

Received June 20, 2018, accepted August 5, 2018, date of publication August 14, 2018, date of current version September 5, 2018.

Digital Object Identifier 10.1109/ACCESS.2018.2865470

# Review of Proposals for the Construction and Management of the Catalog of Information Technology Services

CRISTIAN MERA MACIAS<sup>1,2</sup> AND IGOR AGUILAR ALONSO<sup>1</sup>

<sup>1</sup>Faculty of Systems Engineering and Informatics, National University of San Marcos, Lima 15081, Peru

<sup>2</sup>Technical Area, Universidad Laica Eloy Alfaro de Manabí, Chone 130704, Ecuador

Corresponding author: Cristian Mera (angel.mera@uleam.edu.ec)

This work was supported in part by the Research Group of Artificial Intelligence of the Faculty of Systems Engineering and Informatics, National University of San Marcos, and in part by the Universidad Laica Eloy Alfaro de Manabí.

**ABSTRACT** The catalog of information technology services is a structure where the information technology services are identified and classified within a given organization. This catalog is the basis for the information technology services portfolio to be properly managed during its useful life so that the financial, technological, and human and time resources are used correctly. There are many problems within the management of information technology services, beginning with the planning since many organizations avoid the construction of the information technology services catalog due to the complexity of this activity and the lack of proven proposals. Therefore, the general objective of this research project is to identify and compare the existing proposals for the construction and management of this catalog. As a methodology, a systematic review of the literature was done, with several proposals for the construction and management of the catalog in public and private entities. These proposals include models, frameworks, methods, and approaches, with the purpose of highlighting the characteristics of each one and serving as a basis for catalog management on bettering the information technology services. As a result of the research carried out, 14 proposals have been found for the construction and management of the information technology services catalog, reaching the conclusion that none of the proposals complies with all the activities of the information technology service catalog management. It is also necessary to experiment with the merger of one or more proposals in order to rescue the positive aspects of each one in order to devise a better proposal to properly manage information technology service catalogs, which guaranteeing its validity over time.

**INDEX TERMS** IT demand, IT services catalog, IT services management, IT services portfolio.

## I. INTRODUCTION

As the importance of information technology (IT) increases, the requirements placed on IT service providers by IT service applicants are changing. In order to meet these requirements, many methods and approaches are discussed and studied in science and in practices. Issues such as the orientation of IT services, IT service management (ITSM) and IT industrialization have been gaining importance in recent years [1]. An IT service can be defined as a package of services that are provided by an IT system or the IT department (respectively an external IT service provider) to support business processes [2], identification, classification, and withdrawal of IT services which are very important processes that must be considered in order for the business to function properly.

Organizations achieve their success by understanding the business, which must undergo the clarification of services, which lies in the identification of a service catalog (SC). An SC is a good basis for best practice initiatives, such as those established in the Information Technology Infrastructure Library (ITIL) and allows organizations to understand the needs of the business and the technical services that support these needs. Unfortunately, organizations do not identify the SC [3]. The SC is the cornerstone for defining the needs of the IT business [4], the definition of the SC together with appropriate financial planning leads to a better organization of the portfolio of IT services.

In an investigation carried out by Rudolph and Kremar [5] it is affirmed that the IT organizations of the participants in

this work were aware of the importance of establishing an SC, but they did not apply it, this is attributed to factors linked to deficient technical knowledge, lack of documentation of the IT portfolio, insufficient support from senior management, as well as difficulties in understanding the clients perspective. For Montenegro [6] the “Design of IT services” consists of designing new services or modifying existing ones to incorporate them into the SC and then into the production environment. The Design of the Service must balance the requirements of the service as the available resources and capacities, an imbalance could result in services where the functionality or the guarantee is compromised.

The SC is composed of the customer-oriented catalog (or external), which describes the services experienced by customers and the internal catalog, which describes the activities carried out to deliver customer-oriented services [7]. The implementation of IT service catalogs (ITSC) in practice is not standardized. Organizations decide individually whether to implement both or only one of the views in the ITSC. Often, ITSCs are established within the ITSM tools that include these views [8]. For the identification of the services that the IT area offers to its internal and external clients, a review of elements of the base infrastructure must be carried out, based on that revision, the ITSC will be built [9].

The design of the ITSC requires the evaluation of the current situation. It is essential to identify the baseline and the formation of an implementation. Maturity models are very suitable to determine the current position in an objective manner [5]. When it comes to services, the main problem of the organization is in making a correct identification of the service [10]. An ITSC implementation should begin with the service identification activity, even though this is the activity that most organizations do not perform correctly. When an ITSC is implemented, it is never completely finished, the reason is that emerging technologies continually emerge that force us to redefine it. Organizations must be constantly prepared for changes based on customer feedback, as well as for business development and improvement [3]. With this background emerged the questions that guide this research and seek to show existing models, frameworks, methods, and approaches that contain specific proposals for the identification, definition, classification, and withdrawal of services that are contained in the ITSC.

The general objective of this research project is to identify and compare the existing proposals for the construction and management of the ITSC, with the aim of clarifying the range of existing options to identify, define, classify and withdraw the services that could be specified in the ITSC. Therefore, it has been necessary to apply the guidelines of Kitchenham and Charters [11] for the review of the literature, methodology that raises the review, realization and obtaining of results. In addition, the motivation for conducting this review is based on the multiple disadvantages to define IT services and classify them appropriately in order to manage the ITSC, a situation that forces us to know the works and/or proposals made in this ambit.

This research project is structured as follows: Chapter II shows the background of the research, i.e. the information referring to the work done by other researchers in relation to the management of ITSC, these contributions vary in their type, that have allowed progress in this aspect of the ITSM until the 2004 year. Chapter III shows the definition of the ITSM, including the differentiation between the portfolio of IT services and the ITSC, in addition to an important aspect, such as the management of the demand for IT services, showing the differences between tactical, strategic and operational demand. Chapter IV details the methodology used, in this case, highlights fundamental aspects such as the formulation of the problem that includes the field, objective and target group, as well as the requirements for the management of the ITSC, on the other hand, it includes the identification of the proposals for the construction and management of ITSC found in the ACM Digital Library, ScienceDirect, IEEE Explore, Springer Link I, Wiley Online Library and Taylor & Francis from 2005 to 2017. Chapter V presents the results of the proposals found, here the findings are shown, highlighting the most relevant aspects of the selected studies that contain the proposals for the management of the ITSC. Chapter VI shows the analysis of the proposals by means of a detailed comparison and the answer to the questions that have guided this research work, and finally, the conclusions that highlight the most relevant aspects found in this research work are detailed.

## II. BACKGROUND

IT management is responsible for the establishing methods and practices that support IT operations. In order to support the challenges imposed on IT. IT management has evolved significantly to include ITSM devices, network, and systems management [12]. IT managers at companies are increasingly realizing that IT management should be a global approach to aligning IT services with business processes, which are focused on meeting the needs of end users and customers while improving the quality of service and reducing the costs of services [13]. Businesses require quality IT services economically in order to be efficient and effective organizations within their infrastructure and IT services [12]. The concept of service is fundamental to understand the main principles along with the best practices that the IT industry tries to follow [14], for this reason, the ITSM is currently a very important aspect that organizations consider for their operation.

When talking about ITSM it is necessary to mention the fundamental role that the IT Service Management Forum (ITSMF) has had, which is a global, independent and non-profit organization dedicated to continuous improvement in ITSM [15]. According to Clancy and Jennings [15], the ITSMF was established in the United Kingdom in 1991 and the founding chapter of the United Kingdom has made a significant contribution over the years in establishing the ITSMF as an international organization, as well as supporting the development of ITIL and the associated

schemes of qualification and certification. These authors state that it continues to be one of the most mature chapters, although it now manages several of its initiatives to continue developing and sharing these activities throughout the world. The identification, classification, and lowering of IT services is a very important task in the ITSM, as important as the management of IT demand, as well as the financial planning and the costs for the provision of these services. For the management of the ITSC several studies have been carried out, among them are mentioned:

Since 1998 Niessin and van Vliet [16] have worked on a maturity model of IT services capabilities that originated from the idea of developing a quality improvement framework that was oriented to help organizations to be more efficient with their services. One of the edges of the work done was the ITSC, which concluded that an SC needs experience with services and service level agreements (SLA).

In the year 2001 Walker [17] included in his book “IT problem management” a section dedicated to the maintenance of the SC, where he addressed the process to add services and to remove services. However, no evidence was found to corroborate the effectiveness of the processes proposed. Then, in 2002, Sullivan *et al.* [18], worked on a description of the general nature of services based on a review of the literature, where they define the SC as the list of services categorized according to specific classification schemes.

In the year 2004 Sallé [19], made a review of the existing literature to date, where it points out the importance of the design, development, operation, and delivery of services, as a fundamental aspect of the management of services, to several frameworks such as ITIL, British Standards (BS) 15000, HP IT Service Management Reference Model, Microsoft Operations Framework (MOF) and IBM’s Systems Management Solution Lifecycle.

The ITSC is one of the most valuable elements of a comprehensive approach in the provision of services and, as such, should receive due care and attention. The SC management process provides the means to devote that attention in a consistent manner, ensuring that the organization accumulates all the potential benefits of an ITSC in the most efficient way possible [20] to achieve the desired results.

### III. THE ITSC IN IT SERVICES MANAGEMENT

The ITSM is a subset of Services that focuses on IT operations, such as the provision of services and service support. ITSM is an emerging discipline that focuses on a set of well-established processes. These processes correspond to standards such as ISO/IEC 20000 and best practices such as ITIL [21]. ITSM is characterized by its emphasis on IT services, customers, SLA, and the management of the IT function and its daily activities function through processes [22].

At the strategic level, for the design of a particular service, it is necessary to consider the resources of a given provider, its competitive environment, and the needs of the clients. The latter is manifested in a perception of a set of “ideal

characteristics” [23]. To specify the coordination between IT providers and IT clients, it is necessary to define IT services. The service and quality characteristics of these IT services are negotiated between service providers and customers and are specified by an SLA [2]. The SLA is defined as a contract between the service provider and the customer, which documents the service levels stipulated for a given IT service [52], as well as the corrective measures and sanctions imposed on the provider if the service does not match what is requested of the customer. The SLAs are the essential basis for the legal contract between the supplier and the client, in the sense that it guarantees the same quality assessment criteria that will be used to clarify the responsibilities, so that it can establish a healthy relationship and a common framework between the parties involved [24].

Providing consistent quality of IT services has become essential for organizations to achieve success and customer satisfaction. The fundamental objective of the ITSM is to guarantee the quality of IT services [10], [25]. Organizations use different approaches to improve the quality of IT services. One of the initiatives adopted by organizations is to work with frameworks such as ITIL. The ITSM offers methods and measures to achieve the optimal support of the IT organization for business processes [8], especially the ITIL framework which allows conceptualizing, guide and optimizing IT services becoming one of the most important frameworks for this task. It consists of five phases: service strategy, service design, service transition, service operation and continuous service improvement. In each phase, a series of processes, roles, tasks, and tools are described. Within the service design phase, ITSCs become increasingly important [8], [26].

Successful management of service provision requires close integration between service operation management and service level management [27]. To achieve an effective ITSM, most organizations implement the ITIL framework. However, some of the implementations have failed due to several reasons, including the cost and nature of complexity in ITIL projects. According to a study by Mukwasi and Seymour [28], they suggest the possibility of having contradictory organizational culture assumptions between the organizations and the framework, which could be hindering the successful implementation of the framework. The framework is also incorrectly described as a framework of “best practices” instead of “common practices” for these authors.

The ITSC is a fundamental component of the portfolio of IT services in the ITSM, and since IT demand is an element that interacts directly with this portfolio, it is necessary to deepen this terminology in order to better contextualize the present study, therefore, we proceed to describe below: the management of IT demand management, the ITSC and the IT services portfolio.

#### A. IT DEMAND MANAGEMENT

Within an entity, it is necessary that the IT department can properly manage the various requirements that their internal clients can present. This range of requests based on IT

requirements is part of the “IT demand management,” for Alonso *et al.* [29] the importance of demand management lies in achieving benefits for the company and to achieve them is necessary to take into account the steps of the demanding life cycle. The demand for IT products and services come from the needs of the different business processes of the customers in the form of ideas, new well-informed business opportunities, delivery dates, costs, and benefits [30].

It is necessary to understand that IT service demand management is a systematic process by which the access of clients and/or users of the IT services established in the ITSC must be managed. According to Legner and Löhe [31], organizations convert their IT demands into IT solutions through multiple steps:

- Collection
- Evaluation, prioritization, and planning,
- Specification and realization,
- Deployment and operation

Alonso [32] collected some important criteria from various authors about demand management, for example, Mercury [33], which in 2006 defined it as the management of the requirements made by customers, this process is one of the impact elements in the corporate governance of IT, Alonso [32] also cites Symons *et al.* [34] that in 2006 they highlighted that the demand for IT services comes from very different sources and in very different ways. Because demand is very broad, it has been segmented into three broad categories: strategic demand, tactical demand, and operational demand.

- 1) The strategic demand is the one that is managed through the portfolio of projects and is the demand for new projects that introduce innovation and activate new businesses, products, and services [29].
- 2) The tactical demand is managed through the portfolio of services, this portfolio interacts with clients through various means, and this portfolio provides IT operations as a process to offer a wide range of services efficiently and effectively [29].
- 3) Operational demand is the one that manages the construction, maintenance of the IT infrastructure, this demand comes from the IT department, and its own internal activities to carry out activities aimed at the management of IT key assets that directly affect the company in the development of their business capabilities [29].

## B. IT SERVICE CATALOG

The ITSC is a structure that contains the list of IT services offered by IT departments to provide direct assistance to the other departments of the organization. The SC is composed of the customer-oriented catalog (or external), which describes the services experienced by customers and the internal catalog, which describes the activities carried out to deliver customer-oriented services [7]. As stated above, normally, ITSCs contains two views: a business view and an IT view. While the business vision as the basis for service

requests focuses on the customer, the IT view shows technical details and relationships between customer-focused services and technical services, components and configuration elements [8]. To begin to apply SC management, organizations must begin with the activity of service identification, an activity that most organizations do not perform correctly. There are several types of information that should be included in the SC such as the description of the service, type of service, policy, SLA, etc. for all IT services within an organization [10].

An ITSC is like a restaurant menu: it presents the IT services that can be provided and supports the clients. This definitely influences the decisions that customers have about what can help IT. The objective of the SC management process is to ensure that the catalog is produced and maintained, that it contains accurate information on all operational services and those that are prepared to operate in an operational manner. Therefore, it is necessary to define the services, produce and maintain an accurate SC [4].

Clients can use the SC to understand what the service provider can do for them and to interact with the service provider regarding the services. The service provider's staff members can use the SC to understand how the service provider's support services, resources, capabilities and support commercial activity. Users or individual consumers of a service can use the SC to understand the scope of the available services and to know how to make service requests and/or report incidents associated with the services provided [20]. The ITSC management (ITSCM) process is responsible for directing all catalog information and ensuring that the data is correct and up-to-date. Therefore, it is responsible for defining, standardizing, refreshing, publishing, communicating, protecting and ensuring the quality of an ITSC [8]. Among the activities of the ITSCM are:

- The identification of the service
- Classification of services
- The construction of the technical SC
- The construction of the SC facing the user
- Withdrawal of services
- Innovation of services
- Evaluation of the catalog
- Catalog feedback

## C. IT SERVICES PORTFOLIO

The service portfolio is the complete set of services managed by a service provider and represents the commitments and investments of the service provider with all customers and market spaces. It also represents the current contractual commitments, the development of new services and the continuous service improvement plans initiated by the continuous improvement of the service [20]. The IT services portfolio contains an ITSC and financial planning to execute the service offering in a specific organization. The management of the service portfolio (which includes the services catalog) and the financial management of IT services are included in the service strategy phase. Detailed information about the SC is

also included in the SC management process that is included in the service design phase [4].

The portfolio management process at a general level is defined as a dynamic decision-making process to evaluate, select, request adaptation, approval or cancellation of versions and variations of products and services [35]. The characteristics of the services contained in the portfolio may include the functionality of individual software components, as well as packages of software components, infrastructure elements and additional services. Additional services are usually information services, consulting services, training services, problem-solving services or update services [2].

The portfolio of IT services must adapt optimally to the needs of the business at any time. If the portfolio of IT services does not reflect business requirements at all or simply with a significant delay, serious problems can arise for the company. Therefore, a continuous review and adaptation of the IT services portfolio are required for an optimal contribution of IT innovations in the business units [36].

#### IV. METHODOLOGY

For the development of this research Project the following guidelines set by Kitenham and Charters [11], determining 3 phases have been followed:

- 1) Review planning. - In this phase, it is necessary to confirm the need to carry out the review, in the same way, the research questions and the revision protocol that has been followed must be considered.
- 2) Carrying out the review. - In this phase, primary studies are selected in a methodical manner, according to the inclusion and exclusion criteria.
- 3) Results of the review. - In this phase, the results of the statistics and the analysis of the selected studies for the review are shown.

##### A. PLANNING THE REVIEW

In the review carried out, some drawbacks detailed in several scientific articles could be noted, for example: Rosa *et al.* [10] states that most organizations fail to implement ITIL due to their complexity, and emphasize that the identification of services is generally avoided, likewise Arcilla *et al.* [4] claims that more rigorous validations are missing for existing SC construction models and adds that automation is lacking for the ITSC construction models. The work of Gama *et al.* [3] who affirms that companies do not regularly identify their SC, due to the difficulty that this represents, and highlight that the language between IT professionals and the business becomes a barrier. Another study that stands out is that of Rudolph and Kremar [5] where it is stated that the additional investigation of a work developed by them should focus on the development of a service structure that supports the classification and definition of the portfolio of services, as well as a modular application. Finally, in another study conducted by Barlatier *et al.* [37], it is affirmed that there are difficulties in identifying the processes for the development of new services.

Based on the affirmation of several authors of previous investigations about inconveniences for the construction of the ITSC, the following questions were asked:

- Q1. What methods are there for the construction and management of IT service catalogs?
- Q2. What approaches are there for the construction and management of IT service catalogs?
- Q3. What models exist for the construction and management of IT service catalogs?
- Q4. What framework exists for the construction and management of IT service catalogs?

- 1) Field, objective and target group: The field is the ITSCM regarding the domain of the construction of the catalog. The objective of the research work is to identify and compare the existing proposals for the construction of the ITSC. The target group includes the organizations that use the ITSC concept, in particular, the managers of the ITSC. The work is aimed at IT service providers.
- 2) Requirements: The requirements for the construction of the ITSC were derived from the existing literature. In a first step, the literature on foundations of the ITSM, the portfolios of IT services, the ITSC and the IT demand management was analyzed. The literature was researched in order to identify the requirements related to the content in terms of the best practices for the management of the ITSC. The literature was reviewed in relation to the development methods to gather architectural requirements and related to the conception of the ITSC.

The existing literature on the conceptual foundations of ITSC is based mainly on the ITIL framework and on the proposals that refer to ITIL. There are recommended practices for the following fields: ITSC, a method for identifying services for an ITSC, development of new services, management of service innovation and ITSCM. There are several important contributions for the management of the ITSC. The objective of the analysis is to identify existing models, frameworks, approaches and methods for ITSC management. A search by word was made in the titles and abstracts of each of the articles in the IEEE Explore, ACM Digital Library, ScienceDirect, SpringerLink, Wiley Online Library and Taylor & Francis databases.

To carry out this research, the inclusion and exclusion criteria shown in Table 1 was considered.

Similarly, several search chains were defined, see table 2. The results were included from the year 2005 in 2017 as shown in table 1.

##### B. CARRYING OUT THE REVIEW

According to the studies identified in the search process applying the chains established in Table 1, a discrimination process has been followed according to the inclusion and exclusion criteria defined in Table 2, most of the studies were discarded because they do not correspond to proposals for

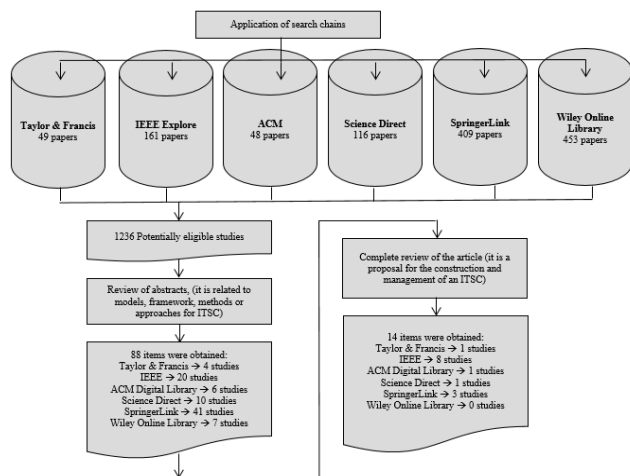
**TABLE 1. Inclusion and exclusion criteria.**

Inclusion Criteria	Exclusion Criteria
Articles related to research questions	Studies other than English
Studies included from 2005 to 2017	Studies that do not meet the inclusion criteria
Studies related to models, framework, methods, and approaches for the construction of the ITSC	
Articles that are in journals and congresses	
Complete studies	

**TABLE 2. Literature search chains.**

Question	Search string
1	METHOD AND (BUILD OR DESIGN OR IMPLEMENT OR MANAGEMENT) AND (IT OR TECHNOLOGY) AND "SERVICE CATALOGUE"
2	(APPROACH OR REFERENCE) AND (BUILD OR DESIGN OR IMPLEMENT OR MANAGEMENT) AND (IT OR TECHNOLOGY) AND "SERVICE CATALOG"
3	MODEL AND (BUILD OR DESIGN OR IMPLEMENT OR MANAGEMENT) AND (IT OR TECHNOLOGY) AND "SERVICE CATALOGUE"
4	FRAMEWORK AND (BUILD OR DESIGN OR IMPLEMENT OR MANAGEMENT) AND (IT OR TECHNOLOGY) AND "SERVICE CATALOGUE"

the construction and management of the ITSC, the process is detailed in figure 1.



**FIGURE 1. Process for the search of selected studies.**

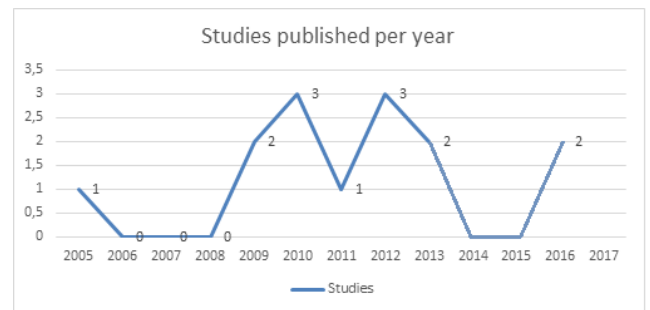
In total, fourteen proposals have been found for the construction and management of ITSC. Next, the detail of the studies found in each of the search engines used are shown.

**C. RESULTS OF THE REVIEW**

The result of the process of systematic search of the literature gave a total of 1236 studies, of which there are 88 relevant studies and 14 selected studies. Table 3 shows the number of studies selected by each source consulted.

**TABLE 3. Potentially eligible studies, relevant studies and selected studies**

Databases consulted	Potentially eligible studies	Number of relevant studies	Number of selected studies	Percentage
Taylor & Francis	49	4	1	7 %
IEEE Explore	161	20	8	57 %
ACM Digital Library	48	6	1	7 %
ScienceDirect	116	10	1	7 %
SpringerLink	409	41	3	22 %
Wiley Online Library	453	7	0	0%
TOTALS	1236	88	14	100%



**FIGURE 2. Number of proposals for the management of ITSC published per year.**

From the percentage point of view, it is well known that most of the studies analyzed in this paper correspond to the IEEE Explore, followed by SpringerLink. Figure 2 shows the number of studies that contain proposals for the management of an ITSC selected from the year 2005 until 2017.

Among the included or selected studies that contain specific proposals for the management of an ITSC, the oldest is from 2005 and the most recent is from 2016. The years where there is more production of proposals for the management of ITSC are highlighted corresponding to the years 2010 and 2012, with three proposals each, however, in the years 2009, 2013 and 2016 there were also two proposals per year.

**TABLE 4. Potentially eligible studies, relevant studies and selected studies.**

Source type	Taylor & Francis	IEEE Explore	ACM Digital Library	ScienceDirect	SpringerLink	Wiley Online Library	Total	Percent
Journal	1	0	0	1	1	0	3	22.00 %
Proceedings	0	8	1	0	2	0	11	78.00 %
TOTAL	1	8	1	1	3	0	14	100 %

Next, the results of the research are shown in table 4, where information about the studies found by their type of source is displayed, that is, if they have been published in a journal

or proceedings, it is necessary to highlight that most of the studies are from the IEEE and that most have been published.

## V. FOUND RESULTS

During the search performed in the databases mentioned above, fourteen studies containing proposals for the construction and management of an ITSC were identified, including models, framework, methods and approaches or references, and the results are shown in table 5, detailing the title and conclusion of each article found.

## VI. ANALYSIS OF THE PROPOSALS AND ANSWER TO THE INVESTIGATION QUESTIONS

According to the information found in this review, it is important to analyze these proposals from different angles. Before developing the corresponding analysis, it is necessary to specify the meaning of a method, approach, model and framework for this study.

A method is a regular, explicit and repeatable procedure to achieve something, whether material or conceptual [48], it can also be said that a method is a procedure that will be carried out in order to achieve certain objectives [49].

An approach refers to the way in which an individual or organization solves a certain situation, that is, the steps it has taken to solve a problem, without the need to pose it as a method, but rather, as an experience.

A model is a representation of a complex reality. Modeling a process is to synthesize the dynamic relationships that exist in it, test its premises and predict its defects [50].

A framework is a set of tools and procedures that have been used successfully in the solution of a certain type of problem, and that can be reused to solve other similar problems with greater security, productivity and with less effort [51].

### A. IDENTIFICATION OF THE METHODS, APPROACHES, MODELS AND FRAMEWORK OF EACH PROPOSAL

During research process among in the proposals found methods, approaches, models, and framework have been identified, then the detail of this statement is presented in table 6.

Taking as reference table 6, several important aspects stand out:

- 42% of the proposals found offer methods for the management of the ITSC, 28% of the proposals found offer approaches for the management of the ITSC, 50% of the proposals found offer models for the management of the ITSC, finally, 14% of the proposals found offer framework for the management of the ITSC

- Of the studies found, 7% presented a proposal that includes a method and a model, which is presented by Trastour and Christodoulou [40] in 2009.

- Of the studies found, 14% present a proposal that includes an approach and a model, which are those presented by Zimin and Kulakov [43] in 2010 and by Arcilla *et al.* [4] in the year 2013.

TABLE 5. Description of results found, ordered per year.

Paper title	Reference and year	Results/Conclusion
Development of a generic IT service catalog as pre-arrangement for service level agreements	[38], 2005	The specification of IT services allows the instantaneous classification of who should handle the activity and how it should be managed. The atomic structure provides the representation of functional dependence. More about the hierarchical design makes the relationships between the different components clearer.
Developing a service catalog for higher education information technology services	[39], 2009	Since the deployment of this SC, we have seen: - Increase in traffic to the ITSC site. -Improvement of the completeness of the information presented in the service requests -The increase of the general satisfaction of the client thanks to the improvement of the quality of the information available -Decreased call volume around some of the most frequent requests.
Towards Robust IT Service Portfolio Management	[40], 2009	An idea was given of the problem of portfolio selection of IT services and an indication of the demanding requirements that the solutions must meet. While these preliminary results are encouraging, more work needs to be done regarding the validation of the approach. Important issues such as the modeling of uncertainty, the nature of underlying distributions, the complexity of assets, services, and metrics, which will be the subject of more work, are not addressed here.
ICT Service Catalogue Representation Method and Application	[41], 2010	This ITSC prototype system is designed and implemented to validate the accuracy and efficiency of IT services under a catalog representation method. The reuse of the ITSC should be improved with a following standard representation method, using the general template of the representation.
BHive: A Reference Framework for Business-Driven Service Design and Management	[42], 2010	BHive does not provide the level of detail and sharpness of the definitions that other frames make. However, BHive provides a level of holism that is not found in other frameworks. Although BHive was originally designed to organize instruments for the design and administration of services managed by companies, it is possible to see it and use it as a process quality instrument in the same type of functions performed by ITIL, TOGAF, and COBIT in their respective areas of coverage.
Dynamic Lifecycle Management of IT Services in Corporate Information Systems	[43], 2010	This approach allows a very efficient management of IT services in external and internal conditions that change rapidly

**TABLE 5. (Continued.) Description of results found, ordered per year.**

Towards a Method for IT Service Management	[44], 2011	The proposed objective was achieved, however, developing a method requires additional considerations, for example, guidelines, a companion process model and support of a modeling tool.
A practical approach for implementing the service catalog in micro, small and medium enterprises	[45], 2012	The implementation of the IT services catalog has allowed the company object of the case study, to know the IT services offered by your IT department and the purposes for which they serve the business. In addition, it is the entry point for the implementation of the process Financial Management of IT.
Using DEMO to Identify IT Services	[46], 2012	DEMO is a formal method with clear steps to follow and generic enough to apply to all types of services, it also allows identifying the services that customers understand and prefer.
A Method for Identifying IT Services Using Incidents	[10], 2012	It is highlighted that after having applied the service identification method in 1,600 incidents that represent six months of recorded incidents. There were 29 technical services in this ITSRC. After the application of the proposed method, 83% (24 services) of the technical services were registered in the reference catalog.
IT Services Reference Catalog	[3], 2013	The quality of the artifacts of the proposal dealing with the ITSRC application was evaluated in the case studies presented previously. Secondly, the ITSRC was compared with SC of organizations that already have one, the differences between them were evaluated. Finally, it was noted that, in addition to the vast majority of IT services that were in the SC of the organization, these do not cover all those presented in the ITSRC, so the proposal is much more complete.
Building an IT service catalog in a small company as the main input for the IT financial management	[4], 2013	The implementation of the SC has allowed the company to know the services provided by its IT department and the purposes for which they relate to the business. It is also the entry point for the implementation of the IT financial management process. After implementing the categories of IT services and services, the company is ready to develop budgets, controlling the money spent per department which is implementing the IT financial management process.
Structure, Content, and Use of IT Service Catalogs -- Empirical Analysis and Development of a Maturity Model	[8], 2016	This research shows that ITSC is implemented very heterogeneously and that there is no single ITSC. The proposal of concrete methods for the inclusion of clients in ITSCM processes would help IT organizations increase the acceptance of the catalog within the organization.

**TABLE 5. (Continued.) Description of results found, ordered per year.**

Service Catalogue Implementation Model	[47], 2016	The proposal is very clear, however, validations are missing in real environments, which could provide important data to know the efficiency level of this model.
--	------------	---

**TABLE 6. Methods, approaches, models and framework found.**

Paper title	It includes			
	Method	Approach	Model	Framework
Development of a generic IT service catalog as pre-arrangement for service level agreements				X
Developing a service catalog for higher education information technology services		X		
Towards Robust IT Service Portfolio Management	X		X	
ICT Service Catalogue Representation Method and Application	X			
BHive: A Reference Framework for Business-Driven Service Design and Management				X
Dynamic Lifecycle Management of IT Services in Corporate Information Systems		X	X	
Towards a Method for IT Service Management	X			
A practical approach for implementing the service catalogue in micro, small and medium enterprises				X
Using DEMO to Identify IT Services	X			
A Method for Identifying IT Services Using Incidents	X			
IT Services Reference Catalog		X		
Building an IT service catalog in a small company as the main input for the IT financial management		X	X	
Structure, Content and Use of IT Service Catalogs -- Empirical Analysis and Development of a Maturity Model			X	
Service Catalogue Implementation Model			X	X

**Legend**  
Fully meets: X  
Fails:

● Of the studies found, 7% submit a proposal that includes a model and a framework, which is the proposal presented by Sembiring and Surendro [47] in 2016.

1) THE ANSWER TO RESEARCH QUESTION NUMBER 1  
What methods are there for the management of IT service catalog?  
According to table 7, five methods have been found:

2) THE ANSWER TO RESEARCH QUESTION NUMBER 2  
What approaches are there for the management of IT service catalogs?



**TABLE 7. Methods identified in the review.**

Paper title	Reference and year	Denomination
Towards Robust IT Service Portfolio Management	Trastour and Christodoulou [40], 2009	Method to generate "Best" portfolios to guide IT executives in the ITSM.
ICT Service Catalog Representation Method and Application	Xu et al. [41], 2010	Standard representation method for service catalogs.
Towards a Method for IT Service Management	Kattenstroth and Heise [44], 2011	Method for the management of IT services
Using DEMO to Identify IT Services	Mendes et al. [46], 2012	Method based on DEMO for the identification of IT services.
A Method for Identifying IT Services Using Incidents	Rosa et al. [10], 2012	Method for identifying IT services using incidents.

**TABLE 8. Approaches identified in the review.**

Paper title	Reference and year	Denomination
Developing a service catalog for higher education information technology services	Lyons [39], 2009	Development of a web catalog for the management of IT services in Hobart and William Smith Colleges.
Dynamic Lifecycle Management of IT Services in Corporate Information Systems	Zimin and Kulakov [43], 2010	Methodology for the management of information technology services.
IT Services Reference Catalog	Gama et al. [3], 2013	Reference catalog of information technology services.
Building an IT service catalog in a small company as the main input for the IT financial management	Arcilla et al. [4], 2013	Approach to define and implement the catalog of services in companies as an input for your IT financial management.

According to Table 8, four approaches have been found:

3) THE ANSWER TO RESEARCH QUESTION NUMBER 3

What models exist for the management of IT service catalogs?

According to table 9, six models have been found:

4) THE ANSWER TO RESEARCH QUESTION NUMBER 4

What framework exist for the management of catalogs of IT services?

According to table 10, two frameworks have been found:

**TABLE 9. Models identified in the review.**

Paper title	Reference and year	Denomination
Development of a generic IT service catalog as pre-arrangement for service level agreements	Anders [38], 2005	Generic model for catalogs of information technology services for IT providers in the field of service management projects.
Towards Robust IT Service Portfolio Management	Trastour and Christodoulou [40], 2009	Model to link the selection of IT investment with the value of the business.
Dynamic Lifecycle Management of IT Services in Corporate Information Systems	Zimin and Kulakov [43], 2010	Dynamic management model for the life cycle of IT services.
A practical approach for implementing the service catalogue in micro, small and medium enterprises	Magdalena et al. [45], 2012	Model based on the concept of a library of process assets to implement service catalogs for a micro, small and medium-sized company.
Building an IT service catalog in a small company as the main input for the IT financial management	Arcilla et al. [4], 2013	
Structure, Content and Use of IT Service Catalogs -- Empirical Analysis and Development of a Maturity Model	Nord et al. [8], 2016	Maturity model for IT service catalogs that covers the structure and content, as well as the use and integration.
Service Catalogue Implementation Model	Semiring and Surendro [47], 2016	Model for the implementation of the services catalog.

**TABLE 10. Frameworks identified in the review.**

Paper title	Reference and year	Denomination
BHive: A Reference Framework for Business-Driven Service Design and Management	Gangadharan y Luttighuis [42], 2010	BHive framework to incorporate services, service contracts, service architecture, life cycle of the service portfolio, service risk, service change and service compliance management.
Service Catalogue Implementation Model	Semiring y Surendro [47], 2016	Framework for the construction of the service catalog

**B. ANALYSIS OF THE COVERAGE OF EACH PROPOSAL IN CORRESPONDENCE WITH THE MANAGEMENT ACTIVITIES OF THE ITSC**

The ITSCM includes the identification of services, the classification of services, the construction of the SC for the

**TABLE 11. Coverage of each proposal in correspondence with the activities of ITSC construction and management.**

Title of the proposal	Activities of the ITSCM								
	Identification of services	Classification of services	Construction of the Technical SC	Construction of the SC facing the user	Withdrawal of services	Service innovation	Catalog evaluation	Catalog Feedback	It has been applied
Development of a generic IT service catalog as pre-arrangement for service level agreements	X	X	X	O					
Developing a service catalog for higher education information technology services	X	X	X	X					X
Towards Robust IT Service Portfolio Management	X	X	X						X
ICT Service Catalogue Representation Method and Application	O	X	X	X	O	X			
BHive: A Reference Framework for Business-Driven Service Design and Management	X	X	X	O		X			
Dynamic Lifecycle Management of IT Services in Corporate Information Systems	X	X	X			O			
Towards a Method for IT Service Management	X	X	X						
A practical approach for implementing the service catalogue in micro, small and medium enterprises	X	X	X			X			X
Using DEMO to Identify IT Services	X	O	O						X
A Method for Identifying IT Services Using Incidents	X	X	X	X				X	X
IT Services Reference Catalog	X	X	X	X					X
Building an IT service catalog in a small company as the main input for the IT financial management	X	X	X	O		X			X
Structure, Content and Use of IT Service Catalogs -- Empirical Analysis and Development of a Maturity Model							X		X
Service Catalogue Implementation Model	X	X	X	X		X	O		
TOTALS	X=12, O=1, =1	X=12, O=1, =1	X=12, O=1, =1	X=5, O=3, =6	X=0, O=1, =13	X=4, O=1, =9	X=2, O=0, =12	X=1, O=1, =12	X=8, O=0, =6

**TABLE 11. (Continued.) Coverage of each proposal in correspondence with the activities of ITSC construction and management.**

**Legend**  
 Fully meets: X  
 Partially complies: O  
 Fails:

user, the lowering of services, the innovation of the services, the evaluation of the catalogue and the feedback of the catalogue, then the detail of the coverage level of each proposal in correspondence with the management activities of the ITSC:

Taking a reference to table 11, several important aspects stand out:

- None of the proposals covers all the activities of the ITSCM.

- Of all the proposals submitted, only 57% have been applied, that is, almost half of the proposals have not been applied to verify their operation.

- 85% of the proposals or studies carried out cover three of the essential tasks of the ITSCM, such as the identification of the services, the classification of the services and the guidelines for the confirmation of the technical SC, however, of these proposals only 58% have been applied to demonstrate its operation, that is, almost half have not been applied.

- Only 42% of the proposals have fully addressed the construction of the SC for the user or business, of this percentage only 50% of the proposals have been applied. On the other hand, 14% of the proposals have partially addressed the construction of the SC for the user or business, of this percentage only half has been tested.

- Only 7% of the proposals presented partially address the drop in services, this proposal has not been applied.

- 28% of the proposals presented have incorporated the innovation of services completely, however, of these proposals only 50% have been applied. On the other hand, 7% of the proposals found have partially addressed the innovation of services, this proposal has not been applied.

- Only 14% of the proposals submitted have considered the evaluation of the catalog, of those proposals only 50% have been applied.

- 7% of the proposals presented have considered a feedback mechanism of the catalog, this proposal if it has been applied. On the other hand, 7% of the proposals found have partially considered a feedback mechanism of the catalog, this proposal has not been applied.

- Of all the proposals presented that have not been applied in practical cases, the most complete is presented by Sembiring and Surendro [47] in 2016, since it has covered the identification of services, classification of services, construction of technical SC, construction of the SC of each to the user and the evaluation of the catalogue of complete form, and the feedback of the catalogue of partial form.

- Of all the proposals presented that have already been applied in practical cases, the most complete is presented by Rosa *et al.* [10] in 2012, since it has covered the identification

of services, the classification of services, the construction of the technical SC, the construction of the SC for the user and the feedback of the catalogue, punctually through the registration of incidents.

- It is important to point out that of the 8 activities covered by the ITSCM, the proposal that covers most of these activities are presented by Sembiring and Surendro [47] in 2016, which covers 5 activities totally and one partially. Likewise, the proposal that covers the least part of the ITSCM activities is presented by Nord *et al.* [8] in 2016, which covers only the evaluation of the catalogue, however, it is still important, since it presents a maturity model that clarifies the management level of the ITSC in a very detailed way, the advantage of this proposal is that it has already been applied with satisfactory results.

- Of all the activities of the ITSCM, the reduction of services is the least addressed, since it has only been partially considered in the proposal presented by Xu *et al.* [41] in the year 2010, followed by the catalogue feedback that was only fully addressed by Rosa *et al.* [10] in 2012 and partially by the proposal of Sembiring and Surendro [47] in 2016. Then it is followed by the evaluation of the catalog that was fully addressed in the proposals presented by Nord *et al.* [8] in 2016 and by Sembiring and Surendro [47] in 2016.

## VII. CONCLUSION

The following conclusions have been identified in relation to the research carried out:

- In the literature reviewed, fourteen studies have been found that address one or several activities of the ITSCM, these proposals contain methods, approaches, models, and frameworks. However, none of the proposals found addresses all the activities of the ITSCM, this may be a cause for many organizations not to implement these proposals, in fact, only half of these proposals have been applied in real cases, which means that more checks are needed to establish their levels of effectiveness.

- In the review carried out, proposals have been found that include methods and models, approaches and models, models and frameworks that are mixed proposals. It is necessary to highlight that, of all the activities of the ITSCM, the withdrawal in services is the least addressed, followed by the feedback of the catalog that was only fully addressed in two proposals, likewise, the evaluation of the catalogue was only fully addressed in two proposals, therefore, it is still pending to develop these three activities in a better way, and most of all to put them into practice to verify their operation.

- It is striking that the evaluation activity of the ITSC is addressed in few proposals, since, in order to guarantee the validity and quality of the ITSC, it is necessary that there are efficient and proven mechanisms to properly evaluate its structure. More attention to the SC construction for the client, since another important aspect that must be analyzed, is the usability of the ITSC, that is, to what extent the ITSC is or is not friendly with the IT user so that the IT department can meet your requirements efficiently.

- As future research, several aspects should be take account, as well as: a) Proposals should be proposed for activities such as the withdrawal of services, feedback, and evaluation of the catalog since these are the activities least addressed in the proposals found. b) It is necessary to work on a possible merger of the existing proposals that have been proven to offer a more comprehensive solution for the construction and management of the ITSC. c) Mechanisms must be developed to automate the activities of the ITSCM. d) It is necessary to apply existing proposals that have not been proven in real environments, in order to demonstrate their levels of effectiveness in the ITSCM.

## REFERENCES

- [1] E. Kozlova, U. Hasenkamp, and E. Kopanakis, "Use of IT best practices for non-IT services," in *Proc. Annu. SRII Global Conf.*, 2012, pp. 725–734.
- [2] C. Braun and R. Winter, "Integration of IT service management into enterprise architecture," in *Proc. ACM Symp. Appl. Comput.*, New York, NY, USA, 2007, pp. 1215–1219.
- [3] N. Gama, M. Do Mar Rosa, and M. M. da Silva, "IT services reference catalog," in *Proc. IFIP/IEEE Int. Symp. Integr. Netw. Manage. (IM)*, 2013, pp. 764–767.
- [4] M. Arcilla, J. A. Calvo-Manzano, and T. S. Feliu, "Building an IT service catalog in a small company as the main input for the IT financial management," *Comput. Standards Interfaces*, vol. 36, no. 1, pp. 42–53, Nov. 2013.
- [5] S. Rudolph and H. Kremer, "Maturity model for IT service catalogues an approach to assess the quality of IT service documentation," in *Proc. AMCIS*, Jan. 2009, pp. 1–11.
- [6] M. Cantos and P. Renata, "Propuesta de un modelo para la definición y mantenimiento del catálogo de servicios de TI del Departamento de Tecnología de la Cooperativa de Ahorro y Crédito Juventud Ecuatoriana Progresista basado en las mejores prácticas propuestas en la biblioteca de infraestructura de tecnologías de información ITIL V. 3.0," M.S. thesis, Univ. Cuenca, Cuenca, Ecuador, 2012.
- [7] M. Buce, D. Rosu, D. Meliksetian, F. Wu, and N. Anerousis, "Effort instrumentation and management in service delivery environments," in *Proc. 8th Int. Conf. Netw. Service Manage.*, Laxenburg, Austria, 2013, pp. 257–260.
- [8] F. Nord, R. Dörbecker, and T. Böhmman, "Structure, content and use of IT service catalogs—Empirical analysis and development of a maturity model," in *Proc. 49th Hawaii Int. Conf. Syst. Sci. (HICSS)*, 2016, pp. 1642–1651.
- [9] C. Cisneros, C. Alberto, S. del Castillo, and C. Fernanda, "Diseño de un modelo de procesos para construir el portafolio de servicios de tics en la corporación financiera nacional," Escuela Politécnica Nacional, Quito, Ecuador, Tech. Rep., 2014.
- [10] M. Do Mar Rosa, N. Gama, and M. M. da Silva, "A method for identifying IT services using incidents," in *Proc. 8th Int. Conf. Quality Inf. Commun. Technol.*, 2012, pp. 172–177.
- [11] B. Kitchenham and S. Charters, "Guidelines for performing systematic literature reviews in software engineering version 2.3," Tech. Rep., 2007.
- [12] G. Baioco, A. C. M. Costa, C. Z. Calvi, and A. S. Garcia, "IT service management and governance modeling an ITSM Configuration process: A foundational ontology approach," in *Proc. IFIP/IEEE Int. Symp. Integr. Netw. Manage.-Workshops*, Jun. 2009, pp. 24–33.
- [13] H. Wang, B. Yang, L. Liu, Q. Ma, K. W. Sun, and Y. Chen, "Knowledge enhanced IT service management," in *Proc. IEEE Int. Conf. e-Bus. Eng. (ICEBE)*, Oct. 2007, pp. 173–180.
- [14] C. Mendes and M. M. da Silva, "Implementing the service catalogue management," in *Proc. 7th Int. Conf. Quality Inf. Commun. Technol.*, 2010, pp. 159–164.
- [15] B. Clacy and B. Jennings, "Service management: Driving the future of IT," *Computer*, vol. 40, no. 5, pp. 98–100, May 2007.
- [16] F. Niessink and H. Van Vliet. (1998). *Towards Mature IT Services*. Accessed: Mar. 17, 2018. [Online]. Available: [http://scholar.googleusercontent.com/scholar?q=cache:JH0fWRNgaQJ:scholar.google.com/+METHOD+OR+MODEL+OR+FRAMEWORK+OR+APPROACH+OR+REFERENCE,IT+OR+TECHNOLOG,%22SERVICE+CATALOG%22&hl=en&lr=&as\\_sdt=0,5&as\\_ylo=1980&as\\_yhi=2004](http://scholar.googleusercontent.com/scholar?q=cache:JH0fWRNgaQJ:scholar.google.com/+METHOD+OR+MODEL+OR+FRAMEWORK+OR+APPROACH+OR+REFERENCE,IT+OR+TECHNOLOG,%22SERVICE+CATALOG%22&hl=en&lr=&as_sdt=0,5&as_ylo=1980&as_yhi=2004)

- [17] G. Walker, *IT Problem Management*. Upper Saddle River, NJ, USA: Prentice-Hall, 2001.
- [18] J. Sullivan, D. Edmond, and A. H. M. ter Hofstede, "Service Description: A survey of the general nature of services," *Distrib. Parallel Databases J.*, pp. 117–133, 2002.
- [19] M. Sallé, "IT service management and IT governance: Review, comparative analysis and their impact on utility computing," Hewlett-Packard Company, Palo Alto, CA, USA, Tech. Rep., 2004.
- [20] V. Lloyd and C. Rudd, *ITIL Service Design*. 2011.
- [21] S. D. Galup, R. Dattero, J. J. Quan, and S. Conger, "An overview of IT service management," *Commun ACM*, vol. 52, no. 5, pp. 124–127, May 2009.
- [22] J. Iden and T. R. Eikebrokk, "Implementing IT service management: A systematic literature review," *Int. J. Inf. Manage.*, vol. 33, no. 3, pp. 512–523, Jun. 2013.
- [23] K. Brockhoff, "Customer integration in technology development of IT-based services," in *Proc. PICMET Technol. Manage. IT-Driven Services (PICMET)*, 2013, pp. 41–47.
- [24] J. Lourenço, C. Santos-Pereira, R. Rijo, and R. Cruz-Correia, "Service level agreement of information and communication technologies in portuguese hospitals," *Procedia Technol.*, vol. 16, pp. 1397–1402, 2014.
- [25] W.-G. Tan, A. Cater-Steel, and M. Toleman, "Implementing it service management: A case study focussing on critical success factors," *J. Comput. Inf. Syst.*, vol. 50, no. 2, pp. 1–12, Dec. 2009.
- [26] H. R. Motahari-Nezhad, S. Graupner, and C. Bartolini, "A framework for modeling and enabling reuse of best practice IT processes," in *Proc. Bus. Process Manage. Workshops*, 2010, pp. 226–231.
- [27] D. Loewenstern and Y. Diao, "A dynamic request dispatching system for IT service management," in *Proc. 8th Int. Conf. Netw. Service Manage.*, Laxenburg, Austria, 2013, pp. 271–275.
- [28] C. M. Mukwasi and L. F. Seymour, "Customer relationship management in IT service delivery: A practitioner-based inquiry in a higher education institution," in *Proc. Annu. Conf. South African Inst. Comput. Sci. Inf. Technol.*, 2016, p. 27.
- [29] I. A. Alonso, J. C. Verdún, J. Domingo, and T. Caro, "Importancia de la Gestion del Proceso de la Demanda de TI," *Rev. Procesos Metricas*, vol. 5, no. 2, pp. 25–34, May 2008.
- [30] I. A. Alonso, J. C. Verdún, and E. T. Caro, "Description of the structure of the IT demand management process framework," *Int. J. Inf. Manag.*, vol. 37, no. 1, pp. 1461–1473, Feb. 2017.
- [31] C. Legner and J. Löhe, "Improving the realization of IT demands: A design theory for end-to-end demand management," in *Proc. ICIS*, Dec. 2012, p. 3.
- [32] I. A. Alonso, "Estructuras, Procesos, Indicadores para Gestionar el Proceso de la Demanda Estratégica en las TI," Ph.D. dissertation, Lenguajes Sistemas Informáticos Ingeniería Softw., Facultad Inf. (UPM), Univ. Politécnica Madrid, Madrid, Spain, 2013.
- [33] *IT Demand Management for the Real World*, EEUU, Mercury, 2006.
- [34] C. Symons, B. Cameron, L. M. Orlov, and L. Sessions, "How IT must shape and manage demand," in *Best Practices*. 2006.
- [35] G. P. Garbi and G. Loureiro, "Business-product-service portfolio management," in *Proc. ISPE CE*, 2013, pp. 137–146.
- [36] M. Lang, "Fostering IT-based innovations through innovation conducive IT process and IT service portfolio management," presented at the 5th Int. Conf. Inf. Commun. Technol. Syst., 2009.
- [37] P.-J. Barlatier, J.-C. Bernacconi, and S. Reiter, "Service portfolio design for service innovation management: The case of a luxemburgish research and technology organization," in *Exploring Services Science*. Berlin, Germany: Springer, 2010, pp. 82–95.
- [38] T. Anders, "Development of a generic IT service catalog as pre-arrangement for service level agreements," in *Proc. IEEE Conf. Emerg. Technol. Factory Automat.*, vol. 2, Sep. 2005, p. 573.
- [39] A. H. Lyons, "Developing a service catalog for higher education information technology services," in *Proc. 37th Annu. ACM SIGUCCS Fall Conf. Commun. Collaboration*, New York, NY, USA, 2009, pp. 67–74.
- [40] D. Trastour and A. Christodoulou, "Towards robust IT service portfolio management," in *Integrated Management of Systems, Services, Processes and People in IT*. Berlin, Germany: Springer, 2009, pp. 152–163.
- [41] D. Xu, Y. Wang, C. Tian, and X.-S. Qiu, "ICT service catalogue representation method and application," in *Proc. IEEE 12th Int. Conf. Commun. Technol.*, Nov. 2010, pp. 1295–1298.
- [42] G. R. Gangadharan and P. O. Luttighuis, "BHive: A reference framework for business-driven service design and management," *J. Service Sci.*, vol. 2, no. 1, pp. 81–110, Jun. 2010.
- [43] V. V. Zimin and S. M. Kulakov, "Dynamic lifecycle management of IT services in corporate information systems," *Steel Transl.*, vol. 40, no. 6, pp. 539–548, Jun. 2010.
- [44] H. Kattenstroth and D. Heise, "Towards a method for IT service management," in *The Practice of Enterprise Modeling*. Berlin, Germany: Springer, 2011, pp. 178–192.
- [45] A. Magdalena, J. A. Cerrada, and J. A. Calvo-Manzano, "A practical approach for implementing the service catalogue in micro, small and medium enterprises," in *Proc. 7th Iberian Conf. Inf. Syst. Technol. (CISTI)*, 2012, pp. 1–8.
- [46] C. Mendes, J. Ferreira, and M. M. da Silva, "Using DEMO to identify IT services," in *Proc. 8th Int. Conf. Quality Inf. Commun. Technol.*, 2012, pp. 166–171.
- [47] M. Sembiring and K. Surendro, "Service catalogue implementation model," in *Proc. 4th Int. Conf. Inf. Commun. Technol. (ICoICT)*, 2016, pp. 1–6.
- [48] G. E. Barchini, "Métodos 'I + D' de la Informática," Univ. Buenos Aires, Buenos Aires, Argentina, Tech. Rep., 2005.
- [49] R. Arrieta, W. Nilton, C. Gómez, and P. Daniel, "Metodología táctica para la implantación de sistemas de información basado en métrica y COBIT," Ph.D. dissertation, Facultad de Ingeniería de Sistemas e Informática, Nat. Univ. San Marcos, Lima, Peru, 2010.
- [50] C. Cobo and L. Fernando, "Planificación estratégica para la creación del departamento de tecnología de la información y de la comunicación (TIC), para la empresa Net People Ecuador S.A.," Univ. Católica Ecuador, Quito, Ecuador, Tech. Rep., 2011.
- [51] A. Díaz, "Creación de un framework de presentación para aplicaciones JEE," Univ. Oberta Catalunya, Catalunya, Spain, Tech. Rep., 2012.
- [52] S. Ali, L. Hongqi, S. U. Khan, Y. Zhongguo, and Z. Liping, "Success factors for software outsourcing partnership management: an exploratory study using systematic literature review," *IEEE Access*, vol. 5, pp. 23589–23612, 2017.



**CRISTIAN MERA MACIAS** received the Magister degree in business computing from the Universidad Regional Autónoma de Los Andes, Ecuador, under the research supervision of Prof. E. Fernandez. He is currently pursuing the Ph.D. degree in system engineering degree with the National University of San Marcos, Peru, under the supervision of Dr. I. Aguilar Alonso. He is currently a Teacher with the Universidad Laica Eloy Alfaro de Manabí, Ecuador. His research interests lie in IT management, business intelligence, and automation of organizational processes in public and private entities.



**IGOR AGUILAR ALONSO** received the Ph.D. degree from Madrid Technical University (UPM), Spain, in 2013. He was an employee at IBM Global Service, Spain. He is currently an active member of the GICA Innovation Group, School of Computer Engineering, UPM. He is also a Professor with the Postgraduate Unit, School of Systems and Computer Engineering, National University of San Marcos, Peru. His research papers have been presented at conferences and published in international journals. He is currently serving as a Referee of research for national and international scientific journals, and conference proceedings. His research areas are IT governance, IT services management, and business. He is a Reviewer of the National Council for Science and Technology, Peru.

• • •