Improvement of IT Infrastructure Management by Using Configuration Management and Maturity Models: A Systematic Literature Review and a Critical Analysis

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Background and purpose: This research aims to investigate which benefits one may expect using Maturity Models in Configuration Management (CM) domain. CM is a support process that helps organizations have better management of their infrastructure. Its importance, in the Information Technology (IT) domain, has increased in recent years, despite this process not being technologically new, and the fact that many organizations implement this process in a haphazard way, which results in it not producing the benefits that it should produce. With the intention of assessing and improving the organizations' IT processes practices and capabilities, MMs have been developed and implemented. However, the application of MM in the CM domain is yet to be explored.

Design/Methodology/Approach: Two Systematic Literature Reviews (SLRs) and a Critical Analysis were performed. In sum, 80 scientific articles of the most rated conferences and scientific journals were analyzed and conclusions were drawn.

Results: This research concludes that despite the CM process being badly implemented, using a MM this process could decrease operational costs and increase the quality management of the infrastructure.

Conclusion: However, no MM has been developed so far for the CM process practices. This MM would be a viable support tool for the IT organizations providers since this would help organizations have a mature CM process and better control of their IT infrastructure. Therefore, the existence of a MM for the CM domain would be a welcome advancement that should be developed in the future.

Keywords: Configuration Management Process, Maturity Models, IT Services Providers, Systematic Literature Review

1 Introduction

Nowadays, it is imperative that IT organizations follow consumer tendencies and wills, with maximum effectiveness and efficiency (Asif, 2016). In fact, IT infrastructures are becoming more organizationally centralized, as these infrastructures are becoming more important, with organizations being more IT-dependent. This environment increases the importance and essentiality of IT organizations' business development and organization strategies (Ertürk & Vurgun, 2015). As a result of the considerable number of internal dependencies and relations among the systems and services provided by an organization (Vanbrabant & Joosen, 2013), it is making IT infrastructures

more complex and wider. Because of that reason and the increase of IT systems' heterogeneity, the weight of IT infrastructure management is increasing in our society, causing an increase in administration costs (Giese et al. 2010). This crucial environment, where IT performance impacts organization revenue, if not efficiently managed, can "lead to errors and subsequently to failures", determining the difference between profit and loss (Baiôco et al. 2009; Vanbrabant & Joosen, 2013).

In line with the substantial increase of the IT value in organizations is the evolution that it has provided. In an environment where success depends on clients, it is critical to address customer demands and explore new business opportunities. These conditions have allowed significant advances in IT, granting an evolution in IT services, and the satisfaction of internal and external organizational customer requirements (Johnson et al. 2007). The rising number of service providers allowed the increase of their share in the IT market (Levstek et al., 2018). Subsequently, they have naturally become important to the world's economy (Hashmi et al. 2010).

The services are developed and implemented on a subjacent IT infrastructure, which may consist of thousands of components, from software to hardware, which requires management in conformity with organizational objectives (Hashmi et al., 2010; Madduri et al., 2007). In this complex universe, where there is a competitive and rigorous market that gives rise to constant technological evolution (Baiôco et al., 2009), not only is the management of infrastructure changes necessary, ,but also an awareness of the risk and impact that they can impose on the organization (Ali & Kidd, 2013).

Therefore, the necessity to implement a process that would be essential to manage the whole IT infrastructure information has emerged (Madduri et al., 2007). Many solutions to support this kind of task were proposed in order to make a feasible "platform" that allowed the organization's collaborators to manage the infrastructure information and changes (Yang, 2010), which has led to the emergence in recent years of studies on the process of CM and its feasibility.

The importance of the CM process has been growing (Ali & Kidd, 2015), providing clear and fundamental information to all "kinds of performers" in enterprises (Baiôco et al., 2009). In spite of CM being essential to organizations, it is often misunderstood and is not given the proper importance by strategic management (Ali & Kidd, 2013; Shah et al. 2012). This process, if implemented in a careless and inaccurate way, can lead to equipment failures or even service disruptions, hence the increase in costs increase and the decrease in effectiveness in organizations (Choi & Bae, 2001).

With the purpose of assessing organizational practices, organizations have been using MMs (Haes & Grembergen, 2004; Patas et al. 2013), which in the IT industry has grown exponentially due to its importance. Organizations have applied these models not exclusively for evaluation, but also to "benchmark and to improve their process capabilities" (Proença, 2016).

This research aims to give further insights about the following research question:

- Would the CM domain benefit from the application of MM?

In order to review the CM process and the MM domain over the years and draw conclusions about the possibility of the conjunction of both domains, the Systematical Literature Review (SLR) methodology was adopted.

This research is structured as follows. The next chapter introduces the methodology used to obtain the final articles and a brief introduction is given to the CM and MM domains. Chapter 3 includes a discussion about the necessity to create a MM for the CM process. Finally, in the last chapter, some conclusions of this research are presented.

2 Methodology

SLR is a type of literature review and an approach to conducting a rigorous literature review, with the view of collecting data and found evidence in order to draw conclusions about research investigations. The authors Okoli and Schabram (2010) define SLR as "a systematic, explicit and reproducible method for identifying, evaluating, and synthesizing the existing body of completed and recorded work produced by researchers, scholars, and practitioners". SLR can improve literature reviews by bringing transparency and rigours in numerous ways, with the support of several systematic methods (Mallett et al. 2012).

With the intention of meeting the goals attached to this investigation and with the requirement to explain the "context" and the main concepts of this research, two SLRs were conducted, with the support of the Concept Centric (CC) method. This research is based on the guidelines for conducting a SLR of the author Kitchenham (2004). The steps taken to conduct these reviews are visible in Figure 1.

In order to present the insights generated by the SLR methodology, this research adopted the CC guidelines of Jane Webster and Richard Watson (2002).

2.1 Outlining Systematic Literature Review

These SLRs not only have the objective of justifying why the creation of a MM for the CM process is a feasible solution, granting many benefits to the management of an organization, but also the contextualization of the concepts of CM and MM. In order to achieve these objectives two SLRs were individually conducted: for the CM process and MM domain. For each domain, the CC approach was adopted to "centralized" the principal concepts intrinsical-

ly connected with each domain.

To obtain information about these two domains, five electronical repositories were selected: IEEE Online Library, SpringerLink, Elsevier, ACM and ResearchGate. The electronic repositories were the same for both approaches. However, two different keywords were used, for which an explanation lies in the following sections. Further, this review included only English and Portuguese articles and exclusively articles published on Journals or Scientific Magazines and Conferences Proceedings were accepted. Additionally, no date filter was used. Two search strings were used, one for each domain. Even though the keywords were established at this stage, with a view of research structuration it was decided to introduce them in the following sections.

The search process was the same for both domains. Initially a search was carried out with the selected keywords in each repository, without any filter. After that, four filters were created. Nevertheless, all the electronic libraries use different "search approaches", so a keyword adaptation for each repository was done.

The first filter applies the keywords from the article title, or the abstract or the author's keywords; In the second one, duplicated articles are removed; In the third filter, articles that are published in lower publications/journals rank are removed. For that reason, two websites, Scimago[1] and Conference Ranks[2], were used, which provide journals and conferences ranks, respectively. For conferences only A, B, A1, A2, B1 and B2 ranks of ERA and Qualis rankings were accepted. When an article was assessed by both rankings, Qualis prevailed. For journals, only Q1 and Q2 ranks were accepted. Finally, the last stage of filtration was realized by assessing articles' introductions and conclusions. The inclusion criteria of this filter of each domain are explained in the next sub-sections.

2.2 Conducting a Systematic Literature Review

As previously mentioned, SLR was divided into two domains and the resulting articles needed to "proceed" through four filters. Both domains filtration process, by each online repository and each filter, are demonstrated in the following sub-sections.

The first filter had the purpose of separating the articles that are exclusively related to both domains of those which just made a reference to these concepts in the body of the article, by just selecting the ones that had the keywords in the title, abstract and author's keywords. These three article sections were chosen for being the main parts that summarise the article's content. With this filter it was possible to discard a substantial number of articles.

The second filter had the intention of eliminating the duplicated articles.

In the third filter, 1336 articles were ranked based on their publication, which was in total nearly 890 publications since various articles had the same publication (conference/journal). Consequently, 577 articles' introduction and conclusion were read and evaluated by each domain inclusion criteria, which resulted in 80 final articles. The final articles divided by each publication rank are shown in Table 1. Articles from conference proceedings were the main contributor, making up 60% of the resulting articles from conferences. It is important to mention that approximately 28% of the final articles are from journals with a Q1 rank.
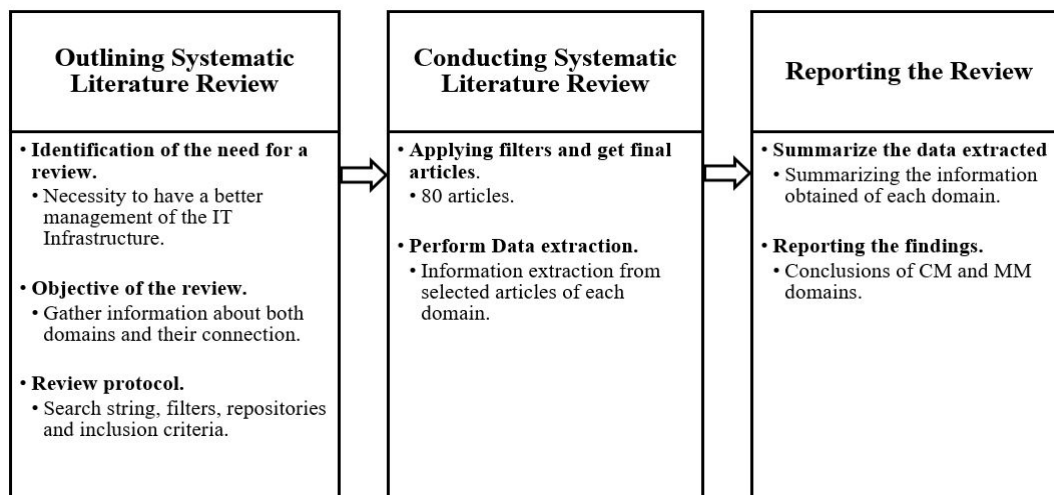

Figure 1: Systematic Literature Review Stages (Adapted from Kitchenham (2004) guidelines)

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1 Scimago website: https://www.scimagojr.com
2 Conference Ranks website: http://www.conferenceranks.com/#data

Table 1: Final Articles by Publication Rank of Both Domains

	Conference rank	Total
ERA	A	5
	B	2
Qualis	A1	8
	A2	10
	B1	13
	B2	10
		48

Journal rank	Total
Q1	22
Q2	10
	32

2.2.1 Systematic Literature Review of Configuration Management

The CM domain search had the purpose of finding its main concepts in "generic" domains, but with a focus on the IT services field. Keywords (listed below) were used in all repositories with operators AND and OR, being "Configuration Management" the main keyword. The flow of the entire filtration process can be seen in Figure 2.

"Configuration Management"
AND
("Maturity Model" OR "Frameworks" OR "Good Management Practices" OR "International Standards" OR "Main Concepts" OR "Barriers" OR "IT Service Management"

Since ResearchGate is a social network for professionals where it is possible to publish articles, which are accessible to the entire community, there may be articles from other online libraries. In fact, on ResearchGate four articles from IEEE repository were found, two from ACM and two from SpringerLink that were not found in their own repository with the same keywords, which shows the differences between each repository search approach.

In the last filter, where an evaluation of the article's introduction and conclusion is realized as mentioned previously, the following inclusion criteria were followed:

- articles, exclusively about CM theme, in any domain, were accepted;
- articles about CM benefits and the problems/risks of a bad process implementation were accepted;
- articles about CM process characteristics were accepted.

Articles that did not meet at least one of these "requirements" were rejected. The comparison number between conference papers and journal articles that fulfil all requisites, is visible in Table 2.

Table 2: Conference Papers vs Journal Articles of Configuration Management Domain

	Total
Conference Papers	18
Scientific Magazines/Journals	12
	30

Table 3: Filtration Process of Configuration Management Domain

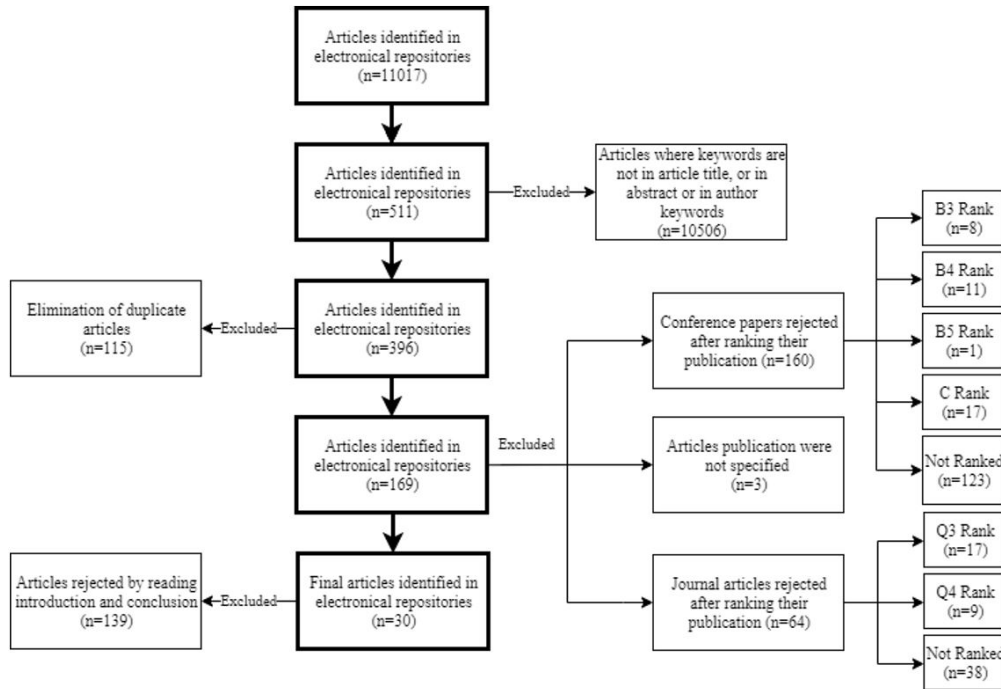|	No Filter	1st Filter	2nd Filter	3rd Filter	4th Filter
IEEE	3022	86	81	38	5
ACM	2792	118	67	35	3
SpringerLink	3249	78	78	24	1
ScienceDirect	1755	30	30	19	1
ResearchGate	199	199	140	52	20
Total	11017	511	396	169	30

Figure 2: Flow of all Filtration Process of Configuration Management Domain

In sum, it is possible to visualize the filtration process for this domain by each filter and by each repository, in Table 3.

2.2.2 Systematic Literature Review of Maturity Model

Following the generic search approach discussed initially in this chapter, on MM domain the focus was not just in the IT domain, but as also in other domains, with a view to finding general benefits and difficulties in this domain. Specific keywords (listed below) for this search were used in all repositories with operators AND and OR, with the "Maturity Model" concept being the main keyword.

"Maturity Model"
AND
("IT Frameworks" OR "Best practices" OR "Main Con-
cepts" OR "Benefits" OR
"IT Management" OR "Risks")

In the same way, as in the CM domain research, the articles found in ResearchGate's repository were added manually and the first filter was not applied in this case. In ResearchGate four articles from SpringerLink and one from IEEE were found, which were not found in their own repositories with the same keywords. Figure 3 shows all the filtration process in MM domain research.

On the last filter, the inclusion criteria were:
- articles about MM in any domain were accepted;
- articles about MM general characteristics were accepted;
- articles about MM benefits of any domain and MM general problems were accepted.

Articles that did not meet at least one of these "requirements" were rejected.

Table 4 shows a comparison between the number of journal articles and conference papers of the filtration result.

With the same view of the CM SLR, in order to have a higher understanding and comprehension of the MM domain filtration process was constructed the Table 5.

Table 4: Conference Papers vs Journal Articles of Maturity Model Domain

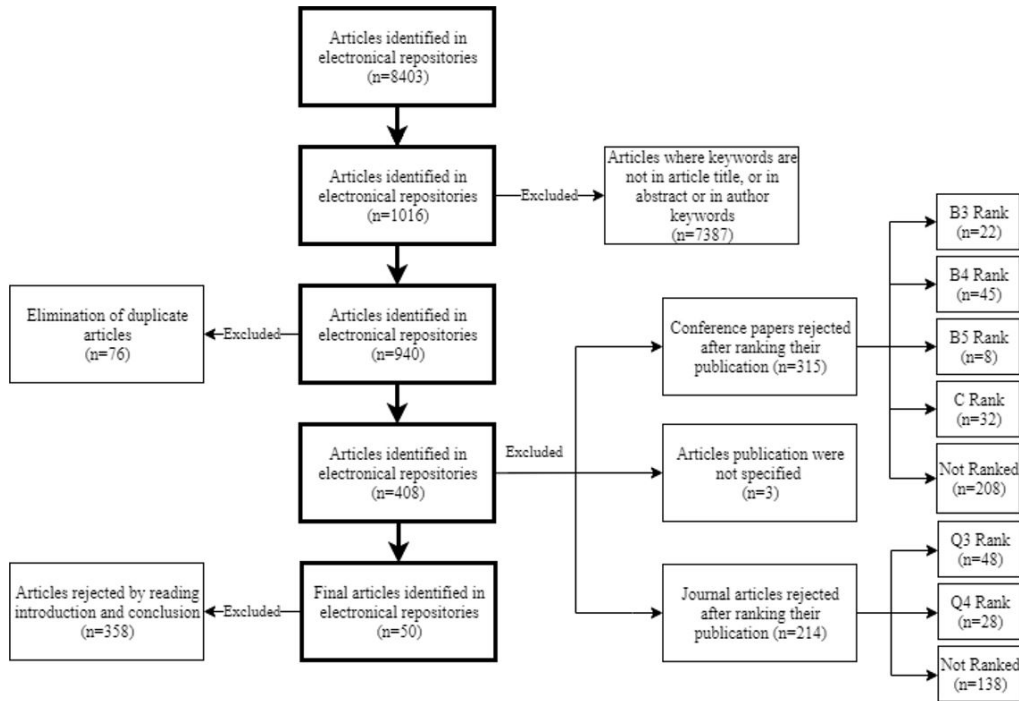|	Total
Conference Papers	30
Scientific articles (Scientific Magazines/Journals)	20
	50

Figure 3: Flow of all Filtration Process of Maturity Model Domain

Table 5: Filtration Process of Maturity Model Domain

	No Filter	1st Filter	2nd Filter	3rd Filter	4th Filter
IEEE	2729	232	231	94	5
ACM	174	54	54	18	6
SpringerLink	2529	126	126	52	12
ScienceDirect	2560	193	193	122	11
ResearchGate	411	411	335	122	16
Total	8403	1016	940	408	50

3 Configuration Management

Making important decisions is a critical and decisive point in organizations. These days, ITs are becoming fundamental tools for this type of tasks, allowing organizations to achieve their structural and strategic objectives (Na-Lampang & Vatanawood, 2016), enhancing their indispensability in organizations. Modifications to IT services and IT infrastructure configurations must be managed with extreme caution in order to prevent service interruptions (Johnson et al., 2007). CM is an important support process in the management of any infrastructure that permits an efficient and effective control, promoting critical and important information in any organization division (Baiôco & Garcia, 2010), attending to these configurations changes in a secure way.

Despite the fact that the importance of CM has been in-creasing in recent years, this process is not technologically new. In the 1950s, during the period of the "arms race", in order to enhance the production pipeline to reduce the missiles manufacturing time of missiles, the US Department of Defense established CM to control product specifications and deal with alterations during the product life cycle, as well as to create an accessible and conformed documentation. Therefore, with the purpose of having better control and to regulate how projects should be managed, CM standards were developed. CM expanded beyond its industries roots, since "society" started to become aware of the fact that the majority of businesses are comprised of systems with high complexity which suffer constant changes due to their dynamic environment (Ali & Kidd, 2014; Burgess et al. 2005).

CM recognition has been growing (Ali & Kidd, 2015), despite not being a new concept (Ali & Kidd, 2014). It is

a set of actions whose aim is the management of services and product configurations (Aleksic et al. 2010), and to enhance the service provision quality (Hashmi et al., 2010). This process has a big responsibility not just in managing IT assets and its configurations (Lahtela & Jantti, 2010), but also in providing crucial and accurate information about these "components" to organization operators, such as organization collaborators or even to other service management processes (Baiôco et al., 2009). This conceded information permits an image of the constitution of the IT infrastructure , allowing them to identify any change that might affect the systems or the infrastructure, assuring the collaborators of fundamental information in decisions that may be taken (Yang, 2010). In Table 6, the main concepts associated with CM are shown: Configuration, Configuration Item and CM Database.

As previously mentioned, CM provides an infrastructure or service model through "identification, controlling, maintaining and verification of existing Configuration Items versions" (Baiôco et al., 2009). CM is defined as having several sub-processes: Configuration Item Identification, Configuration Item Control, Configuration Item Verification and Audit, and finally Configuration Item Status Accounting and Reporting (Madduri et al., 2007). CM sub-processes definitions can be seen in Table 7.

Despite the fact that the influence of CM is expanding in the IT Services context (Na-Lampang & Vatanawood, 2016), in this state-of-the-art research, this process was also found in other IT scenarios, being closely related to Engineering Software, the CM concept having been identified in various contexts, such as project management, defined as Project Configuration Management (PCM), and in software development, designated as Software Configuration Management (SCM), for which a brief explanation is given in Table 8.

Table 6: Main Configuration Management Concepts Found

Concepts	Description	References
Configuration	A configuration is frequently referred to as all of the connection of all computer system parts, or a set of items that form a product.	(Aleksic et al., 2010; Calhau & de Almeida Falbo, 2012; Choi & Bae, 2001; Whyte et al. 2016)
Configuration Item	When a configuration product item is under management is called Configuration Item. Configuration Item is defined as "an infrastructure component or an item" that have value to the organization, and are vulnerable to change, with the necessity to be tracked throughout its lifecycle. These items may have different sizes and might be services, incidents, hardware components or even software packages. In several cases, it may well be persons.	(Aleksic et al., 2010; Baiôco et al., 2009; Calhau & de Almeida Falbo, 2012; Giese et al., 2010; Johnson et al., 2007; Lahtela & Jantti, 2010; Na-Lampang & Vatanawood, 2016; Pantoni et al. 2007; Ward et al. 2007; Whyte et al., 2016)
CM Database	Configuration Items and their relations are saved in a database known as CM Database. CM Database is an IT conceptual model with a predominant role in efficient IT service management. This database is an auxiliary valuable tool to perform decisions providing Configuration Items dependencies and links in the business, showing promptly the IT infrastructure details, enhancing the quality and efficiency of IT systems.	(Baiôco et al., 2009; Giese et al., 2010; Johnson et al., 2007; Lahtela & Jantti, 2010; Madduri et al., 2007; Na-Lampang & Vatanawood, 2016; Ward et al., 2007; Yang, 2010)

Table 7: Configuration Management Sub-Processes

Sub-processes	Description	References
Configuration Item Identification	Configuration Item identification is considered as an essential process to the system efficiency, where the identification of the items that will be under tracking will be realized.	(Aleksic et al., 2010; Ali & Kidd, 2013, 2015; Baiô-co et al., 2009; Calhau & de Almeida Falbo, 2012; Fowler, 1996; Madduri et al., 2007; Na-Lampang & Vatanawood, 2016; Ward et al., 2007; Whyte et al., 2016)
Configuration Item Control	Configuration Item control sub-process permits only authorized changes realized to Configuration Items.	
Configuration Item Verification and Audit	This sub-process proceeds to the verification of Configuration Item status and integrity, checking if they are in conformity with organization policies and standards.	
Configuration Item status accounting and reporting	Configuration Item status accounting sub-process, realizes information and historic report of the Configuration Items, guaranteeing the availability of this data to the organization executors.	

Table 8: Configuration Management IT Contexts Found

Contexts	Description	References
SCM	SCM gained particular recognition when Capability Maturity Model was developed, being this process established as a discipline of software development support in teams, which its main function is the accompaniment of the software products development. SCM is a set of principles and practices that are crucial to the software development support, directing the product changes, like programming code (source code), following the software design documentation. SCM comes to support brief software development in a manner that can increase the quality and decrease the development time.	(Buchmann et al. 2013; Choi & Bae, 2001; Conradi & Westfechtel, 1998; Fahmy, Deraman, & Yahaya, 2018; Pala Er & Erbaş, 2010; Pantoni et al., 2007; Park, Kim, & Lee, 2007; Tellioglu, 1996; Wandel et al. 2013; Whyte et al., 2016)
PCM	Since information asset in a project has become a project deliverable, PCM importance has gained some relevance. It is referred to as PCM when is necessary bigger control documentation and deliverable, resulting in better monitoring for project managers in the product lifecycle, that praise the PCM as a significant factor in project management.	(Fowler, 1996; Pantoni et al., 2007; Whyte et al., 2016)

4 Maturity Models

As previously mentioned, the technological evolution rendered organizations more IT-dependent, motivating them to improve IT's control and security (Rao & Jamieson, 2003). IT Organizations are growing in a complex way, having the requirement to evaluate their present situation, in order to, in a profitable manner, achieve their strategic objectives and project their future (Reis et al. 2017).

Managing IT practices is crucial to conducting the growing IT business value (Curley et al., 2008). Certifying the effectiveness and efficiency of these practices is an IT strategic management role (Hamel et al. 2013), whose main goal is to "continually improve IT performance with regard to its economic efficiency" (Becker et al. 2009). Hence, enterprises need to evaluate their actual position to in a strategic way, plan their proper investments (Schäffer et al., 2018). However, traditional measures were inadequate and consequently, a new "assessing methodology" emerged known as MM (Karni et al. 2013).

MMs are gradually becoming more important to organizations and any domain (Hammers et al., 2017). This concept began to be recognized 40 years ago (J. V. Carvalho et al., 2017). These models started to emerge when quality management practices were successfully implemented in manufacturing processes (Kwak et al. 2015).

Crosby was one of the pioneers, when in 1979 the structure that is subjacent to the maturity framework was created (Rao & Jamieson, 2003), conceiving a Quality Management Maturity Grid (Nord et al. 2016). His creation contributed significantly to the development of the quality maturity concept (Wang et al. 2016). At the end of the 1980s, the US Government with the intention of evaluating the capabilities of software companies, proposed to Watts Humphrey, to the Software Engineering Institute and to Miter Corporation to solve this task. The result of this task was the well-known Capability Maturity Model (CMM) (Humphrey, 1988). The MM's notoriety grew with the creation of this model (Mettler & Rohner, 2009), which provoked a strong adherence by organizations of

all domains and the attention of the research community (Achi et al., 2016), and diverse models in different domains were created, in construction (Jia et al., 2013), or in project management (Brookes et al. 2014), or even in the agriculture sector (L. Reis et al., 2018). MM is intrinsically associated with three concepts. Their description can be visualized in Table 9.

The author M. Fairchild (2004) defines the MM as "a method for judging whether processes used, and the way they are used, are characteristic of a mature organization". MMs can be seen as a tool (Curry et al., 2013), used to evaluate the as-is state of an organization (Antunes et al. 2014) and to enhance the organization's capabilities (Proença et al., 2013). The main idea of the MM concept is, in a succinct manner, to assess the activities behaviour of an organization at a certain number of maturity levels et al. 2009). This assessment is "constructed" by a comparison between a set of criteria and characteristics, provided by a MM, and the organization activities behaviour, shown in a gradual scale (Lã, 2011), assigning a state or a maturity level to an organization capability or a capability

combination (Desharnais & April, 2010).

MM defines an improvement path for the development of these organizational capabilities (Carvalho et al. 2018), displaying the best procedures to obtain a higher level of maturity (Proença & Borbinha, 2018). Although it is not an indispensable requisite to obtain the MM maximum level (Hamel et al., 2013) since each organization has its optimum level, which is defined as "the level that delivers the organization's strategic objectives most effectively and efficiently", which does not correspond to the scale's highest level (Introna et al. 2014). The improvement/implementation path can distinguish the type of MM. The two types of paths are characterized in Table 10.

One of the MM's main roles is to identify an organization's weaknesses and strengths (Lahrmann et al., 2010) in order to subsequently be able to create a capability improvement path and create a strategic plan for the future (Frick et al., 2013). In the literature, three specific purposes for the use of MMs were found. The description of these three purposes is presented in Table 11.

Table 9: Maturity Model Concepts

Concepts	Description	References
Maturity	Maturity concept has been described as a "state in which an organization is perfectly able to achieve the goals it sets itself". This concept is recognized as a measure to assess how-well are the organization capabilities. The maturity "component" it may be an object, a system or a person.	(Antunes et al., 2014; Brooks et al. 2015; Cleven et al. 2014; Hammers et al., 2017; Introna et al., 2014; Karni et al., 2013; Mayer & Fagundes, 2009; Mettler & Rohner, 2009; Proença & Borbinha, 2018; Proença et al., 2017, 2018; T. L. Reis et al., 2017; Vezzetti et al. 2014)
Capability	A Capability is characterized as the ability of an organization to produce value. Organizations use their capabilities strategically to improve their "abilities" to another level of efficient and effective.	(Bezerra et al. 2014; Curley et al., 2008; Hauck & Wangenheim, 2011; Karni et al., 2013; Picard et al., 2015; T. L. Reis et al., 2017; Wendler, 2012)
Maturity Levels	Maturity Levels or stages are a sequential path, not just to give an improvement path to organization, but as well as "situate" organization capabilities in a hierarchal level. Maturity Levels are often five, and each one has its procedures to implement in order to achieve that level.	(Antunes et al., 2014; Brooks et al., 2015; J. Carvalho et al., 2018; Cleven et al., 2014; Frick et al. 2013; Introna et al., 2014; Lahrmann et al., 2010; Mettler & Rohner, 2009; Nord et al., 2016; Proença & Borbinha, 2018; Serenko et al. 2016; Vezzetti et al., 2014)

Table 10: Types of Improvement/Implementation Path

Paths	Description	References
Staged	The staged model helps an organization to improve its capabilities "as a whole". To achieve a certain maturity level is required that the organization capabilities are compliance with the characteristics of that level. This model help organizations to characterize the "overall state of the organization's capabilities".	(Antunes et al., 2014; Cleven et al., 2014; Finnerty et al. 2017; Karni et al., 2013; Kayaga et al. 2013; Lahrmann et al., 2010; Mayer & Fagundes, 2009; Picard et al., 2015)
Continuous	In continuous path is the description of the procedures to improve/evaluate individually each capability of a domain to improve. Each capability can be at different maturity level. This helps the organization to develop and characterize the state of their individual capabilities and abilities.	

Table 11: Maturity Model Specific Purposes

Purposes	Description	References
Descriptive	MM can be used for an as-is situation of an organization, easing a basic assessment of the organization's capabilities. In descriptive purpose, MM is used as a "diagnostic tool".	(Cleven et al., 2014; Finnerty et al., 2017; Kayaga et al., 2013; Pã, 2011; T. L. Reis et al., 2017; Röglinger et al. 2012; Röglinger et al., 2018; Serenko et al., 2016)
Prescriptive	MM has a prescriptive purpose when gives an improvement path to higher maturity level, providing guidelines and measures to an organization.	
Comparative	Comparative purpose permits an organization to benchmark its capabilities in externally and internally way, using a large number of historical data from another organization's assessments.	

5 Discussion

As previously mentioned, CM is considered a process with the focus on quality. This process has great benefits, in terms of the identification of changes and the responsibility identification of those who performed them, maintaining the service's quality and integrity (Aleksic et al., 2010). Organizations in the service industry undergo changes frequently, and it is required to have a process that not only controls those changes but also maintains the IT infrastructure control and integrity in order to enhance the service's development and provision.

The CM process, at a developmental level, can be an essential tool in project delivery strategy because it reduces development time and minimizes risk or errors (Ali & Kidd, 2014), which allows a substantial increase in the final product quality (Fowler, 1996). This process can be a core support tool of organization operationality by diminishing the delays in development and operations (Ali & Kidd, 2013), not only that, but many of the enterprises implement this process to help in ensuring that the infrastructure is in conformity with the legislation and policies of its environment (Baiôco et al., 2009).

With all the literature review, it can be affirmed that the CM process can "produce" several benefits to an organization. This process intends to reduce the number of quality and conformity problems providing important information and also seeks to increase the capabilities and resources of the organization and reduce the risks. The CM process, being properly implemented and monitored, can "deliver" transparency, integrity and a bigger control to enterprises, increasing the quality of provision service's and client's satisfaction. However, it seems, by observing the number of papers in higher quality journals/conference's proceedings in the CM domain, that has not been given proper importance to this discipline. Moreover, it is defended that this process has not been taken into account by strategic management (Ali & Kidd, 2013).

A bad or inexistent implementation of this process might bring problems such as service failures and deficiencies in performance (Hashmi et al., 2010), leading to an increase in operational costs as well as a decrease in effectiveness, thus leading to the reduction of quality (Choi & Bae, 2001).

It is clear to note that, by comparing the benefits and the losses of a "bad or inexistent implementation" of the CM process and observing the research carried out in this domain, it is important that an organization have a proper implementation of the CM process and an improvement path plan.

In immature organizations, their processes are improvised and implemented in an ad-hoc manner, being difficult to take benefits from these processes. In this sort of organizations, where there is no process improvement plan, it may be a problem to achieve quality products. At the same time, in mature organizations where their processes are constantly updated, these enterprises can obtain quality products and exert more control over their projects and infrastructures (T. L. Reis et al., 2017).

MMs can help immature organizations become more robust and sustainable. These tools support organizations by assessing their process's current state and by defining an improvement path (Achi et al., 2016). This kind of assessment tools assists an organization in adapting to their environment and being more agile (Mettler & Rohner, 2009), helping to find weak and strong "spots" and improving an organization's process quality (Achi et al., 2016). They will ensure low costs and the process's execution in lower time (Hamel et al., 2013).

According to the literature review, MMs are being developed in a wide scope of domains. In the IT domain, these tools contributed to the creation of best practices (Proença et al., 2013), helping the management in IT organizations (Curry et al., 2013). IT management practices are critical to IT business (Curley et al., 2008), so it is becoming necessary to have these practices at their maximum maturity level, depending on the organizations' objectives.

It is believed that the use of best-practices following standards and frameworks in the IT Service domain can bring many benefits to the organization's performance

(Knahl, Bayro-Corrochano, & Hancock, 2013). Several researchers have created MMs to help IT organizations implement important frameworks in their infrastructure, by helping them have a robust and easy control of the overall processes (Pereira & Mira, 2010). In a practical way, some studies, with the realization of questionnaires to organizations that use best practices of frameworks like Capability Maturity Model Integration (CMMI) and Information Technology Infrastructure Library (ITIL), conclude that as processes' maturity levels grows, more benefits and fewer issues organizations will have, such as a positive impact on business performance, an increase in organization profitability and competitive leverage (Marrone & Kolbe, 2010, 2011; Salman, Daim, Raffo, & Dabic, 2018). In another study, the creation of MM for Incident Management process by following several frameworks has received good feedback from experts in the domain (Pereira et al. 2018), which seems that the utilization of frameworks for the creation of a MM could be a preference of IT organizations.

Even though MMs can bring many benefits, the improvement process is slow and it can take years to achieve a superior maturity level and to realize the benefits (Jiang et al. 2004).

Considering the losses that an organization can have by not giving importance to the CM process and the requirement to enhance this process by creating a strategic improvement plan, MM is a viable solution. By observing the benefits and objectives of both domains (CM and MMs) it can be concluded that MM domain complements the CM process by assessing its current state and supporting it through an improvement path, rendering it a robust and mature process. On that premise, the creation of a MM for CM based on frameworks can be an essential tool for an organization, generating many benefits and mitigating the problems of an immature CM process.

Eventually, this research carried out a search for MMs that would address the CM process or other IT processes that would help to justify the necessity of creating this tool, and two MMs were found (Table 12).

To fulfil the gap of the inexistence of roadmaps that elucidates an organization about their CM process's maturity level, the authors Niknam, Bonnal and Ovtcharova (2013) have created a Configuration Management Maturity Model (CMMM) in the PLM domain. Their MM intends to evaluate the maturity of the CM process in scientific facilities to help them find their own gaps and improve this process. The authors of this model, with state-of-the-art analysis and a study of the current MMs and standards, extracted the critical activities and dimensions of the CM. Subsequently, the authors developed four maturity levels.

In other research, with the requirement of having medical devices conformed with some directives and with the necessity the companies of medical devices produce files of histories with the software components used in the development of these devices, Caffery and Coleman (2007) have developed a MM for the medical device industry. The authors compared the regulations of medical device regulations and the best practices of the CM process domain of the CMMI model. MM is composed of five maturity levels.

These are the MMs created by the scientific research community that are most related to this research scope. Despite the fact that there are already two MMs for the CM, they do not have the scope on IT Services, where there is a domain that is constantly evolving, and its importance is growing. Considering there was no MM for CM process found that solves the problems that every service provider faces every day, the creation of this model can be a contribution to the scientific community, by helping to "add value" to the CM process of the IT providers. This model can support IT organizations by evaluating the CM process and planning an improvement path, which can converge to profit and better control their IT infrastructure.

For better comprehension of the results of this research, a summary is presented in Table 13.

Table 12: MMs Found in the Literature

Articles	Scope	Area	Methodology adopted	Based on	Maturity Levels
(Caffery & Coleman, 2007)	Software	Medical devices industry	Ad-Hoc	CMMI	5
(Niknam, Bonnal, & Ovtcharova, 2013)	Product Lifecycle Management (PLM)	Scientific facilities	Ad-Hoc	CMMI, International Atomic Energy Agency (standards), SPICE-BOOTSTRAP, Project Management Maturity Model, Systems Engineering Capability Model, ISO 9000-3, ISO/IEC 12207, ISO 9001, ISO 10007: 2003, EIA-649-B, MIL-STD-3046	4

Table 13: Summary of Research Results

CM   **MM**

Benefits	Problems Found
• Focus on the service's quality and integrity; • A process that can manage and identify changes to the IT infrastructure; • Reduces development time and minimizes risks of errors; • Provides important information about the infrastructure to all other processes;	• Lack of high-quality papers (lack of information); • It is not taking into account by the organizations strategic management; • Immature CM process decreases the quality of services.

Benefits	Problems Found
• Evaluates the processes maturity; • Creates an improvement path; • Helps to find weak "spots" and improve the organization's processes quality; • Ensures a low cost of operational processes; • MMs created by following standards can bring benefits to organizations.	• The improvement process is slow; • Plenty of time for benefits to be seen;

Benefits of the conjunction of both domains
• Creates an improvement path to the CM process; • Evaluates the *as-is* state of the CM process; • Better knowledge and management of the CM process, which brings a better quality of management and efficiency of the IT infrastructure; • Possibility of mitigating the problems and errors of the bad CM process execution.

Conclusion
Two MMs that address the CM practices were found, however, none of those MMs focus on IT Services. This research can represent an opportunity for the development of MM for the CM process.

6 Conclusion

Due to the constant pressures of the market and the environment, such as the reduced costs of operations, but with the requirement of maintaining the same or better quality, organizations need to constantly upgrade themselves by having mature processes, and MMs can serve as an excellent tool to improve organizations' processes. With the Systematic Literature Review methodology and Concept Centric method, it was possible to explain the CM and MMs concepts and their main characteristics and benefits, such as their problems and difficulties.

On the CM domain research, the number of result articles was just 30, and some of them are from the 1990s. This demonstrates that, although it is proven that the CM process could be essential for an organization, research done by the scientific community in higher-ranked journals/conferences in this domain and CM recognition is much more underdeveloped than it should be. Different from CM, on MMs research, many articles about the creation of new MMs and their importance in a broad domain variety were found, which reveals the substantial MM importance for an organization.

Still, a brief search of MMs for CM was made and two articles were found. However, any of these MMs address the IT Services domain, which underscores the fact that the development of a MM for the CM would be a feasible and helpful tool for IT Services providers.

Also, this investigation, by comparing the benefits and the utility that a CM would have in the management of an IT organization, concluded that a MM specific for CM would be an essential quality tool for an organization, such as the utilization of frameworks for the development of this kind of utensil.

These reviews will help new researchers to have a knowledge basis to start new research in these domains and can be a support base for the creation of a MM for the CM process.

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Izboljšanje upravljanja IT infrastrukture z uporabo upravljanja konfiguracije in zrelostnih modelov: sistematičen pregled literature in kritična analiza

Ozadje in namen: Cilj raziskave je proučiti, katere koristi lahko pričakujemo od uporabe modelov zrelosti (MM) v domeni upravljanja konfiguracije (CM). CM je podporni postopek, ki organizacijam pomaga, da imajo boljše upravljanje svoje infrastrukture. Njegov pomen na področju informacijske tehnologije (IT) se je v zadnjih letih povečal, čeprav ta postopek ni tehnološko nov. Številne organizacije izvajajo CM na neorganiziran in površen način, zato ne prinaša pričakovanih koristi. Z namenom ocenjevanja in izboljšanja praks in zmogljivosti IT v organizacijah so bili razviti in implementirani modeli zrelosti (MM). Uporaba MM v domeni CM še vedno ni ustrezno raziskana.

Zasnova / metodologija / pristop: Izvedena sta bila dva sistematična pregleda literature in kritična analiza. V celoti je bilo analiziranih 80 znanstvenih člankov najbolje uveljavljenih konferenc in znanstvenih revij.

Rezultati: V tej raziskavi ugotovili, da kljub slabemu izvajanju postopka upravljanja CM, lahko le-ta vseeno zmanjša operativne stroške in poveča kakovost upravljanja informacijske infrastrukture.

Zaključek: Do sedaj še ni bil razvit noben MM za prakse postopkov CM. Ta MM bi bil podporno orodje za upravljalce IT organizacij, saj bi s tem organizacijam pomagal do zrelega procesa upravljanja CM in boljšega nadzora nad svojo infrastrukturo IT. Zato bi bil obstoj MM za področje CM dobrodošel napredek, ki ga bi bilo treba razviti v prihodnosti.

Ključne besede: postopek upravljanja konfiguracije, modeli zrelosti, ponudniki IT storitev, sistematični pregled literature.