Key Perspectives in Information Technology Infrastructure Management

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***Abstract*—Information technology management challenges managers to create a robust platform for other systems in the organization. However, it is not only about reliability of technology, systems should also be secure, flexible and adapt to future business needs. Clearly, there are several perspectives to information technology infrastructure management. Understanding development and maintenance activities which take the human element in technology into consideration is the key to successful information technology infrastructure management.**

***Index Terms*—information technology, infrastructure, management, perspectives, development**

I. Introduction

Infrastructure is used in information systems to refer to the basic systems that are shared amongst users of information systems. Infrastructure includes a wide range of technologies, computers and components together with applications and systems. Organization-wide email-systems are examples of infrastructure – they are common for all departments, users and provide communication services for a range of purposes.

Infrastructure is expected to provide access to data at any time, with a variety of terminal devices [1]. It is also increasingly common that systems can be used independently of location, from a portable computer, tablet or smartphone. There are several key areas in information technology infrastructure management, among the most important issues are [2], [3]:

- *Flexibility* which refers to the possibility to make changes in technologies and systems. Flexibility makes it possible to adapt to changing requirements.
- *Modularity* is manifested in ability to make changes in hardware and software components so that changes to one module are possible without the need to modify other parts of the system [3]. Modularity makes it possible to make changes to changing business needs rapidly.
- *Integration* is about the compatibility of hardware components and applications [3]. Integration is result of connectivity and compatibility, it refers to the ability to access information across different platforms [2].

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It is expected that infrastructure should act as a reliable basis for operations, but at the same time it should also be flexible, modular and tightly integrated. As a result, flexibility, modularity could be considered as an organizational core competency [4], and cornerstones in information technology infrastructure management. From the business perspective they are critical, they allow organization to respond to new conditions rapidly [5]. It is here important to understand that flexibility is not only a technical issue, there is also a human dimension.

In this article we look at information technology infrastructure management. Information technology is usually managed by organization's IT department. Other stakeholders in information technology management are users and management. It is also noteworthy that the role of external partners like application developers, providers of key technologies and systems can be significant in information technology management. Here the focus is in IT department, management and users – these are considered as key resources and perspectives in information technology management.

II. Resources and Perspectives

Information technology is more than state-of-the-art devices and components. Especially when it comes to evaluating the value and benefits of technology it is often noticed that technology alone does not guarantee good results. Byrd - Turner [3] argue that skills and knowledge in technology management, in information technology itself, and overall business management, are required. Clearly, people in the IT department should have technical knowledge [6], but IT management demands also management skills and understanding of business requirements.

Accordingly, the human component is a critical part of infrastructure. Human component refers to management of technology development, expertize in the IT department and skills of end-users [4], [3].

Here we emphasize:

- Attitudes
- Organizational fit
- Management support and
- IT department

Attitudes are here understood as the commitment and motivation of the people involved in development and use of information technology, especially the development group members and the attitudes of the

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management. Furthermore, user motivation has an important role in adoption of IT skills. Attitudes are among the most important success factor in infrastructure development and management [7].

Organizational fit refers to the way how technology adapts to the organizational structures of each company. Information technology should support and fit the organization and the way it works [8], [9]. Generally, ability to adopt technology is based on existing resources in the organization [10]. These resources can be technical or human. Technical resources include hardware and software that together form the installed technological basic infrastructure. Human resources refer to the skills and knowledge in using technology and systems for business purposes; and here also working practices and the way processes are organized are important.

Information technology has the potential to make changes in organizational processes, some of the changes are goals in the development and desirable, but some may be not known before. [11] Understanding technologies, their limitations and looking at other similar cases can decrease the possibility of unwanted results [12], [13].

Organizational support and especially managers have a significant impact on utilization of information technology [14], [15]. Management support is important in the development of processes and implementation of new technologies. Managers make decisions, for example, on what should be developed and when. Managers have a relatively direct control on development activities, they assign people, time and provide funding for projects. Development activities change existing systems, process and habits. Here manager's role is important because this is the time when management, coordination, conflict resolution among individuals and the organizational units is needed the most [16].

Acceptance of technological changes is a process that involves two stages [17]. Firstly, management should inform about the change, why it is needed and what are the goals. Secondly, there is a need for breaking existing norms, encouragement and motivation are important. Here managers have a critical role, their encouragement impacts the adoption of technology [18]. Users need examples to make their own decisions on how to adopt technology.

The successfulness of change management depends of experience and management skills but requires also understanding the role of information technology and potential that it provides in the development process [14]. Management and organizational support extends beyond projects. It can take a variety of forms, such as training, encouragement to use technology and experiment with it [15].

IT department has a key role in development and maintenance of information technology infrastructure [19], [15], [20]. It is expected that IT department understands and develop information systems so that they support organizations' operations in the best possible way. IT department provides user support, advice and solves problems [15]. Unsurprisingly, expertise of IT staff has been found to have a direct impact on IT utilization [15]. Another important source of support is colleagues that are close to each user [21].

Motivated and qualified IT staff is not the only factor affecting IT usage in organizations. Communicative skills are also important and have influence on users' satisfaction [22]. It is not only about technical expertise of IT staff, the ability to understand the problems that users have, together with communication capabilities, all have a positive impact on IT utilization in the organization.

The relationship between IT support arrangements and IT utilization is not straightforward [23]. Extensive IT support does not automatically maximize IT deployment and missing, or non-organized IT support doesn't mean that investments in information systems would not add business value.

III. Key Domains in IT Management

In general, information systems management is divided into development and maintenance. Consequently, development and maintenance are domains which connect to several processes, activities and roles in information systems and information technology management [24], [25].

A. Development

Information technology development should be based on priorities and targets that are mutually agreed and understood [26]. Key issues include the role and purpose of the infrastructure, main applications and systems, and how widely are they used within the organization. In all systems reliability is a key factor [27], [28].

Technology should be robust and reliable, and failsafe even in extreme situations. This means there should be plenty of capacity, processing power and bandwidth to ensure services in most demanding moments. On the other hand, reliability is result of redundancy, meaning there are resources that take over if the primary systems fail. For critical systems it is a good idea to develop solutions type "plan B", or at least consider carefully whether they are needed or not. The challenge of reliability of technology is often approached by seeking capable partners, providers of systems and technologies, together with choosing technologies that follow standards and are widely used in the industry [24]. Compatibility and interoperability of systems and technologies are important in information technology management, and this is where standards become important. Choosing technologies that follow standards make it possible to make modifications into existing systems, and allow adding new components, modules or other systems into existing infrastructures [29].

Information technology development is a continuous process. New advanced technologies are emerging, updated and revised applications are being introduces, all that the developers of technological infrastructure need to evaluate, implemented and utilize to better meet organizational targets. It may also be the case that there have been changes in the environment or the organization,

and the information technology needs to adapt to the changing conditions.

All changes, independently of their origin, should be managed in a way that expandability, compatibility and flexibility of the infrastructure can be maximized [30].

B. Maintenance

The maintenance of information technology is an important task. Infrastructure is the basis for other systems and processes, therefore there it is expected to operate smoothly and without interruptions [31], [32]. Especially systems that affect users widely across the organization are critical, and this is often the case with infrastructure. If there are problems with shared services such as printing or email systems, they tend to have impact on all other systems. Depending on the role of technology and whether the system is critical for operations maintenance related activities need to be organized in a manner that interruptions to operations can be minimized.

Infrastructure management is often about technical problems and solving them as fast as possible. This means that key technologies and resources are monitored and controlled with sensors or tools that automatically log data from selected sources. Especially in larger infrastructures and geographically widespread organizations remote control is important, and it can prevent and solve problems rapidly without need to physically reboot a network device in a distant facility, for example.

When the infrastructure grows, central control and management of network devices becomes imperative [31]. Similarly, management of applications and systems calls for management from a distance. Automatic monitoring of devices and applications can prevent problems in advance. Today it is normal to monitor key resources like servers, network connections and storage devices automatically, and alarm so that problems can be solved even before the problem escalates or shuts down services.

In a multivendor is monitoring, controlling and management not a straightforward issue. Monitoring is often based on manufacturer-specific applications, or software that can be used with certain generation of devices. There is a need to use several different applications for different devices, or one might want to standardize the infrastructure to only certain brands and devices. Another possibility is to use applications that allow monitoring and controlling devices from different manufacturers. Even in this case there is often a need to use more than one tool to control and monitor all the devices in the infrastructure. Furthermore, even in best case there may be the case that there still are some resources that cannot be managed from a distance. As a result, one development goal is to establish standards and procedures that apply across different manufacturers and technologies, allowing better infrastructure management [33].

Problems with performance are often signals that indicate there is a problem that may become more serious, even stopping operations all together. In order to manage and develop the infrastructure performance criteria is needed. This means that there has to be criteria that can be used when looking at various log information, indicating the system is operating normally or are the problems requiring device or service restarting, or other service activities. Problems may be result of inadequate capacity or bandwidth, failures or technical hardware errors, and often inappropriate configurations. Independently of their origin, problems require attention.

There should be criteria for different indicators in areas like network speed, response time, and overall reliability [31], [34]. The indicators reflect areas that the organization sees important and they also should be measurable. Studying deviations from set criteria is part of maintenance work and can be an area for future development.

IV. Importance of Security Management

Security is a challenging topic for organizations [26], [28], [35]. In order to keep uninvited guests away are alarm systems and security services are needed [36]. However, keeping traditional intruders away is far from enough. As organizations are typically connected to others over networks, there is a significant possibility of being infected by computer viruses, or being subject to other threats, intruders coming from the networks, for example. There are also other unwanted incidents that can cause severe problems or halt operations, like fire, thunder or interruptions in power delivery. Here we use the term crisis management which includes threats from intrusion, viruses and malware together with threats like fire or interruptions in power delivery.

Clearly, crisis management is one of the most important tasks in information systems management [37]. There should be clear responsibilities, planning and preparation so that the increasingly demanding and changing management of security related issues could be covered. In order to prepare for the worst, it is advisable to appoint an individual or a team with responsibilities in planning and preparation, in areas like training users in security so that possible crisis could be prevented, or damages minimized. Preventive planning should also include proper data backup procedures, so that operations can continue even after a serious disaster [26].

V. Conclusion

The role of information systems in organizations is in most processes critical. The importance of information technology is affected by the nature of industry and nature of operations. It is also typical that organizations have different requirements for processing of data and information [4], [25].

In general, information technology and systems should act as a reliable foundation for business operations [4]. For example, the reliability of the basic networking infrastructure in organizations is seen as a critical issue [24]. In addition, the importance of human component in information technology infrastructure is critical. Firstly, information technology infrastructure should meet user needs. Secondly, management is in a key role as

strategies, goals and resources impact directly decisions in information systems development [38].

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