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## Comparison of models and standards for implementing IT service capacity management

## Comparación de modelos y estándares para implementar la gestión de la capacidad de servicios de TI

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### Abstract

Due to the recent and significant growth of the information technology (IT) services, industries need some sort of framework and / or standards for the management of their services, especially IT services. So, it becomes necessary and essential to define and adopt a set of best practices for providing and effectively managing the technology and services offered throughout its life cycle. Currently, the management of IT applications and services becomes more complex. Predicting and controlling the problems associated with system performance and capacity planning has become a difficult task. For large IT projects, the costs related to performance tuning, performance management and capacity planning, generally turn out to be the biggest and the most uncontrollable costs. In recent years, a number of frameworks aimed at covering certain issues of IT service management have been developed. One of these issues is the IT service capability management. In this paper, a comparison between the models and standards used today regarding capacity management are presented. A comparison of the strengths and weaknesses of each of the models/standards on the capacity management is presented, so that it can guide organizations to select the model/standard that best suits their needs.

-----*Keywords:* capacity management, service management, IT models and standards, ISO/IEC 20000:2005, ITIL V3, CMMI for Services V1.3, COBIT 5, eSCM-CL V1.1, eSCM-SP V1.1

### Resumen

Debido al gran crecimiento que han tenido hoy en día los servicios de Tecnologías de la Información (TI), las industrias necesitan algún tipo de marco

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y/o normas para la gestión de sus servicios, especialmente los servicios de TI, por lo que se hace necesario e imprescindible definir y adoptar un conjunto de buenas prácticas para proveer y gestionar de forma eficaz la tecnología y los servicios ofrecidos a lo largo de todo su ciclo de vida. Actualmente, la gestión de aplicaciones y servicios de TI se vuelve más compleja, predecir y controlar los problemas relacionados con el rendimiento del sistema y planificación de la capacidad se ha convertido en una tarea difícil. Para grandes proyectos de TI, generalmente los costes relativos al ajuste del rendimiento, gestión del rendimiento y planificación de capacidad, resultan ser los más grandes y los más incontrolables. En los últimos años han surgido una serie de marcos de trabajo enfocados a cubrir ciertos aspectos de la gestión de servicios de TI. Uno de estos aspectos es la gestión de la capacidad de servicios de TI. En este artículo, presentaremos una comparación de los modelos y estándares más usados en la actualidad con respecto a la gestión de la capacidad. El resultado es una comparación con las debilidades y fortalezas de cada uno de los modelos/estándares respecto a la gestión de la capacidad, de forma que pueda guiar a las organizaciones a seleccionar el modelo que mejor se ajuste a sus necesidades.

-----*Palabras clave:* gestión de la capacidad, gestión de servicios, modelos y estándares de TI, ISO/IEC 20000:2005, ITIL V3, CMMI para Servicios V1.3, COBIT 5, eSCM-CL V1.1, eSCM-SP V1.1

## Introduction

Currently, having an area of Information Technology (IT) that simply meets specific tasks for managing and configuring servers, network management, technical support, upgrading of equipment, installation and development applications, etc. is no longer enough for organizations. Today markets' demands are increasing and the IT function must meet more requirements [1]: an effective management, predictable and reliable operation, efficient in terms of resources (time and money), with well-defined and automated processes and roles and responsibilities clearly defined, among others.

The increasing use of models and standards has raised new challenges and new demands, such as: 1) raising awareness of the purpose of the business and the benefits of these models, 2) aid in making decisions about which practices to use and how to integrate them with internal policies and procedures, and 3) adaptation of models and standards to the specific requirements of the organization.

IT resources are managed by IT processes, which enable the technology area service delivery for the organization to meet its objectives [1].

Today, the IT service managers with responsibilities for the allocation of IT resources complain that the capacity management consumes more time and effort, and therefore cost, compared to the value it delivers. Service organizations that follow this negative approach tend to have the following problems [2]:

- Customer expectations often exceed the technical capabilities.
- The purchase of IT equipment is justified by the return of the capital invested, not by the general corporate needs.
- The manufacturers' expected performance is often not achievable within a production environment.
- There isn't a corporate capacity plan.
- Lack of forecasting related to the business capacity management.

- Management of network capacity and servers is made reactively and not proactively, and infrequently.
- The capacity management of desktops is minimal or not performed at all.

It is necessary to consider different processes for the management of IT services. One of them is the process of capacity management. The capacity management is a vital process for the organization, because it ensures the availability of adequate capacity at all times to meet the needs of the organization by balancing “business demand with IT supply”. Poor management capacity may lead to situations where the existing infrastructure is insufficient to handle the demands coming from the users, and this can cause a reduction of the quality of the service rendered, and even the disruption of the same service. Another risk is that the infrastructure becomes oversized, there is not an intensive use of the available resources and, therefore, the same infrastructure becomes not cost efficient.

In recent years, there have been a number of frameworks aimed to cover aspects of IT service management [3]. Through these IT service management models and standards, the intention is to analyze further the process of capacity management among others.

This paper is organized as follows: first, the process of capacity management is introduced. Then, the research method that was used to select the models and standards is defined. Then, the selection of the models and standards is presented. Then, the analysis of the selected models and standards is shown. Next, the results of the comparison between models and standards, through the use of tables, are illustrated. Finally, conclusions are presented.

### **The IT service capacity management process**

In the context of the services, the capacity may refer to the maximum amount of the services rendered or the maximum number of service requests that

a service system can successfully manage within a fixed time period. The capacity is a quality attribute. The definition and measurement of the capacity may differ based on the different types of services and service systems, and it can be defined in the service contract [4].

The capacity management is a highly technical, complex and demanding process [5]. The ability to properly manage the IT services requires a systematic review process for the current performance and capacity of the IT resources. This process has a capacity plan that includes forecasting future needs based on workload, storage and contingencies’ requirements.

The capacity management must create and maintain a capacity plan that considers the needs of the business. The capacity plan is a tool that enables organizations to efficiently manage all the resources necessary for the development of their business [1, 4]. Having a plan for capacity management allows any organization to manage the change related to the market demand, identifying gaps or risks in the implementation of business processes, allowing performing studies for the prediction of situations, and analyzing whether the organization can absorb a change in customer demand.

The process of Capacity Management should be the main point of all executions related to IT services resources [1]. The process should cover both the operational and the development environment:

- All hardware, equipment from the workplace to the servers that make up the various systems and platforms and cross corporate applications.
- All equipment networks (LANs, WANs, wireless, bridges, routers, etc.).
- All peripherals (storage systems, save and restore systems, printers, and others.)
- All software, operating systems and network software, internal and external developments,

and corporate applications, educational applications packages, etc...

- Human resources involved in the processes of IT service management.

The capacity management ensures that capacity exists in all areas of IT, at a justifiable cost, and it is sufficient for current and future capabilities. It includes requirements by the proactive study of business and services capabilities or by users. And it concludes with the reporting and capacity plans.

### Research method

The selection of the models and standards has been carried out using the Method of Study of Similarity of Models and Standards (MSSS) [6]. The MSSS method has been proposed by the Research Chair for Software Process Improvement for Spain and the Latin American Region (MPSEI) of the Universidad Politécnica de Madrid, and has been validated by authors in different fields of study. The MSSS method has been developed after a thorough analysis of available studies on different mapping models and standards. These studies consist of seven phases to find the similarities between the models and the criteria considered in the study.

The MSSS method formalizes these phases, through the phases it proposes. These phases are:

- A. Identifying potential models and standards to analyze.
- B. Selecting or defining the reference model.
- C. Selecting the process (or processes) that is going to be analyzed.
- D. Establishing the level of detail.
- E. Creating a template for the comparison.
- F. Identifying the similarities between the models.
- G. Presenting the results.

These stages are general and have been adapted for the study and research area of knowledge addressed in this article; then, the adapted method is presented for the study of similarity from the capacity management of IT services (see Table 1).

**Table 1** Adaptation of the phases of the MSSS method

		<i><b>Adaptation of MSSS method for Capacity Management</b></i>
<i><b>Methodology</b></i>	<i><b>Phases</b></i>	
<i><b>Selection</b></i>	A	Criteria for the selection of models and standards.
	B	Description of the option selected.
<i><b>Analysis</b></i>	C	Identifying the processes to be analyzed.
	D	Defining the aspects to analyze the processes related with capacity management of the different models and standards.
	E	Setting the objective of the analysis.
<i><b>Results</b></i>	F	Identifying similarities, synthesizing information and collecting results.
	G	Presentation of the comparison of models and standards.

### Selection of models and standards

Stages A and B of the proposed method are followed for selecting the models and standards.

#### ***A. Criteria for selecting the models and standards***

The selection of models and standards has been carried out according to the following criteria:

- Those models or standards that relate to the IT service capacity management.

- Those models or standards with available information.
- Those models or standards that address the process related to capacity management.

### **B. Description of the selected models**

According to the above criteria, the following models and standards were selected:

- ISO/IEC 20000:2005 INFORMATION TECHNOLOGY - SERVICE MANAGEMENT [7, 8].

It helps organizations to demonstrate their ability to manage IT services in line with the specific customer needs. The scope defines the limits of application of the management system to implement, and its determination involves the following attributes: service, functions of the organization, geographic location, infrastructure and language.

- INFORMATION TECHNOLOGY INFRASTRUCTURE LIBRARY, ITIL V3 [1, 5, 9, 10,11].

It is applicable to any organization worldwide. It is used by organizations to create and maintain service management capabilities. ITIL proposes an independent standard industry terminology and technology, which defines “DOs” and “DON’Ts” in an organization that applies IT service management.

- CAPABILITY MATURITY MODEL FOR INTEGRATION - CMMI for Services (CMMI-SVC) V1.3 [4].

It is a best-practice model that helps organizations providing services to establish, to manage and to offer successful services.

- CONTROL OBJECTIVES FOR INFORMATION AND RELATED TECHNOLOGY, COBIT 5 [12].

It is an IT governance framework that helps to create optimal value of IT keeping a balance between the benefits and the optimization

of the risk levels, and use of the resources. COBIT enables that information and the related technology are governed and managed holistically across the enterprise, covering the business and functional areas from start to finish, and taking into account the interests of internal and external stakeholders.

- eSOURCING CAPABILITY MODEL FOR CLIENT (eSCM-CL V1.1)[13].

It is a capability model customized to the client organizations, a set of best practices to evaluate and improve the ability to develop more effective relationships and to improve the management of these relationships.

- eSOURCING CAPABILITY MODEL FOR SERVICE PROVIDERS (eSCM-SP V1.1) [14].

It is a model of best practices that provides a framework for service providers of eSourcing to manage risks and improve its service capabilities across all sourcing lifecycle.

### **Analysis**

Stages C, D and E of the proposed method were followed for the analysis of the selected models and standards.

#### **C. Identify the processes to be analyzed**

The processes that will be analyzed are determined by the field of IT service management. Processes and elements of the selected models and standards will be analyzed in order to identify their areas of capacity management. Table 2 shows the processes involved in each of the models/standards.

#### **D. Define the issues to analyze of the processes related to the management capacity for the different models and standards**

This analysis is carried out in relation to the following issues: 1) purpose, 2) scope, 3) structure and 4) process related to capacity management.

From the above issues for the analysis of models and standards, table 2 shows a summary of the purpose of the process related to the capacity

management that is established by each selected model and standard.

**Table 2** Purpose of the processes related to the capacity management of the models and standards

<i>Model/Standard</i>	<i>Process related to Capacity Management</i>	<i>Purpose</i>
<b>ISO/IEC 20000:2005</b>	Capacity Management	The purpose is to ensure that the service provider has, at any given time, sufficient capacity to meet the agreed upon current and future demands of the client's business needs.
<b>ITIL V3</b>	Capacity Management	The purpose of achieving results requires three supporting sub-processes: Managing the Business Capacity, managing the Service Capacity and managing the Resources Capacity.
<b>CMMI for Services V1.3</b>	Capacity and Availability Management	The purpose is to ensure the efficient operation of the service system and that the resources are used efficiently to support the requirements of the service at a justifiable cost.
<b>COBIT 5</b>	Capacity and Availability Management	The purpose is to maintain service availability, the efficient management of the resources and the optimization of the performance of the system by predicting future performance and capacity requirements.
<b>eSCM-CL V1.1</b>	Capacity baselines	The purpose of this practice is to establish the baseline performance for the capacity sourcing.
<b>eSCM-SP V1.1</b>	Capacity baselines	The purpose of this practice is to establish the baseline performance of the specific capabilities of the organization.
<b>MOF 4.0</b>	Capacity Management	The purpose is to ensure that current and future needs of IT activities are met in a cost effective manner.

**E. Set the objective of the analysis**

This analysis seeks to determine the activities and characteristics of the models and standards regarding the IT capacity management in the service management. Depending on the model or standard, the structure of the capacity management can be referred as: process (ISO/20000, ITIL and COBIT), process area (CMMI), and practice (eSCM-CL/SP). In this paper we use the term “process”.

Also the phases are named differently: activities (ISO/20000, ITIL, and eSCM-CL/SP), subpractices (CMMI), and goals (COBIT). We will use the term “activities”.

Once the activities and characteristics of the capacity management process for the different models and standards are selected, we will compare the most important activities (see Table 3) and characteristics (see Table 4). This comparison will determine which of the models and standards are considered relevant to carry out capacity management.

## Results

Stages F and G of the selected method were followed to obtain the results from analysis of the selected models and standards.

### ***F. Identifying similarities synthesizing information and collecting results***

As a result of the analysis of each of the models, and following the method proposed, it was possible to identify the similarities, strengths and weaknesses of the models. The results are presented through two tables (Tables 3 and 4): a table comparing the activities of the models and standards (Table 3), and another table (Table 4) comparing the most representative features for implementing the capacity management.

### ***G. Presentation of the comparison between models and standards***

After having analyzed the models and standards used for the capacity management of IT services, the comparison between them is summarized as follows:

It is necessary to perform a set of activities to optimize the performance, efficiency and costs for having a proactive capacity management of IT services, with fewer incidents and less forecast risk (possible saturation systems, possible broken agreements). For this reason, it has been carried out an analysis of the activities of the different models and standards, taking as reference the ITIL model, because it has the activities relating to capacity management in a more detailed way.

Table 3 shows a comparison of the activities of the capacity management process, detailed in the different models and standards. In this analysis the most relevant features of the models and standards for an efficient IT services capacity management are determined, and also the features that are addresses by the different models and standards are presented.

The models and standards that provide a solid basis for establishing a capacity plan should

be considered in the IT services capability management. In table 4, models and standards presented previously are compared, and their weaknesses and strengths regarding the capacity management are presented (a “•” means a strength of the model/standard related to the characteristics assessed while a blank means there is a weakness). The models that have more features in relation to the management of IT service capacity are the ITIL model [1]. For this reason, the management of IT service capacity may be based on the ITIL model and, specifically, on the Capacity Management (CAM Capacity Management) process.

The ITIL V3 model and the other models and standards mentioned are just some of those considered useful for determining which activities should be carried out to implement a plan to manage the capacity of IT services. Moreover, as models and standards they are, none of them focuses on how to develop such activities (the “how”). In addition, these proposals have a high level of complexity, which increases, in turn, the level of difficulty in the implementation.

A systematic review has been conducted in order to know the current situation of the capacity management process related to the different models and standards. Ninety primary papers were found, but all of them only compare the models at a high level, without going into details for any particular process, either for the capacity management (some of these papers are the following [3, 15-23]). Therefore, the authors of this article have selected the 8 characteristics presented in table 4, based on the activities a capacity management process must have.

This creates another problem for the organizations looking to implement these types of models or standards, especially when it comes to small environments, which represent the highest percentage among small, medium and large enterprises according to the Central Companies Directory (DIRCE) [24] (see Table 5).

**Table 3** Relation of the activities of the capacity management in the different models and standards

<b>Activities of the Capacity Management</b>			
<b>ITIL V3</b>	<b>ISO/IEC 20000</b>	<b>CMMI SVC</b>	<b>COBIT</b>
<b>eSCM-SP</b>	<b>eSCM -CL</b>	<b>eSCM -CL</b>	<b>eSCM-SP</b>
<b>Modeling</b>			
<b>Service monitoring</b>	The capacity and availability are monitored and analyzed to manage resources and demand.	Providing support for creating and maintaining the work output and tasks for defining the capacity baselines for the client's organization.	Providing support for creating and maintaining the work output and tasks for defining the capacity baselines for the client's organization.
<b>Measuring the performance of the various components</b>			
<b>Managing the demand</b>	Delivery of the IT services in accordance with business requirements.		
<b>Analyzing load thresholds of the components</b>			
<b>Optimizing the use of available resources</b>	Optimization of the IT assets, resources and capabilities.		
<b>Implementing the changes related to the capacity</b>	Preparation for capacity management and availability is implemented.	Supporting the implementation of the definition of the capacity baselines for the client's organization.	Supporting the implementation of the definition of the capacity baselines.
<b>Developing a capacity plan</b>	The requirements for capacity, performance and behavior, actual and forecasted.	Documenting and implementing the work output and tasks necessary for the definition of the capacity baselines for the client's organization.	Documenting and implementing the work output and tasks necessary for the definition of the capacity baselines.



**Table 4** Comparison of the characteristics of the models and standards

	ISO/IEC 20000	ITIL	CMMI SVC	COBIT	eSCM (CL/SP)
Focus on the field of IT services	•	•	•	•	•
Model / standards of best practice		•	•	•	•
Definition of the process of capacity management	•	•	•	•	
Definition of the process of management capacity independent of other process areas	•	•			
Defining of the activities of capacity management	•	•	•	•	•
Development of the capacity plan		•			
Definition of the metrics for capacity management		•	•	•	
Developed for SMEs	•			•	•

**Table 5** Spanish companies according to workforce numbers and percentage of total, DIRCE 2014

Range of Employed	Self-employed	Very Small 1-9	Small 10-49	Medium 50-199	Large +200	Total
<b># Enterprises</b>	1.672.483	1.316.431	108.383	16.976	5.127	3.119.310
<b>% Total</b>	53,61%	42,20%	3,47%	0,54%	0,21%	
<b>% Cumulative</b>	53,61%	95,82%	99,29%	99,84%	100%	

## Conclusions

The models and standards are essential to ensure that: 1) IT resources are aligned with business objectives, and 2) the information and the services meet the quality, financial and security requirements. They can be combined to obtain a powerful framework of best practices, with a better control and governance related to the management of IT services.

Incrementally, the use of models and standards such as ISO/IEC 20000:2005, ITIL V3, CMMI for Services V1.3, COBIT 5, eSCM-CL V1.1, and eSCM-SP V1.1, is being driven by the business requirements for performance improvements, transparency and control over the activities of IT service management. And the capacity management of IT services is included in these activities.

The adoption of models and standards facilitates the rapid implementation of good procedures and helps avoiding unnecessary delays in the development of new approaches. All businesses

need to adapt the use of models and set standards to adjust their individual requirements.

It is important to understand that the adoption of a framework for managing IT service capacity is not a magic solution. It is a difficult task, and achieving the benefits requires time, planning and commitment.

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