Submitted on: 22 July 2014

Cloud Computing and Information Technology Governance Supporting the Digital Library Strategy

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Abstract:

This paper is dedicated to the study of the role of Information Technology Governance in Digital Library Cloud Computing Strategy and its structures, processes and relational mechanisms to control the formulation and implementation of IT strategy and in this way to help the Digital Libraries to prepare themselves to take advantage of the IT Cloud Computing Infrastructure to support the Library operational mode in the digital environment. For many Digital Libraries, the increasing availability of technologies has shown an ambiguity in their management. The study is done based on the dynamics of ICTs and the ability to generate innovations with a direct impact on the services provided by the Library. It is necessary to professionalize and classify the decision-making processes and provide the commitment, setting priorities for investment, monitoring IT contribution to the operation of the Digital Library as well as to demonstrate results that can be understood by the Library manager. The correct investment in IT has been pressured for tangible and sustainable results and the management of IT resources is essential to the Digital Library. Analyzing the organizational models of Libraries that stand out in the use of technology, the study points out the best practices on three key aspects to an effective organization of IT: defining the most appropriate organizational structure, functions and critical competencies that should be centralized and governance for investments in technology. The paper studies how the cloud computing approach can help to increase the productivity of the Library and the main challenges that the Digital Library will have to face in relation to the management of their computing environments, aiming to achieve high quality of services, productivity, and develop agile environments that allow the Library to meet the demands of governance and digital information management.

Keywords: *Cloud Computing, Digital Library, Information Technology Governance, IT Lifecycle Management, Innovation, Information Users.*

1 INTRODUCTION

The Internet is entering a new phase that represents a fundamental shift in how computing is done. This phase, called cloud computing, includes activities such as Web 2.0, web services, the Grid, and Software as a Service (SaaS), which are enabling users to tap data and software residing on the Internet, rather than on a personal computer or a local server. Some leading technologists have forecast that within five to ten years more than half of the world's computing and data storage will occur "in the Cloud. Although the shift toward the Cloud is clear, the shape of the Cloud—its technical, legal, economic, and security details—is not. Public policy decisions will be critical in determining the pace of development as well as the characteristics of the Cloud (Nelson, 2009).

According to IFLA/UNESCO Manifesto for Digital Libraries, the dissemination of information enables citizens to participate in life-long learning and education. Information about the world's achievements allows everyone to participate constructively in the development of their own social environment. Equal access to the cultural and scientific heritage of mankind is every person's right and helps promote learning and understanding of the richness and diversity of the world, not only for the present generation, but also for the generations to come. Libraries have long been essential agents in fostering peace and human values. Libraries now operate digitally, and their digital services open up a new channel to the universe of knowledge and information, connecting cultures across geographical and social boundaries.

For many Digital Libraries, the increasing availability of technologies has shown an ambiguity in their management. The management and support of these complex and heterogeneous environments - full of different PCs, desktops and laptops, mobile and wireless devices, printers, networks and applications - have demonstrably proven difficult and expensive for the departments of Information Technology.

According to OECD (2010), cloud computing should strengthen demand for ICT specialists but it is likely to have more impact on value added and growth than on employment. In 2008 the term "cloud computing" became fashionable as a way to refer to a number of interlinked information technology trends. There are a number of competing interpretations of what cloud computing is about, but in its simplest formulation the expression refers to the provision of computing resources at a distance, over the Internet. This would hardly seem to be a novel concept, and indeed it harkens back in some respects to the early days of computing with big mainframes doing the computing work for remote users at work stations. Yet the term is suggestive of important shifts in IT, which may bring economic, policy and possibly regulatory implications. The Information and Communication Technologies (ICTs) play an important and growing role in world economy, and organizations, industries and governments are getting increasing benefits from their continuous investments in ICTs, as well as from a wider use of the Internet in a knowledge-based economy. ICTs have stimulated innovation in services, increased the efficiency of production and creation, and at the same time, facilitated the management of inventories and administrative costs. It was a catalyst of changes in organizations, improving the organization of work, helping organizations to reduce the cost of their routine transactions and streamlining their supply chains. So crucial, ICTs, especially when associated with the raise of the level of skills and organizational change, apparently seem to support the improvement of productivity within enterprises, both in new sectors and in traditional branches. Such benefits have long term

effects and will continue to develop, despite the difficulties and challenges with which organizations are facing today.

Many new applications of Information and Communication Technologies have a potential meaning and may have economical and social impacts, as well as a key role in the bonding and in the convergence of the various technologies. Among these emerging technologies are the ubiquitous networks, which enable monitoring of people and objects as well as tracing, storing and processing of information in real time. Applications such as radio frequency identification (RFID) and other technological sensors are being used in applications for commercial use. The technology of prevention and warning of natural disasters are becoming more important for reducing the impacts of disasters which result in large economic losses. The participatory Web is the active participation of users on the Internet, creating contents; they adapt the Internet and develop applications for a wide variety of fields. The digital content represents an important factor in the ICT industry. Technological innovation and demand of new users are leading to new forms of creation, distribution and access to digital content.

Based on this scenario, this article proposes to examine the critical factors that should be considered by Digital Libraries in managing the lifecycle of their resources for information technology, cloud computing infrastructure and IT governance with a focus on organizational performance.

2 CLOUD COMPUTING

Information Technology (IT) can be summarized as a set of all activities and solutions provided by computing resources and, with applications related to several areas. Information Technology is also commonly used to denote the set of non-human resources dedicated to storage, processing and communicating information as well as the mode of how these resources are organized in a system capable of executing a set of tasks. IT is not limited to equipment (hardware), software and data communications. There are technologies for the planning of Computing, for the development of systems, for the support, for the software, for the processes of production and operation and for the support of hardware. The acronym IT covers all activities developed in society by using the resources of computers.

There are a number of competing interpretations of what cloud computing is about, but in its simplest formulation the expression refers to the provision of computing resources at a distance, over the Internet. Cloud computing platforms take advantage of a number of broader IT trends. One key element is advances in virtualisation, which allow for the separation of applications from infrastructure. Likewise cloud applications are dependent on the widespread availability of broadband connectivity, including through wireless devices, as well as reductions in storage costs. Some cloud-based service providers find efficiencies through the use of a multi-tenant architecture, to allow different customers to share the same platform (Nelson, 2009).

In a Digital Library environment we can foresee a number of benefits promised by cloud-based services. For example, the computing resources can be made available anywhere there is a computer and Internet connection, minimizing the impact of geography on the service provided by the Library to its information users. And access devices can be simpler (and smaller) if the data and applications reside in the cloud. Cloud services can free up the Digital

Library from capital expenditures on their computing infrastructure and minimise the need for in-house IT expertise.

High-speed networks have become increasingly important for new services and applications. Indeed, the fusion of cloud computing, mobile devices and broadband are changing the way "digital libraries" deal with computing resources and the way people perceive and use computer technology. Tablet PCs and Smartphone are making computers ubiquitous, while cloud services and mobile Internet enable “everything/everywhere” data access (OECD, 2012).

The last two years have seen cloud computing emerge as one of the most important platforms for innovative new services. It is changing the way computing is done. Users no longer have to make significant, up-front investments in IT infrastructure and software, but can now pay for computing resources via a pay-as-you go model. Cloud computing providers have much lower operating costs than companies that run their own IT infrastructure. This is because of the global scale of cloud computing providers and the possibility to aggregate the demands of multiple users, especially in public clouds. Providers are able to provision computing resources in a rapid and elastic way allowing adaptation to changing requirements (OECD, 2012).

According to OECD, cloud computing is defined as “as a service model for computing services based on a set of computing resources that can be accessed in a flexible, elastic, on-demand way with low management effort”. Cloud computing covers a whole range of services that can be further structured into three service models, and four deployment models (private, community, public and hybrid cloud) (Mell and Grance, 2011).

The service model defines the different layers of the traditional IT resource stack: infrastructure, platform and software. Infrastructure as a Service (IaaS) replaces the purchase of hardware like servers or storage. Platform as a Service (PaaS) provides a standardized middleware stack. Software-as-a-Service (SaaS) offerings in the cloud replace the traditional purchase and installation of software packages with subscription access to a managed environment (OECD, 2012).

The deployment model defines with whom IT resources are shared. Levels of sharing start with a single user via a private cloud service, then proceed to a limited number of defined and trusted users, and finally move to up-to-unlimited and general use. A hybrid cloud is a composition of several clouds (e.g. public or community). The latter approach benefits from multiple deployment models. Cloud computing has grown in importance over the last few years and is not confined to storage or web-based services; computing-intensive desktop applications are also moving to the cloud. The shape of personal computing devices is changing from desktop workstations with extensive computational power to thin, mobile devices such as notebooks, tablets and slates, and of course mobile phones (OECD, 2012).

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There are various benefits that a Digital Library can experience when it moves to cloud computing. The table below presents some of the major advantages that one can have by moving to the cloud:

Reduces Investment	When you have all your data on the cloud the need to maintain your own IT infrastructure is minimal. You can save a lot of money that would otherwise be spent on hardware, software and other equipments. The need for storage comes down to a minimum when you store most of your data on the cloud.
Low Cost of Operation	As there is minimum infrastructure setup the need to maintain and upgrade it is also reduced which allows you to save on the maintenance expenses as well and you can operate with less cost which further enhances your productivity. You do not have to spend on expensive software or licenses either which allows you to operate efficiently on a budget.
Better Collaboration	When you have your data in the cloud it can be accessed remotely as well allowing your employees to get the desired information from anywhere and collaborate with their peers easily on different tasks along with saving time and cost.
Increase Efficiency	As there is less equipment you need less people to manage and look after it which allows you to reduce your expenses further and with less amount of people you can be equally efficient. You can prune the support staff and still be equally productive.
Better Accessibility	The cloud can be easily accessed with an internet connection from anywhere and you can have your data wherever you want which makes things a lot easier for you. You can have access to your files without having to be present in your office.
Reduced need for training	Since the cloud software is the responsibility of the service provider the employees need not be trained for upgrading to new software which saves a lot of time which would otherwise be spent on training.
Better Management	Cloud server hosting allows you to monitor your resources in a better manner. You can always keep track of your projects and plan the resource needs in advance to avoid future problems. This way you can keep a tab on your budget and better manage your projects.

Table 1 – Moving to Cloud Computing Benefits
Source: Turner, 2013

2.1 DIGITAL LIBRARIES AND THE INFORMATION TECHNOLOGY PROJECTS

When it happens, the collapse in IT projects takes two forms. The first pattern of failure is marked by a lack of consensus on objectives and lack of confidence in the IT department. Managers are hesitant to invest in major projects in IT, which results in lower budget for the area. In another standard pattern, the IT and the operation of the Library align themselves, and IT spending remains stable, but the Library managers resists investing in something that is not intimately connected with the service quality the Library should provide - the infrastructure becomes obsolete, the common basis of data does not grow and the system becomes complex and fragile. Since the collapse in IT has been avoided and confidence restored, organizations must remain vigilant. The alignment between IT and the library operational foundation is important and requires constant adjustment to keep IT in the right direction (Westerman, 2007).

According to Paletta & Vieira (2008), a survey of IBM Business Consulting Services with 150 organizations based in Brazil with their internal customers show, among others, the need for greater balance between goals of short and long term projects in the IT. Below are the findings of IBM study, together in six broad aspects.

a) Strategic planning: the area should help with questions about the viability of corporate strategies and propose new solutions and alternatives, cannot do strategic planning without any support from IT.

b) Balance between short and long term: the pressure to reduce costs in the short term cannot eliminate R&D, under risk of the company fails to meet the challenges imposed by the competitive environment. It is up to the IT to enhance the individual abilities of each element of value chain, without necessarily bear all the costs and risks of these activities.

c) Governance: It is necessary to professionalize and classify the decision-making processes and provide the commitment, setting priorities for investment, monitoring IT contribution to business as well as the correct capture and allocation of the costs of the department to the areas which use them.

d) Measuring of value: the area of IT needs to demonstrate results that can be understood by managers, which requires assessment systems in structured financial metrics and non-financial, internal and external, to assess the past and the prospects for the future, quantifying the benefits - not only the cost of the activity of IT.

e) IT relationship with users: IT must find a new way of interacting with internal clients, capturing expectations and surpassing them.

f) Sourcing: issues such as strengthening the relationship with a limited number of suppliers, standardization of items of equipment, renegotiation of supply contracts and review of procedures for the management of assets are rarely addressed in an appropriate manner in relation to IT. They are not problems of managing IT, but IT management. For most who write and talk about governance and management of portfolio of investments in IT, there was no such significant changes in these techniques to justify imagine problems that are distinct from those originally discussed by them. People, relationships, communication, planning and control must always be in the foreground.

By including the concepts of a competitive intelligence program, the questions above may be expanded as follows:

a) Considering the range of possibilities available, where is the relevant information found in a faster and more assertive fashion, so as to become original not only to each need, but to each customer as well, gaining more competitive edge?

b) What is the perfect way to suit resources and contents to the information requirement regarding their application and role in the strategy based on the architecture proposed for the design of an intelligence plan?

c) What is each project/resource's most important intelligence requirement when it comes to the key question to be answered, in order to facilitate the most strategic actions and decisions?

d) Considering people, computers, and skills networks' interaction needs required in each competitive intelligence project, which set of resources/applications will result in the best acquisition of technology, innovation, originality, and evolution?

It is also important to highlight the eminence of new research and information treatment methodologies that allow producing documents containing high added value info in less time. Methodologies that are able to, more and more, bring information closer to human perception in order to clear the vision and the capability to build mental models closer to each other, thus making it easier to build the reality desired. That is, methodologies that renews and learns to reinvent themselves from interactions with customers, and is able to bring to the process both the optimization of the perception of demand for information and the decision making context, as well as the political, economic and social setting associated to such context.

According to Philippe Kislin (2011), it is essential to keep in mind that when it comes to CI, the resolution of an informational process is the translation of a decisional problem, where human interaction has the most violent implications and impacts. He points out that "le processus 'rechercher' est entretenu par la relation de prédilection entre le veilleur et l'information, dans toutes les dimensions de la gestion, de la maîtrise et de la protection de l'information". (« The 'research' process is sustained by fondness relationship between the watcher and the information in all dimensions of management, control and protection of information »).

In addition to that, according to that author, a CI program is to cursively interact with three systems, capable of complementing the information and favoring learning through the development of knowledge and erudition, which are: A mediation information system comprised of a space to assess the relevance of the information; an intermediation system comprised of a space of the problem assessed in terms of information preference; a comprehension system that stands as a specific social mediation capable of adding a cognitive and an affective dimension to the process.

Adding the awareness of such elements to the process certainly makes the complexity and the level of refinement of the plan and of the project's results evident. In this light, the bottom line takes on new meaning. In an Internet age where only the fittest services survive, business service models make more sense. Respect is bestowed upon Internet sites and services that users appreciate; if libraries take those sites and services to heart, then the respect will follow. Now that naive notions of binary digits replacing ink on paper anytime in the near future are dwindling, libraries have within their grasp the ability to make the most of automated

services, while preserving their traditional roles as gathering places, cultural centers, and egalitarian sources of information and knowledge (Pace, 2003).

2.2 TECHNOLOGICAL TRENDS FOR DIGITAL LIBRARY

Digital content has become a major driver of the ICT industry. Technological innovation and new consumer demand are leading to new and direct ways of addressing the creativity, new methods of distribution and improvement in access. Research results, for example, are becoming more accessible, and digital content is invading various sectors, for applications that may be more significant than the others for entertainment (OECD, 2012).

Continuous improvements in technology, networking, software and hardware, including cellular and wireless service and protection of content and services, have made possible the development of advanced digital content. Greater cooperation is a major challenge, since the production of digital content requires agreements between content developers, equipment manufacturers and distributors. This successful implementation requires efficient services and low cost in infrastructure and technologies to protect content. Issues of compatibility and interoperability must also be resolved (OECD, 2010).

According to David Cappuccio Gartner (2012), access to everything, all the time, from any device, from anywhere will be essential for any digital strategy. The Gartner report lists 10 critical trends and it is worth noting that many of them together is a common theme which is the coming together of cloud computing, big data, social and mobile.

Organizational entrenchment and disruption	By 2014, 30% of organizations using SaaS (Software as a Service) will revert to on-premise or private cloud due to poor service levels. End users are driving IT; end users demanded access to iPads. Same with iPhone, and other smart phones. There's also a generational 'skills shift,' with many people who are 'baby boomers' as retirees, and generation X people who bring new skills and different work related expectations.
Software-defined networks	A new way to operate networks, in which control of the networks moves into an OS (Operating System). This means the location of the physical data centre is no longer as relevant, creating completely virtual environment. This means there is the potential for significant organizational disruption.
Bigger data and storage	By 2015, big data demand will generate 1 million jobs in the Global 1000, but only a third will get filled due to shortage of talent.
Hybrid cloud services	Combination of private and public clouds. Using cloud as an extension of the internal IT infrastructure. Gartner thinks private clouds improve agility and will dominate. There is also a financial aspect to this because cloud computing will often cause an incremental growth in operating expense, but long-term capital spending is deferred or replaced.

Client and server architectures	One size does not fit all. One OS does not fit all. You will need to decide what to do about OS. The days of the monolithic software suite are going away.
Internet of things	The proliferation of cheap, small inter-connected devices made possible by IPv6. Everything will have a radio and GPS capability. It's not a single technology, it's a concept. Driving the trend are things like embedded sensors, image recognition, augmented reality, near field communication. The result is situational decision support and more transparency.
Operational complexity	By 2014, employee devices will be compromised by malware at 2x the rate of corporate-owned devices. For every 25% increase in functionality of a system, there is 100% increase in complexity.
IT appliance madness	Proliferation of point solutions (again IPv6), which are easy to deploy, with embedded OS, and locked down environments. They contribute to the complexity issue.
Virtual data centers	Ratio of virtual to physical servers is now about 11-to-1. Virtualization creates inexpensive resources and a new server can be made available in minutes. Resources are also distributed to workloads that can be distributed across data centers and geographies and not physical servers. Complexity increases resolution times and masks ownership of issues as workloads and issues are no longer confined to a known environment. Cloud services and hybrid environments exacerbate the support issue.
IT Demand	By 2017, 40% of enterprise contact information will have leaked on to Facebook via employee mobile devices. Server workloads growth 10% a year. Network bandwidth demand growing 35%. Storage capacity, 50%. Power costs growth, 20%. Throwing more capacity at demand is not the solution; you need to optimize capacity in new ways: virtualization, data de-duplication. Over 1.5 billion Web pages are accessible, 450,000 iPhone apps, over 200,000 Android apps, 5,500 magazine. All drives demand for IT.

Table 2 – Ten Critical Tech Trends - Source: Cappuccio, Gartner 2012

In today's Internet age, to think about library services without thinking about business service is to bury one's head in the sand. Despite strong desires to paint them so, libraries are not "utterly at variance" with business. Moreover, there is nothing wrong with watching business from fiscal quarter to fiscal quarter, and emulating its practices, while collectively keeping an eye on the next quarter century and beyond; doing so will not only ensure the future of the library, it will ensure the distinction between businesses and libraries that the latter hold so dear (Pace, 2003).

According to Witten (2010) a digital library is defined as a focused collection of digital objects, including text, video, and audio, along with methods for access and retrieval, and for selection, organization, and maintenance of the collection.

The ability to leverage the potential of the technology is becoming increasingly critical to the success of Digital Libraries operations. The main tool to acquire this ability is to develop an effective organization of IT, focusing on three key areas:

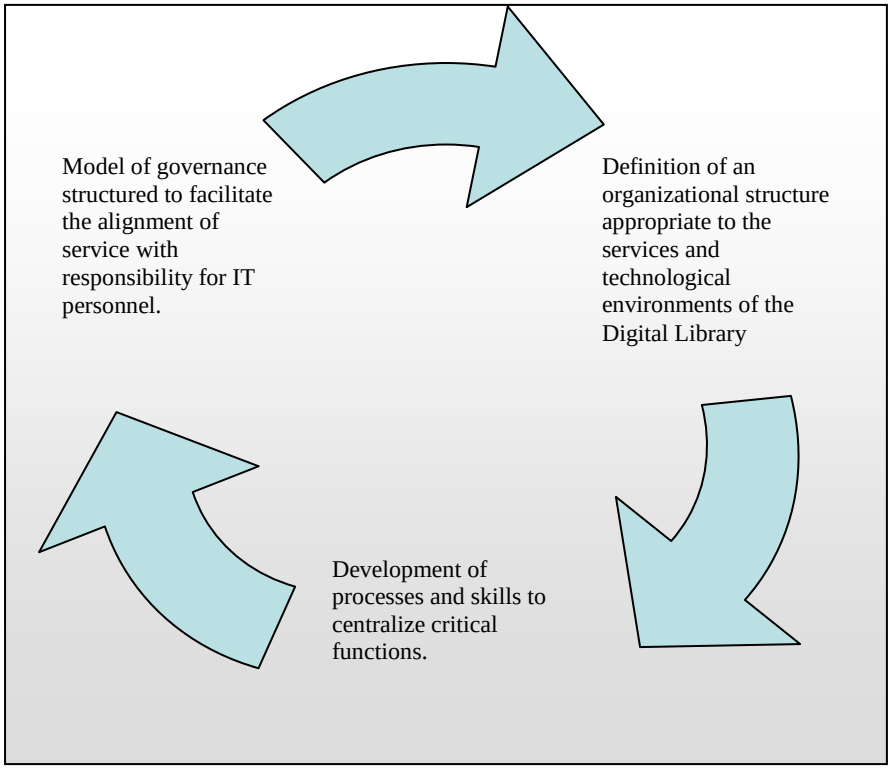

Figure 1 – IT Organization Focus

The library, historically a cornerstone of scholarly endeavor, is reinventing itself in today's networked society to meet these new demands. Instead of a building that holds books, the library is evolving into an electronic portal to a growing global collection of digital content. The doors to this virtual library are now open 24 hours a day, seven days a week, and the library's holdings come to the user when needed. Today's library includes sophisticated tools that make it easy to find the best information resources, delivering them to one's desktop or mobile computing device at the push of a button (Wright, 2002).

3 IT LIFECYCLE MANAGEMENT

The consolidated management of the working environment of IT requires that Digital Libraries adopt a holistic approach directed to people, processes and technology throughout the computing environment. It also requires that Digital Libraries work with suppliers of IT that can analyze their operational needs, assisting the implementation and ongoing management and support of the solutions implemented. The basic challenges that Digital Libraries face in the computing environments include:

a) Reduction of costs – The environments for customer service are moving quickly to mobile search locations, virtual and global, culturally diverse, which are expensive to maintain and support. Through the consolidation of hardware, applications and support processes within their working environments, Digital Libraries can manage and reduce IT costs, while simultaneously improving the return on investment.

b) Increased productivity of professionals of information - To achieve this goal, Digital Libraries are seeking ways to improve collaboration and teamwork by creating a work

environment without borders, reliable and secure, providing the connection and access to information anytime from anywhere.

c) Reducing the complexity of IT - The lack of standardization within the computing environment can increase the time and cost required to manage and support this environment. At the same time, as the computing environments become more complex, the level of knowledge and expertise needed to support those increases. The tools for managing the IT lifecycle allow the standardization of the hardware platform; reducing redundant devices; simplifies and automates the computational processes; besides managing the support functions and building flexibility and stability that allow the creation of a dynamic management of digital information. The management of the IT infrastructure becomes increasingly expensive and complex. Studies indicate that more than 50% of all costs of IT are allocated to configure, upgrade, migrate and manage resources (O'Brien, 2002).

According to Paletta & Vieira (2008), the largest expense of ownership of IT resources is not the initial purchase of hardware and software, but the complexity of implementing and maintaining these devices.

To reduce these costs, Digital Libraries need to invest in management software systems to improve reliability and availability of hardware and software, through all phases of a resource lifecycle. Figure 2 shows the main stages of IT Lifecycle Management.

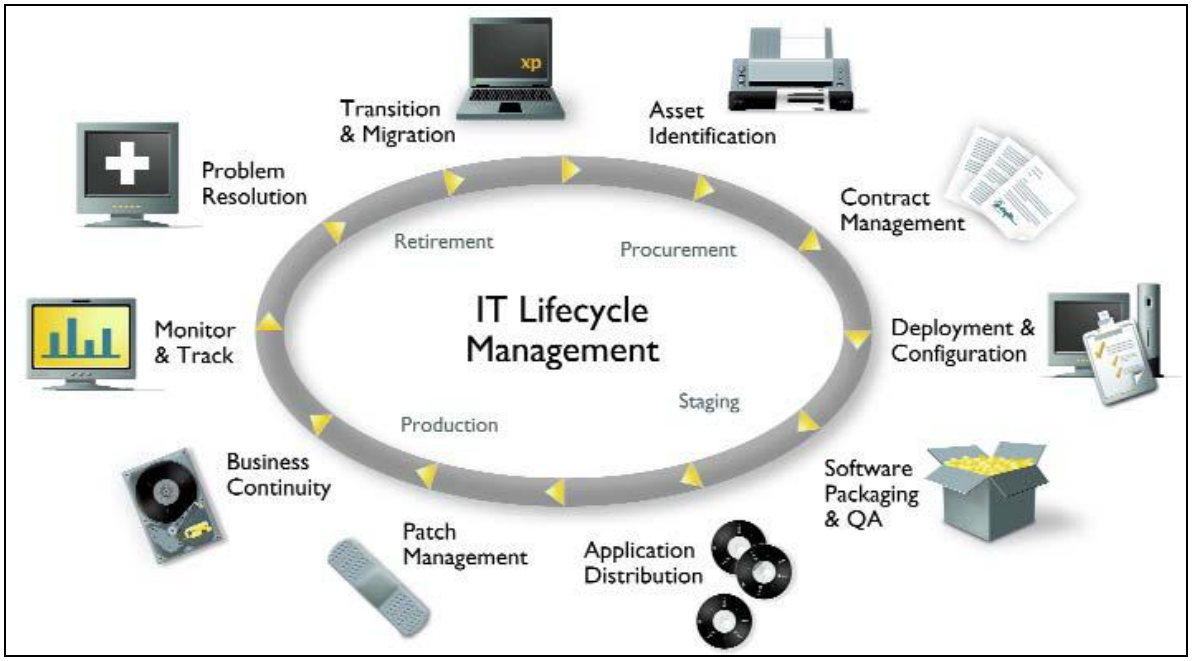

Figure 2 – IT Lifecycle Management
Source: Paletta F C, Vieira N D

When evaluating a tool for IT lifecycle management, it is imperative to consider the following relevant features of the solution (Paletta & Vieira, 2008):

- ✓ Management of the lifecycle of IT assets via Web.
- ✓ Identification and physical location of assets.
- ✓ Physical and logical setting - hardware devices and software.
- ✓ Monitoring of the use of software and hardware.

- ✓ Management of maintenance contracts for HD (Hardware) and SW (Software).
- ✓ Increased productivity of users, IT professionals and network devices.
- ✓ Resolution of problems ensuring the availability of resources and services.
- ✓ Diagnostics and real-time information for decision-making.
- ✓ Modular structure with flexible deployment.
- ✓ Integration via Web with database and repositories of information
- ✓ Technical Support and Training of the user.

As stated by Brown (2005), best practices for managing IT should allow adequate treatment to the complexities associated with the management of IT resources. The systems must be modular, allowing the definition of a technological structure compatible with the computing needs of the organization (Cox, 2005).

3.1 COMPUTING RESOURCES IN A DIGITAL LIBRARY

The increasing complexity of the technological assets has encouraged IT managers to seek ways to improve efficiency in the operation to reduce costs, adhere to the regulatory aspects and meet the constant demands of Digital Libraries for a better response from the department of IT. These factors have been a booster so that IT managers seek efficient ways to take control of everything that exists in their network. According to Rockart (1996), the eight requirements for an organization of IT to achieve operational excellence and maximize their performance are:

a) Getting Strategic Alignment of "two hands" - between IT and "operation": To be an effective strategic alignment between IT and business, it should occur in "two hands": the staff of IT should have a greater understanding of the operation and, concomitantly, the company's executives must keep in mind the potential that IT has to "leverage" or even change the business.

b) Develop effective relationships between IT and operation: As the line managers are key users of IT applications, there should be a close and continuous relationship between them and IT staff, at each level of the organization; successful priority systems and close relationship leads to a better understanding of the operation and a cyclical process of progress and successes.

c) Deliver and deploy new systems: Big change in the process of developing systems. The internal development of transactional systems for greater outsourcing, integrating information focused on re-engineered processes; users less tolerant about long delays in development, inflexible interfaces and over-budgets; placing of high-level line managers in the leadership of the projects, increasing the responsibility of future users with the system; external development and "packages" (for example, the "packages" ERP - Enterprise Resource Planning): faster and less expensive alternative of deployment; and manage this process is very different than in the case of external development.

d) Build and Manage the infrastructure: Need for an infrastructure (in terms of computers, telecommunications, software and data) that enables the provision and integration of information throughout the network and for the re-engineered processes; important for a “globalized” operation; and basic points for this infrastructure: architecture, patterns, team’s ability to operate the IT infrastructure.

e) Re-train (Reskill) the IT Organization: Need of IT staff be re-trained in new ways and methods of development, such as client-server architecture, new languages and

communication protocols; and training in skills and knowledge of the business itself, since IT is increasingly important and ubiquitous in all Digital Libraries. How to promote this training is not consensus among businesses yet.

f) Manage partnerships with suppliers: Outsourcing: is the alternative to supply deficiencies of certain skills in IT, especially those that are not core competencies or competitive differentials. In addition to any economy, would allow high IT directors to focus their attention where is strategic; the implementation and administration of outsourcing demand skills that permit to distinguish when a strategic partnership is being done or simply a business transaction.

g) Develop high-performance: The area of high-performance IT should: seek operational efficiency, either in development or in the internal outsourcing; in the search for efficiency, often IT follows trends in the area of manufacturing, such as TQM (add up to ISO9000 for software development); a concern in the area of IT should be the time for development: information systems should be deployed as soon as possible (today, delays of two or three years are no longer acceptable), so they are not obstacles to the deal.

h) Re-design and administer an IT organization: The question "centralization vs. decentralization" culminated in the organization. A central IT organization to do the planning, allocation of resources and shopping with economy of scale, some autonomy for local businesses to seek their specific solutions. With this structure, one can get the alignment with the business, economy of scale and integrity in systems architecture.

Figure 3 illustrates the modularity necessary for the development of the IT infrastructure, necessary for the deployment of a solution for the management of assets.

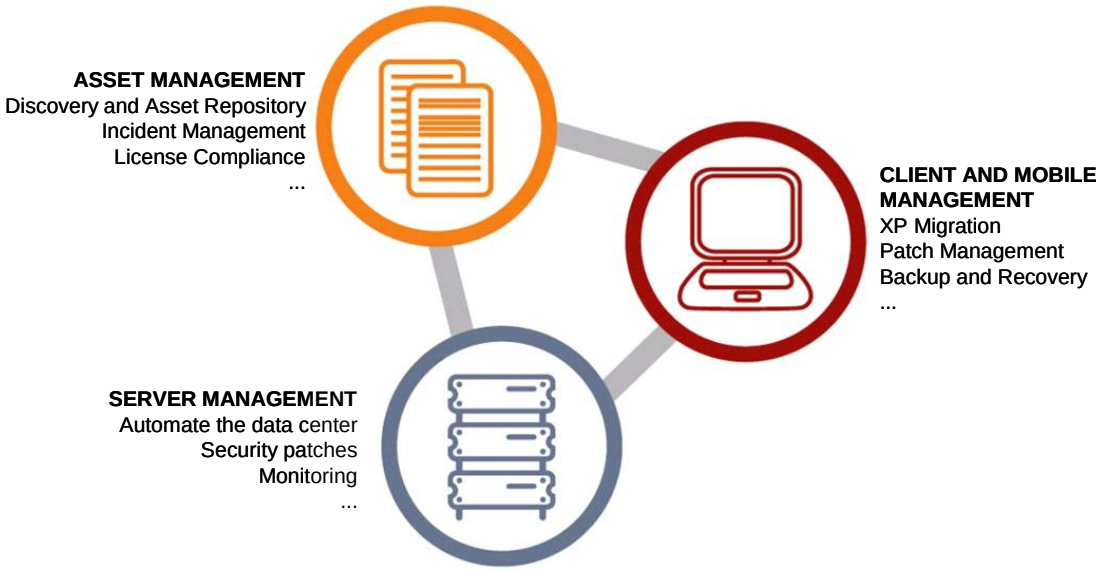

Figure 3 - Management of resources, clients, mobile equipment and server.
Source: Paletta F C, Vieira N D

According to Brown (2005), an integrated solution for the management of assets combines the disciplines of management resources and services of the digital company in a single architecture based on the Web, repository and console, helping to unite various departments and processes. To actively manage the entire lifecycle of resources, the solution helps Digital Libraries to eliminate unnecessary costs for software and hardware, to proactively manage contracts with suppliers and align the resources of services with ITIL (Information Technology Infrastructure Library), to ensure optimization of IT investments. The benefits include:

a) Monitor the configuration, the implemented versions, the relationships and historical information of IT resources.

b) Monitor the use of software and hardware for relocation and negotiation of contracts.

c) Ensure the availability of resources through the management of incidents and problems.

The management of clients and mobile equipment allow administrators to implement, manage and troubleshoot systems from anywhere.

The benefits include:

a) Consolidated management of desktops, notebooks and handhelds.

b) Implementation of the OS (operating system) migration and personality of the PC with zero intervention.

c) Comprehensive inventory of software and hardware with the generation of reports over the Internet.

d) Assessment of the vulnerabilities of the system with software distribution and patch management in real time.

e) Management states through the resources of auto correction and reversal of applications.

The management of servers offers the functions of implementation, management and monitoring from a centralized console, reducing the total cost of infrastructure. The benefits include:

a) Improve the reliability and stability of servers, minimizing downtime of the digital company and improving user satisfaction.

b) Automate the management of IT operations to respond quickly to changing needs of the digital company.

c) Monitor the performance, restore the operation and minimize the security patches to ensure the continuity of the operation.

IT managers need to be increasingly involved in development, control and monitoring technology assets of their Digital Libraries. The constant pressure to keep the efficiency in IT investments shows that it is a priority to manage these assets in two ways: as a function of the IT department as well as an integral part of the Digital Library. IT management should be focused on allowing them to obtain the full potential of technology, working in four main areas: alignment with the business and services, management of complexity, strategic outsourcing and capture of value (Brown, 2005).

The ability to leverage the potential of technology is becoming increasingly critical to the success of small and medium enterprises. The main tool to acquire this ability is to develop an effective IT organization, focusing on three key areas: the definition of an organizational structure appropriated to the business and technological environments of the company, the

development of processes and skills to centralize some critical tasks, and a model of governance structured to facilitate the alignment of those responsible for service with the team of IT (Brown, 2005).

To support these organizational changes, it also needs a strong cultural change: the information technology needs to be perceived as a competitive lever and managers should feel responsible, together with IT professionals, by incorporating the technology in the services strategy. The supports of high direction, as well as the recruitment of professionals with the appropriate profile, are essential elements for achieving the change (Schwaber, 2007). Figure 4 shows how information technology is involved with all operational procedures of the organization and, increasingly, is affecting the ability to offer services influencing the efficiency, quality of customer service and innovative capacity.

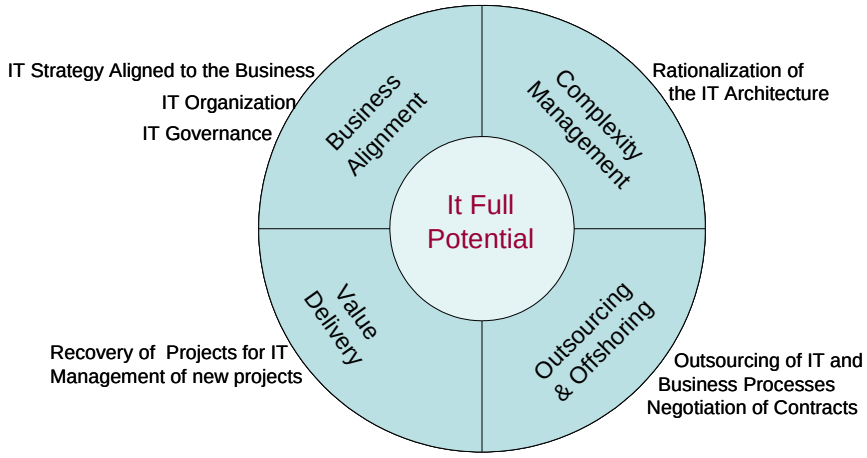

Figure 4 – IT Maximum Potential

Developing the IT organization and structuring its relationship with the areas of services is the main instrument to build skills in IT. Analyzing the organizational models of organizations that stand out in the use of technology, we point out best the practices on three key aspects to an effective organization of IT: defining the most appropriate organizational structure, functions and the critical competencies that should be centralized and governance for investments in technology (UN, 2005).

4 CONCLUSION

The librarian's functions are often overlooked by digital library proponents, who generally have a background in technology and approach their work from this perspective rather than from the viewpoint of library or information science. But selection, organization, and maintenance are central to the notion of a library. If data is characterized as recorded facts, then information is the set of patterns, or expectations, that underlie the data. You could go on to define knowledge as the accumulation of your set of expectations, and wisdom as the value attached to knowledge. Not all information is created equal, and wisdom is what librarians add to the library by making decisions about what to include in a collection—difficult decisions—and by following up with appropriate ways of organizing and

maintaining the information. Indeed, it is exactly these features that distinguish digital libraries from the anarchic mess that we call the World Wide Web (Witten, 2010).

To conduct, effectively, the lifecycle of assets in IT is no longer an option, it is essential. Regardless of the type of asset, Digital Libraries need to understand, at least the minimum, of what was purchased, what is its value and where it is allocated. The solutions for managing the IT lifecycle include a combination of policies, processes, technologies and resources to use, monitor, serve, manage and update the hardware and software assets effectively. The increase in the number of servers and PCs, the mobility trend reflected in a longer list of equipment (laptops, cell phones, PDAs, among others), exponential growth of datacenters, as well as the number of departments within a company, contribute to a greater complexity in the administration of IT assets (Cox, 2005). Additionally, Digital Libraries suffer strong pressure to meet the needs as:

a) Reduction of the total cost of ownership (TCO) of assets through the optimization of procedures for the purchase, implementation, monitoring and administration.

b) To manage the relationships between people and assets, by simplifying the IT workloads, human resources and finance departments.

c) To simplify the process of updating software.

d) To ensure good follow up and monitoring of licenses and other contractual arrangements.

e) Accelerate the service and the support through proactive alerts, thus simplifying time and effort of IT administration.

The solution for managing IT lifecycle is organized on three levels over a model of maturity, as the needs of computing resources (Figure 5).

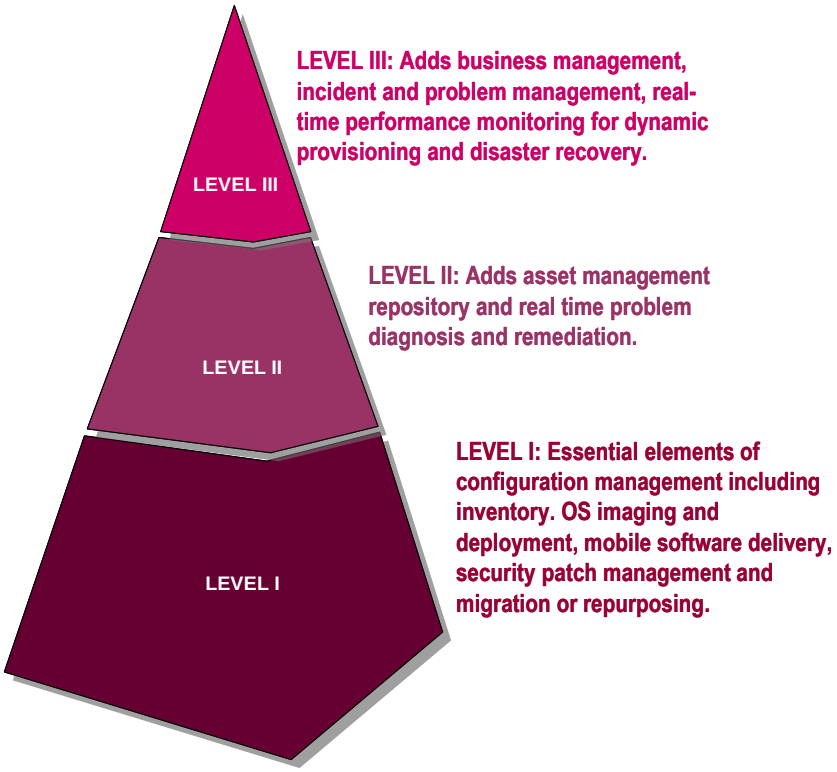

Figure 5 – Maturity Model
Source: Paletta F C, Vieira N D

To manage the IT assets with greater precision and integration, offers greater operational efficiency and greater control and simplification of computing resources (Cox, 2005). Aware of this need, IT managers need to align the company's digital strategies with the policies of deployment and use of Information Technology as essential considering the following items:

a) What are the challenges faced and the paths followed by the Digital Libraries?

b) What are the services offered to customers with the implementation of the practice of managing the IT cycle?

c) How to manage purchasing decisions and processes of IT assets?

d) How to develop predictive information and a real-time view of IT assets to improve the level of service, security and the use thereof?

e) How to keep a consistency and control of costs at a deeper level of user / department?

f) In what degree is your Digital Library and what steps should it follow to optimize its practice of IT Asset Management?

The use of digital technology is evolving toward comprehensive solutions to manage IT using a single repository and a single interface, dramatically reducing the costs and complexity of managing their resources, including desktops, thin clients, laptops, handheld devices and networks. It is essential to automate, simplify and integrate their functions to manage IT from a single console-based Web. Innovations in IT continue to emerge in a frenzied pace, driven by the rapid advancement of technology for semiconductors. Information is key assets of businesses in the post-industrial era. The correct investment in IT has been pressured for tangible and sustainable results and the management of IT resources is essential to corporate success (Paletta, 2008).

The vision of management of IT assets, however, needs to be expanded at a higher level of functionality and processes, since administering assets throughout the lifecycle involves much more than counts them to reduce costs. And to manage the physical assets and software within a Digital Library requires an approach from the technological point of view to business processes.

It’s important to point out that to create additional sources of competitive advantage to prepare Digital Libraries for sustainable growth in the short and long term, the addition of the program of competitive intelligence promotes and optimizes concepts and resources, highlighting choices of bigger value and relevancy for the strategic decisions.

Faced with the emergence and speed of growth in the information economy, organizations have an urgent need to adopt IT governance best practice. The main drivers of the information economy are: the globalization of markets, products and resourcing; electronic information and knowledge intensity; and the geometric increase in the level of electronic networking and connectivity (Calder, 2008).

According to Mell & Grance (2011), cloud computing is a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction. This cloud model promotes availability and is composed of:

Five Essential Characteristics

- ✓ On-demand self-service
- ✓ Broad network access
- ✓ Resource pooling
- ✓ Rapid elasticity
- ✓ Measured Service

Three Service Models

- ✓ Cloud Software as a Service (SaaS)
- ✓ Cloud Platform as a Service (PaaS)
- ✓ Cloud Infrastructure as a Service (IaaS)

Four Deployment Models

- ✓ Private cloud
- ✓ Community cloud
- ✓ Public cloud
- ✓ Hybrid cloud

Key Enabling Technologies

- ✓ Fast wide-area networks,
- ✓ Powerful, inexpensive server computers,
- ✓ High-performance virtualization for commodity hardware

The Cloud Computing model offers the promise of massive cost savings combined with increased IT agility. It is considered an optional for Digital Libraries to begin adoption of this technology in response to difficult economic constraints. However, cloud computing technology challenges many traditional approaches to datacenter and enterprise application design and management. Cloud computing is currently being used; however, security, interoperability, and portability are cited as major barriers to broader adoption.

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