

Measurement Tools of the Maturity Model for IT Service Outsourcing in Higher Education Institutions

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Abstract—Nowadays, the successful implementation of ICTs is vital for almost any kind of organization. Good governance and ICT management are essential for delivering value, managing technological risks, managing resources and performance measurement. In addition, outsourcing is a strategic IT service solution which complements IT services provided internally in organizations. This paper proposes the measurement tools of a new holistic maturity model based on standards ISO/IEC 20000 and ISO/IEC 38500, and the frameworks and best practices of ITIL and COBIT, with a specific focus on IT outsourcing. These measurement tools allow independent validation and practical application in the field of higher education, using a questionnaire, metrics tables, and continuous improvement plan tables as part of the measurement process. Guidelines and standards are proposed in the model for facilitating adaptation to universities and achieving excellence in the outsourcing of IT services.

Keywords—IT Governance, IT Management, IT Services, Maturity Model, Measurement Tools, Outsourcing.

I. INTRODUCTION

ONE thing to change about ICT at university level is the deeply rooted approach which exists, or which used to exist, called infrastructure management. This kind of management has evolved into a governance and management model more in line with the times, which is a professional management of services offered to the university community [6]. It is for this reason that in recent years a set of methodologies, best practices and standards, such as ITIL, ISO 20000, ISO 38500 and COBIT, have been developed to facilitate ICT governance and management in a more effective and efficient way.

These methodologies, which are appropriate and necessary to move from infrastructure management to service management, see a lack of academic research. For that reason it is inadvisable to use these frameworks on their own, and it is advisable to consider other existing frameworks in order to extract the best from each for university level [6].

ICT or IT services have implications for business and innovation processes and may be a determinant in their evolution. The organization of these services, their status within the organization of the university, and their relationships with other management departments and new technologies is therefore vital. At present, the degree of

involvement, the volume of services offered, and the participation or external alliances with partner companies through outsourcing, that Gottschalk and Solli-Saether [7] defined as the “practice of turning over all or part of an organization’s IT function to an IT vendor”, are of special interest.

Currently, and in the years to come, organizations that achieve success are and will be those who recognize the benefits of information technology and make use of it to boost their core businesses in an effective strategic alignment, where delivery of value, technology, risk management, resource management, and performance measurement of resources are the pillars of success.

It is necessary to apply the above-mentioned practices through a framework and process to present the activities in a manageable and logical structure. Good practice should be more strongly focused on control and less on execution. They should help optimize IT investments and ensure optimal service delivery. IT best practices have become significant due to a number of factors, according to COBIT [10]:

- Business managers and boards demanding a better return from IT investments;
- Concern over the generally increasing level of IT expenditure;
- The need to meet regulatory requirements for IT controls;
- The selection of service providers and the management of service outsourcing and acquisition;
- Increasingly complex IT-related risks, such as network security;
- IT governance initiatives that include the adoption of control frameworks and good practices to help monitor and improve critical IT activities to increase business value and reduce business risk;
- The need to optimise costs by following, where possible, standardised, rather than specially developed, approaches;
- The growing maturity and consequent acceptance of well-regarded frameworks, such as COBIT, IT Infrastructure Library (ITIL), ISO 27000 series on information security-related standards, ISO 9001:2000 Quality Management Systems—Requirements Capability Maturity Model ® Integration (CMMI) and Projects in Controlled Environments 2 (PRINCE2); and
- The need for organizations to assess how they are performing against generally accepted standards and their peers (benchmarking).

It is clear that ICTs have become ubiquitous in almost all organizations, institutions and companies, regardless of the sector to which they belong. Hence, effective and efficient ICT management to facilitate optimal results is necessary essential.

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Furthermore, in this environment of total ICT dependency in organizations using ICTs for the management, development and communication of intangible assets, such as information and knowledge [15], organizations become successful if these assets are reliable, accurate, safe, and delivered to the right person at the right time and place, according to ITGI [10]. Also, knowledge integration mechanisms are important in helping knowledge utilization in client firms [17].

In short, Fernández [6] proposes that the proper administration of ICT will add value to the organization, regardless of its sector (whether social, economic or academic) and will assist it in achieving its objectives and minimizing risk.

Given the importance of proper management of ICT, the search for solutions to the alignment of ICT with the core business of organizations has accelerated in recent years. The use of suitable metrics or indicators for measurement and valuation, generate confidence in the management teams. This will ensure that investment in ICTs generates the corresponding business value with minimal risk [6].

The above solutions are models of good practice, metrics, standards and methodologies that enable organizations to properly manage ICTs. And public universities are not outside these organizations, though they are not ahead. In addition, interest in adopting models of governance and management of appropriate ICTs is not as high as it should be.

Two of the factors through which IT best practices have become important are, the selection of appropriate service providers and the management of outsourcing and procurement of IT services.

IT outsourcing has brought potential benefits in addition to many examples of the great organizational losses associated with this practice. Even with awareness of the potential for failure, the IT outsourcing industry continues to grow, as organizations communicate their desire to engage in IT outsourcing and their determination to decipher a method that enables successful IT outsourcing relationships [16].

In addition, a maturity model is a method for judging whether the processes used, and the way they are used, are characteristic of a mature organization [4].

Models by phases or levels allow us to understand how IT management strategies based on computing evolve over time [11]. According to these models, organizations progress through a number of identifiable stages. Each stage or phase reflects a particular level of maturity in terms of IT use and management in the organization.

There are many maturity models in the literature, and they are applied to various fields, such as project management, data management, help desk, systems safety engineering. Most of them refer to either Nolan's original model [14] or the Capability Maturity Model of Software Engineering Institute (Carnegie Mellon Software Engineering Institute). The latter model describes the principles and practices underlying software processes and is intended to help software organizations evolve from ad-hoc, chaotic processes to mature, disciplined software processes.

Nolan was the first to design a descriptive stage theory for planning, organizing and controlling activities associated with managing the computational resources of organizations. His research was motivated by the theoretical need for the management and use of computers in organizations. From 1973 until today, technology and the way it is used has changed a lot, but Nolan's original idea is still valid, and it will remain so as long as the quality of services provided internally in organizations, or by external suppliers, are essential.

II. LITERATURE REVIEW ON MATURITY MODELS FOR IT OUTSOURCING AND COMPARISON CHART

Very few models or frameworks of IT outsourcing can be found in the literature, either from the point of view of the client or outsourcer. The few models or frameworks that exist are varied. After a thorough literature review, and taking into account the point of view of the customer, the following models have been found to be relevant:

- M1: Managing Complex IT Outsourcing – Partnerships [2]
- M2: Information Technology Outsourcing (ITO) Governance: An Examination of the Outsourcing Management Maturity Model [4]
- M3: A Unified Framework for Outsourcing Governance [5]
- M4: IT Outsourcing Maturity Model [1]
- M5: Outsourcing Management Framework Based on ITIL v3 Framework [12]
- M6: Multisourcing Maturity Model [9]
- M7: Maturity Model for IT Outsourcing Relationships [8]
- M8: IT Governance Maturity and IT Outsourcing Degree: An Exploratory Study [3]
- M9: Global Multisourcing Strategy: Integrating Learning From Manufacturing Into IT Service Outsourcing [13]

The following table shows the maturity models and frameworks above, along with the key areas or determinants that they are based on. All key areas shown in the Table I are the bases of the maturity model designed for IT service outsourcing.

Taking into account all key areas shown in Table I, a holistic maturity model (henceforth MM) has been designed with a specific focus on IT outsourcing governance and IT service management. The model establishes where organizations involved in the study are in relation to the following control criteria and information requirements according to Cobit: effectiveness; efficiency; confidentiality; integrity; availability; compliance; and reliability. Other criteria, from the perspective of managing critical IT resources; included: applications; information; infrastructure; and people.

TABLE I
EXISTING MATURITY MODELS AND FRAMEWORKS ON IT OUTSOURCING

Key areas or determinants	Maturity models and frameworks about IT outsourcing								
	M1	M2	M3	M4	M5	M6	M7	M8	M9
Formal Agreement	X			X		X	X		X
Service Measurement		X	X		X	X		X	
Quality Management		X					X		
Monitoring and Adjustments		X	X		X	X		X	
Alignment IT-Business	X	X	X					X	
IT Governance Structure	X		X					X	
Service Level Agreement (SLA)	X	X		X	X		X		
IT Service Registration									
Incident and Problem Management				X	X				
Changes					X				
Testing and Deployment									
Control of External Providers	X	X			X	X	X	X	X
Business Risk		X	X		X			X	
Financial Management					X	X	X	X	X
Legislation			X			X			
Demand and Capacity Management									
Formal Agreement Management	X								X
Knowledge Management	X		X				X		
Guidelines on outsourcing an IT service									

With regard to IT governance, standard ISO/IEC 38500:2008, published in 2008, aims to provide a framework of principles for directors of different organizations in order to manage, evaluate, and monitor the efficient, effective and acceptable use of information and communication technologies. The direction, according to ISO / IEC 38500, must govern IT in three main areas:

- Management. Direct the preparation and implementation of strategic plans and policies, assigning responsibilities. Ensure smooth transition of projects to production, considering the impacts on the operation, the business and infrastructure. Foster a culture of good governance of IT in the organization.
- Evaluation. Examine and judge the current and future use of IT, including strategies, proposals and supply agreements (both internal and external).
- Monitoring. Monitor IT performance measuring systems in order to ensure that they fit as planned.

According to the results of the "IT Governance Study 2007" [18], [19], reasons compelling governments to create an IT structure in the university include: aligning IT objectives with strategic objectives; promoting institutional vision of IT; ensuring transparency in decision-making; cost reduction; increased efficiency; and regulation and compliance audits.

On service management, MM takes into account ISO/IEC 20000 and ITIL v3, but it is customized to integrate governance and management into a single model. The model

moves towards an integration that facilitates the joint use of frameworks efficiently. Thus, the MM designed consists of five levels, with each level having a number of general and specific characteristics that define it. These are determined by the selection of general concepts that underpin the MM (see first column in Table I). The selection is always justified and countersigned by ISO 20000 and ISO 38500 standards and ITIL and COBIT best practice methodologies.

III. MATURITY MODEL PROPOSED

In order to design the proposed maturity model, we studied in detail every reference on the provision of IT services that there is in the ISO 20000 and ISO 38500 standards and ITIL v3 and COBIT methodologies. In addition, we investigated the relevant literature and failed to find any maturity model that brings together the previous methodologies with a specific focus on IT outsourcing. As a result, a number of concepts and subconcepts were categorized to form the basis of the maturity model.

The MM follows a stage structure and has two major components: maturity level and concept. Each maturity level is determined by a number of concepts common to all levels.

Each concept is defined by a number of features that specify the key practices which, when performed, can help organizations meet the objectives of a particular maturity level. These characteristics become indicators, which, when measured, determine the maturity level.

The MM defines five maturity levels: initial or improvised; repeatable or intuitive; defined; managed and measurable; and optimized.

The model proposes that organizations under study should ascend from one level of maturity to the next without skipping any intermediate level. In practice, organizations can accomplish specific practices in upper levels. However, this does not mean they can skip levels, since optimum results are unlikely if practices in lower levels go unfulfilled.

IV. OBJECTIVES OF THE MATURITY MODEL

The main purpose of the model is to fulfill as many requirements of an ideal maturity model for IT outsourcing in the governance and management of outsourced IT services as possible. With the identification and definition of some key concepts and an assessment tool, the model allows a systematic and structured assessment of organizations. Although the assessment instrument has a lot of qualitative responses, it also has quantitative responses, such as the degree of compliance with certain characteristics that define the maturity model (e.g. the degree of influence of the KPIs and KGIs in the penalties for breach of agreements).

The identification of key areas and concepts specifying its characteristics to constitute the underlying structure of the MM, complements the necessity to refer to governance and management concepts tested and backed by standards and methodologies. Moreover, the model advocates continuous learning and improvements in governance in IT outsourcing and good management of outsourced IT services, even when

organizations have reached the maximum level (5).

V. MEASUREMENT TOOLS OF THE MATURITY MODEL

We have designed an assessment tool along with the maturity model that allows independent validation and practical application of the model. Therefore, the maturity of an organization indicates how successfully all practices that characterize a certain maturity level have gone fulfilled. The questions used in the questionnaire consider the basis of the assessment instrument. They were extracted from each of the indicators defining each of the general concepts and key areas of the maturity model. These general concepts and defining characteristics have been extracted from the following standards and methodologies:

- Standard ISO/IEC 20000 and methodology of good practices ITIL v3. Both provide a systematic approach to the provision and management of quality IT services.
- Standard ISO/IEC 38500:2008 provides guiding principles for directors of different organizations to manage, evaluate, and monitor the use of information and communication technologies effectively and efficiently.
- Cobit business-oriented methodology provides good practice through a series of domains and processes, as well as metrics and maturity models in order to measure the achievement of the objectives pursued.

In addition, new indicators have been developed based on the proposed model in order to assess appropriate aspects not reflected either in previous methodologies and standards or in the existing literature (e.g. the inclusion of service performance in the SLA and the use of user-satisfaction surveys in IT-business alignment).

TABLE II
METRICS TABLE AND QUESTIONNAIRE

Level	Code – Indicator – Question of Questionnaire	Source
Concept: <i>Formal Agreement: contract, agreement or similar (FA)</i>		ISO 20000, Cobit, ITIL v3
3	FA1 - Procedures and processes – Are there clear documented procedures to facilitate the control of outsourced IT services with clear processes for negotiating with external providers?	Cobit
	FA2 - Elements of FA - Formal agreements (contracts, agreements or the like) of every outsourced IT service include:	ISO 20000, ITIL, Cobit
3	FA2a - Scope of work	
2	FA2b - Services / deliverables to be provided	
3	FA2c – Timeline	
2	FA2d - Service levels	
2	FA2e – Costs	
3	FA2f - Billing Agreements	
2	FA2g - Responsibilities of the Parties	
	FA3 - Requirements of FAs - Formal agreements meet the following requirements:	Cobit
3	FA3a - Legal (compliance with current regulations)	
3	FA3b - Operational (proper delivery and management of services in operation)	
3	FA3c - Control (for the measurement and analysis of the services)	
4	FA4 - Revision frequency of FAs - Formal agreements are reviewed periodically at predefined intervals	ISO 20000
3	FA5 - Penalties in FAs - There are penalties for breach of formal agreements, including termination of agreements	Self developed
345	FA6 - Enforcement of penalties in FAs - Degree of enforcement of penalties for breach of agreements	Self developed
Concept: <i>IT Governance Structure (EOG)</i>		IT Governance Study 2007, ISO/IEC 38500
2	EOG1 - Board of Directors and CIO – There is a Board of Directors where CIO is a member	
2	EOG2 - IT Strategy Committee - There is an IT Strategy Committee (CIO is a member) that designs the strategy and high-level policies of the university on IT	
3	EOG3 - Audit Committee (external and internal) - There is an Audit Committee (external and internal) that oversees the IT governance and provides support to auditors in their duties	
2	EOG4 - IT Steering Committee - There is an IT Steering Committee led by CIO that designs and implements IT projects that meet IT strategic planning	
3	EOG5 - Commission on Technology and / or IT Architecture - There is a Committee on Technology and / or IT architecture led by CIO that advises and coordinates IT management issues	
2	EOG6 - Projects Office - There is a Projects Office led by CIO that manages IT projects	
2	EOG7 - Services Commission - There is a User Services Commission representing all end users of IT services	
Concept: <i>Service Level Agreement (SLA)</i>		ISO 20000 & ITIL
2	SLA1 - SLA - There is an SLA for each outsourced IT service provided by the service provider	ISO 20000 & ITIL
	SLA2 - Elements of SLA - SLAs include:	
2	SLA2a - Service availability	
5	SLA2b - Service performance	Myself
3	SLA2c - Penalties for breach of SLA	
2	SLA2d - Responsibilities of the parties	
3	SLA2e - Recovery Times	
4	SLA2f - Quality Levels	
4	SLA2g - Security requirements	
3	SLA3 - Frequency reviewing of SLA - SLAs are reviewed periodically at predefined intervals	ISO 20000 & myself

To evaluate the maturity model of an organization using the model and the measurement instruments proposed, it is necessary to obtain a series of data resulting from the responses to the questionnaire based on the indicators that define the general concepts of our maturity model.

Table II shows three of the nineteen key areas or concepts that are the basis of the MM. The first column of the table shows the level or levels corresponding to the indicator located in the second column. The second column shows the survey questions and indicators for each of the questions or part of the questions. Finally, the third column shows the source where the indicator or item has been extracted as a feature of the general concept or key area of the model.

Therefore, the maturity level of every higher education institution studied is measured by evaluating its development in each key area or concept, which is indicated by responses to items or indicators in metrics tables (see Table II). In order to qualify for a specific maturity level, the university surveyed must carry out all key practices of that level successfully.

A. Improvement Plan

Both ISO 20000 and ISO 38500 standards, and ITIL v3 and COBIT methodologies of best practice in IT management and governance, are a good basis for the study and analysis of governance and management of the outsourced IT services in organizations. That is why they allow the design of a new maturity model that facilitates the achievement of an effective transition to a model of good governance and management of outsourced IT services that, aligned with the core business in higher education institutions, impacts on the effectiveness and efficiency of its management, optimizes its value and minimizes risks.

A questionnaire (survey form) forms the basis of the quantitative study of the maturity model. The questionnaire is based on the attributes or indicators that define the different levels of the model. It contains standard and suitable questions, according to the nature of the research.

Questionnaire responses allow the obtaining or calculation of the level of maturity by applying the scale defined in the model. In addition, questionnaire responses, after being properly analysed, shed light on the current situation of the different organizations studied in governance and management of outsourced IT services.

This research also provides specific case studies carried out at some universities. These case studies put the model into practice in order to draw conclusions. The questions used in the questionnaire, completed by the universities under study, bring the design of a proposed improvement plan (see Tables III and IV) to allow a sequential growth by stages. The growth occurs as a hierarchical progression that should not be reversed, for the aforementioned reasons, and involve a broad range of organizational activities in governance and management of IT outsourcing.

Tables III and IV show two different levels (there are five tables, one for each level) of the MM with the key areas or concepts to be improved in order to allow a sequential growth

by stages. The first column of the tables shows the concepts. The second column of the tables shows the objectives to achieve corresponding to the concept in the first column. Finally, the third column shows the actions to accomplish in order to achieve the objectives set in the second column.

TABLE III
 IMPROVEMENT PLAN: LEVEL IV

Level IV - Managed and measurable		
Concept	Improvement Objectives	Improvement Actions
Formal Agreement: Contract, agreement or similar (FA)	<ul style="list-style-type: none"> - Signed formal agreements are reviewed periodically at predefined intervals - Good degree of enforcement of penalties for breach of formal agreements 	<ul style="list-style-type: none"> - Signed formal agreements should be reviewed periodically at predefined intervals. Thus, a higher degree of flexibility and alignment of the signed formal agreements to the business requirements could be reach in the organization - IT Management should demand a good degree of enforcement of penalties for breach of formal agreements signed with external providers. The penalties should be stipulated in the agreements signed
Monitoring and adjustments of outsourcing (MON)	<ul style="list-style-type: none"> - KPIs and KGIs affect penalties, contracting and negotiation of outsourced IT services to a great extent - Corrective actions are implemented, if need be, as a result of monitoring 	<ul style="list-style-type: none"> - The results of KPIs and KGIs indicate the degree of compliance with the agreements signed. It would be necessary these results to affect penalties, contracting and negotiation of outsourced IT services to a great extent - Corrective improvement actions should be implemented, if needed, as a result of monitoring
Alignment IT-Business (ALI)	<ul style="list-style-type: none"> - The requirements of the outsourced IT services are very well defined, very well implemented and very well aligned with business objectives in organizations - End-users satisfaction survey responses on the quality of service users receive, affect the provision of services 	<ul style="list-style-type: none"> - The degree of alignment or integration of the outsourced IT services with business depends on how the requirements of the outsourced IT services have been met. Therefore, it would be necessary to have these requirements very well defined, very well implemented and very well aligned with business objectives in organizations - End-users satisfaction surveys should be taken into account and they should affect the provision of service
Service Level Agreement (SLA)	<ul style="list-style-type: none"> - SLA includes: quality levels, and security requirements 	<ul style="list-style-type: none"> - It would be advisable to include in SLAs, in addition to all components included in lower levels, the quality levels demanded and security requirements. Thus, a reliable provision of IT services is ensured
Incident and Problem Management (GIP)	<ul style="list-style-type: none"> - The degree of optimization of problem management process is very high - There is a close link between incident management and service level management 	<ul style="list-style-type: none"> - It would be necessary to have Problem Management Process implemented with a high degree of optimization. IT manager should ultimately be the responsible for supervising the high degree of optimization of the process - As mentioned above, it is important the degree of linkage between incident management and service level management. This link allows prioritizing the resolution of incidents and obtaining good recovery times. Therefore, it would be advisable there were a close link between incident management and service level management
Changes (CAM)	<ul style="list-style-type: none"> - Every approved change has a backout plan to restore a service to its original or earlier state - A post-implementation review is performed in order to find out if the change has been carried out successfully 	<ul style="list-style-type: none"> - It would be advisable to have a backout plan for every approved change in order to be able to restore a service to its original or earlier state. The backout plan would be part of the change management process and it would prevent business risks - In addition, it would be necessary to perform a post-implementation review for every change carried out in order to find out if the change has been carried out successfully and to proceed with the closing of the change, in addition to identify opportunities to improve
Business risk (RIN)	<ul style="list-style-type: none"> - There is a contingency plan (CP) to go back for each outsourced service - The CP is reviewed periodically - Abilities and capacities of external providers are checked continuously over time 	<ul style="list-style-type: none"> - Because IT services support core business in organizations, it is essential to control the risk of disruption of IT services provided by external providers. As part of business continuity plan, it would be necessary there was a contingency plan to go back for each outsourced service that supports the core business in organizations. The CP should include technical, human and organizational measures in order to ensure business continuity and operations in the organization - The CP should be reviewed periodically. In general, the review would be as a result of a new risk analysis - The ability of the external provider refers to the external provider's capacity to provide a service properly. Thus, it would be necessary to check the abilities continuously over time, i.e. to check the strict compliance with signed agreements, e.g. service levels offered, quality of service, business continuity
Demand and capacity management (GDC)	<ul style="list-style-type: none"> - Demand management process (DMP) is implemented - Capacity management process (CMP) is implemented - DMP and CMP (justifiable in terms of cost) of every outsourced IT service are well geared to each other 	<ul style="list-style-type: none"> - Demand management is a process of the service strategy where service provision is tailored to demand predicts it and try to regulate it. It would be necessary to have the demand management process implemented within the IT machinery in the organization - Capacity management is a process that must provide IT capacity, justifiable in terms of cost, in line with the current and future user needs. It would be necessary to have the capacity management process implemented within the IT machinery in the organization - The capacity to generate resources available for an IT service is adjusted according to the provisions and needs defined in the demand. There is a close link between IT demand and IT capacity in organizations, where consumption cycle generates demand and the production cycle addresses it and responds with the capacity. Therefore, there must be a good linkage between demand management and capacity management
Formal Agreement Management (GAF)	<ul style="list-style-type: none"> - There is a formal agreement management system independent of both knowledge management system (KMS) and configuration management system (CMS) 	<ul style="list-style-type: none"> - It would be necessary there was a management system of formal agreements with external providers, in order to obtain high-quality service at a competitive price. Also, it would be advisable to create a data base to manage external providers and agreements signed with them, in order to have the system implemented effectively. However, the system would not be integrated yet into the configuration management system
Knowledge management (GCO)	<ul style="list-style-type: none"> - There is a knowledge management system (KMS) that contains documented outsourced IT services. The KMS is available to all stakeholders, and must provide all kind of information related to IT services requested 	<ul style="list-style-type: none"> - The knowledge management eases decision-making. Also, it provides safe reliable information during the service lifecycle. In order to share knowledge in an effective way, it would be necessary to develop and maintain a knowledge management system of IT services. The KMS should be available to all stakeholders and should provide all kind of information related to IT services requested

TABLE IV
 IMPROVEMENT PLAN: LEVEL V

		Level V - Optimized
Concept	Improvement Objectives	Improvement Actions
Formal Agreement: Contract, agreement or similar (FA)	- Very high degree of enforcement of penalties for breach of formal agreements	- IT Management should demand a very high degree of enforcement of penalties for breach of formal agreements signed with external providers. The penalties should be stipulated in the agreements signed with external providers, in addition to the termination of agreements for breach of them
Quality Management (QM)	- There is an EFQM- or CAF-type quality management system,	- Quality management is essential in order to ensure that IT is providing value to the organization, continuous improvement and excellence through IT services. Thus, it is needed to plan, implement and maintain a quality management system that provides clear requirements and procedures on quality. Quality requirements must be designed and documented with quantifiable and achievable indicators. Continuous improvement is achieved through constant monitoring, correcting deviations and communicating the results to stakeholders. Therefore, it would be necessary to develop and maintain an EFQM- or CAF-type quality management system that includes processes and proven standards
Alignment IT-Business (ALI)	- The requirements of the outsourced IT services are perfectly defined, implemented and aligned with business objectives in organizations	- The degree of alignment or integration of the outsourced IT services with business depends on how the requirements of the outsourced IT services have been met. Therefore, it would be necessary to have these requirements perfectly defined, implemented and aligned with business objectives in organizations
Service Level Agreement (SLA)	- SLA includes the expected performance of the service	- Most service providers, and more specifically cloud service providers, offer SLA with the service availability they provide, but they do not ensure the service performance. If a service is available and meet the percentage agreed, but it has a poor response time, the service can be considered unavailable. Therefore, it would be very important to stipulate in the SLA the service performance to meet the demanded requirements
IT Service Registration (RSS)	- The service catalogue includes for every service the following: conditions in providing the service, SLA, costs, and responsibilities of the parties	- IT Service Registration is like a portal or an acquisition channel for users. The service catalogue should include the costs, SLA, and the responsibilities of the parties, in addition to the terms and conditions in providing the services. Services should be broken down into its components and processes, in addition to defining points of entry and conditions of use and provisioning. This would result in a clearer and more direct information of outsourced IT services that would allow their publicity and good use of them by the end users
Changes (CAM)	- Change management includes an internal study of priorities of requests for change (RFC)	- Change management should include an internal study of costs, if appropriate, depending on the kind of agreement signed with the external provider, and an internal study of priorities of requests for change
Control of External Providers (CPE)	- Independent audits of external providers are carried out to evaluate the efficiency, effectiveness and economy of the IT services provided - Security reports are carried out on external providers in order to monitor and ensure the confidentiality, integrity and availability of information about IT services provided	- External providers should be subject to periodic independent reviews that will provide feedback to improve the delivery of services they provide. Therefore, it would be necessary to control external providers by carrying out independent audits and security reports - Independent audits would include review, evaluation, and reporting in order to assess the efficiency, effectiveness and economy of the suppliers in relation to their operational IT - Security reports would allow monitoring and ensuring the confidentiality, integrity and availability of information about IT services provided by external providers. Thus, risks would be minimized
Financial Management (CGF)	- There is a financial management committee that provides vital information for IT management in order to ensure the provision of outsourced IT services efficiently and cost-effectively	- Financial management implemented correctly provides vital information for IT management that ensures the provision of services efficiently and cost-effectively. Also, financial management ensures transparent service charges, via service catalogue, and allows services to fit into the business. In addition, financial management allows improving the following: decision-making capacity, compliance with the financial regulation, financial and operational control, and creating and capturing value. Therefore, it would be necessary to create a financial management committee. It would provide vital information for IT management in order to ensure the provision of outsourced IT services efficiently and cost-effectively
Demand and Capacity Management (GDC)	- DMP and CMP of every outsourced IT service are perfectly geared to each other	- There is a close link between IT demand and IT capacity in organizations, where consumption cycle generates demand and the production cycle addresses it and responds with the capacity. At this stage, demand management and capacity management must be geared to each other perfectly
Formal Agreement Management (GAF)	- There is a configuration management system (CMS) - The management system of formal agreements signed with external providers is integrated into the CMS	- It would be necessary there was a CMS. This system would allow to know and control easily: the infrastructure; relationships between configuration items that constitute the infrastructure and support services; and the lifecycle of configuration items - The database, which manages external providers and the agreements signed with them, is the core component of the management system of formal agreements signed with external providers. Also, this database should be integrated into the CMS
Knowledge management (GCO)	- The KMS that contains documented outsourced IT services is integrated into the CMS	- The knowledge management system (KMS) available, which improves among other things the quality of decision-making and ensures that safe and reliable information is available during the service lifecycle, should be integrated into the CMS. This way, the CMS sends information to the KMS to facilitate the decision-making process, among other functions - The KMS allows to make decisions easily and to get secure reliable information during the service lifecycle. The KMS should be integrated into the CMS. This facilitates the decision-making process, among other things

In the aforementioned case studies we apply the established scales, which rates the university surveyed and the object of study, at a level of maturity within the MM. Depending on the level of maturity in which the university is rated, improvement actions, according to the continuous improvement plan, will be proposed to achieve a target level.

The measurement process to ascend in the MM is as follows (see Fig. 1):

1. Perform an initial measurement after completing the questionnaire;
2. Set goals (benchmark);
3. Identify the gaps between the current measurement and the objectives set;
4. Recommend actions and policies to be implemented within the improvement plan to ascend in the MM; and
5. Once corrective actions have been implemented, perform a new measurement.

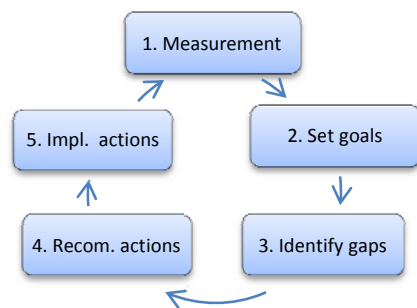


Fig. 1 Measurement process

The continuous improvement plan to apply the established scales (see Table II) in order to achieve a target level is as follows (see Fig. 2):

1. Initial measurement of the current level of the institution studied after completing the questionnaire. Equivalent to step 1 of the measurement process;
2. Identify improvement objectives using the values of the indicators. Equivalent to steps 2 and 3 of the measurement process; and
3. Implement improvement actions or practices in order to achieve the improvement objectives identified in stage 2. Equivalent to steps 4 and 5 of the measurement process. Back to the first stage.

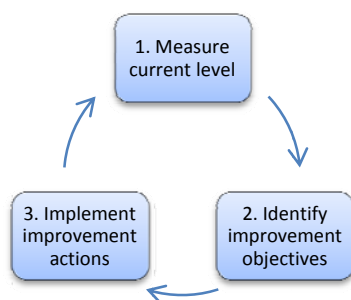


Fig. 2 Continuous improvement plan

The first stage of the continuous improvement plan involves measuring the current level of the institution under study. Once improvement objectives and improvement actions have been identified in the second stage, it is time to implement improvement actions. Once these actions have been implemented successfully, the third stage of the continuous improvement plan has been finished. That means institution under study has achieved the goals set in the stage 2 of the continuous improvement plan.

The continuous improvement plan is designed in such a way that allows moving up gradually in the model by repeating the three stages as many times as necessary.

Therefore, the next step would be to perform the first stage of the plan in order to measure the institution again. This first step is critical because the time between two measurements could be long, and some key practices done in the previous measurement, could not be done in the following measurement; and on the contrary, some key practices not done in the previous measurement, could be done in the next measurement, in addition to the practices to implement identified at the stage two and implemented at the stage three of the previous cycle of the continuous improvement plan.

VI. CONCLUSIONS

In order to design the proposed innovative maturity model and the measurement tools, we studied in detail every reference on the provision of IT services that there is in the ISO 20000 and ISO 38500 standards and ITIL v3 and COBIT methodologies. In addition, we investigated the relevant literature and failed to find any maturity model that brings together the previous methodologies with a specific focus on outsourcing in the IS/IT domain. As a result, a number of concepts and subconcepts were categorized to form the basis of the maturity model.

A questionnaire (survey form) forms the basis of the quantitative study of the maturity model. The questionnaire is based on the attributes or indicators that define the different levels of the model. It contains standard and suitable questions, according to the nature of the research.

Questionnaire responses allow the obtaining or calculation of the level of maturity by applying the scale defined in the metrics tables (see Table II). In addition, questionnaire responses, after being properly analysed, shed light on the current situation of the different organizations under study in governance and management of outsourced IT services.

The model allows organizations under study ascend from one level of maturity to the next without skipping any intermediate level. In practice, organizations can accomplish specific practices in upper levels. However, this does not mean they can skip levels, since optimum results are unlikely if practices in lower levels go unfulfilled.

MM advocates continuous learning and improvements in governance and management of outsourced IT services through the continuous improvement plan by applying the established scales, even when institutions have consolidated the highest level of the maturity model (level 5).

In addition, standards and guidelines showed in the improvement plan tables (see Tables III and IV) are recommended in order to enable and facilitate adaptation to universities so that they can move up the maturity model. Thus, the model, based on standards and best practices, is designed to achieve excellence in the management of IT outsourcing. The applicability of the MM and the measurement tools (questionnaire, metrics tables and continuous improvement plan), allow universities to meet the goal of effective transition to a model of good governance and good management of outsourced IT services. Aligned with the core business of universities (education, research and innovation) this will impact on the effectiveness and efficiency of their management, optimize value and minimize risks.

This study recognizes that it is unlikely to achieve maximum effectiveness and efficiency in the government and management of outsourced IT services, in a higher education institution in a relatively short period of time. The structure of the model proposed, organized in levels, provides a general understanding of the gradual and holistic development of IT governance and management of outsourced IT services. MM expects to be an effective diagnostic tool to measure the efforts made around IT outsourcing in higher education institutions, in addition to a coherent roadmap to guide higher education institutions in their efforts to provide their teaching, research, and administrative staff, and ultimately their students, with a quality and effective IT services in line with the ever-evolving digital era of the XXI century.

On the basis of this research, by categorizing concepts and subconcepts with a specific focus on IT outsourcing, and designing an assessment tool along with the maturity model that allows independent validation and practical application of the model, this study seeks to allow higher education institutions under study to meet successfully the requirements of the European Higher Education Area (EHEA) and the complex digital era of the internet.

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