitment to compliance is measured through external standards. And, finally, a company is issued the legal compliance certification (Sai Chandravadhan, general manager, legal compliance management, Chess Management Services Private Ltd).

Follows accessibility standards for disabled persons like W3C's Web Content Accessibility Guidelines 1.0 (WCAG 1.0): Web Content Accessibility Guidelines (WCAG) 1.0 (W3C) were defined by W3C as a set of 14 guidelines and 65 checkpoints that Web pages should accomplish in order to be accessible to people with disabilities, people using alternative browsers, or even Web agents, as shown at (Centeno et. al., 2004). However, they were defined using fuzzy, ambiguous and subjective terms not being so much focused on the underlying HTML format (Centeno et. al., 2006).

Use of Web Services to support interoperability via XML-based industry standards, including SOAP, UDDI and WSDL: A wide range of services that the firm can provide to users ranging from analyses, news to an

e-marketplace where a company offers employees discounts on products and services that it has negotiated with vendors. Support interoperability via XML-based industry standards, including SOAP, UDDI and WSDL. Simple object access protocol (SOAP) is an XML standard for transmitting service request, responses and notifications. Universal description, discovery and integration (UDDI) is an XML standard for accessing a service registry. WSDL allows the definition of a service to be shared between software development tools, as well as runtimes, from different vendors. Web services can interoperate over many different transport protocols, including HTTP Internet protocol. The HTTP protocol offers a common way of connecting middleware from different vendors.

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