# Evaluating a Maturity Model for Agile Governance in Information and Communication Technology with Survey Based on Expert Opinion

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**Abstract.** Agile governance in Information and Communication Technology (ICT) is based on the application of principles and values of the Manifesto for agile software development to the ICT governance context. This approach to governance has been suggested as an innovative proposal, but the adoption of agile governance in ICT is still considered a challenge. Agile governance in ICT is multidisciplinary and is still regarded as a recent area. This paper aims to present a proposal for a maturity model to systematic and gradual adoption of agile governance in ICT called MAnGve Maturity Model (M3). The proposed maturity model was structured in five levels of maturity, constructed from a set of meta principles identified in an extensive bibliographical study of the area. For the elaboration of the model, a qualitative approach was used, with inductive method and comparative and structuralism procedures. Finally, this article assesses the feasibility of the proposed model, as regards the criteria associated with the feasibility of agile governance in from the point of view of 61 experts.

**Keywords:** Information and Communication Technology Governance; Agile Governance; Maturity models; Governance; Agility in software development;

## 1 Introduction

The proper and efficient application of resources of information and communications technology (ICT) has played a key role in ensuring return on investments. Over the past few years, ICT has become one of the major assets to be governed by the companies.

ICT governance in is defined by the IT Governance Institute as a subset of corporate governance and is considered a discipline focused on ICT and their performance and risk management systems [32]. Corporate governance is the set of processes, customs, policies, laws and institutions affecting the way a corporation is directed, administered or controlled [31].

Several initiatives have contributed to produce more efficient governance processes, which have allowed a better monitoring and control over these resources. Among these initiatives are the models of support for ICT governance.

In the context of this paper, models of support for ICT governance are mechanisms to support more effective governance. This support should always act in line with the alignment between the ICT resources and strategic organizational needs. It is important to highlight that this support may also vary according to the focus of the model. For example, we can cite the ITIL – Information Technology Infrastructure Library [3], as a model of ICT governance support which supports ICT service management. The COBIT-Control Objectives for Information and related Technology [1], promotes support of integrity assurance to information and information systems. In this sense, we can still cite as examples: the Balanced Scorecard – BSC [4], the IT Flex [2], Val IT [10], among others.

Although these models are mostly very well structured, the excessive formalism in the description of its processes and the large amount of information provided can generate unnecessary complexity in an adoption for a more agile context [30].As a result, organizations are having to invest exorbitant costs on external consultancies to guide these adoptions.

In this context, it is possible to check for a conflict between the formalism presented by most of these models and the agility imposed by a competitive market.

In 2001, a similar situation was observed in the context of software development. At that time, methodologies such as the Rational Unified Process (RUP) from IBM-Rational [6], precursors to the prescriptive software development, also encountered a similar problem involving a dichotomy between formalism and agility. Given this scenario, was born the Manifest for Agile Software Development [7]. This promoted a change of paradigm, based on principles and values involving agility and adaptability. At the moment the agile methodologies for software development is strengthened. Among these methodologies include: XP-Extreme Programming [8] and [9] SCRUM.

With this perspective in mind, it is believed that, in a manner analogous to what happened with the software development, ICT governance also lacks alternatives with more agile approach. Luna et al. [19] present a study demonstrating the relationship between the critical success factors for ICT governance and the principles/values of the Manifesto for agile software development. This study reinforces the relationship between these areas. This same author also presents an innovative proposal for ICT

governance, based on the principles and values of the Manifesto for agile software development, called agile governance in ICT [19]. According to studies [35], this area, although promising, can still be considered to be on the rise, requiring initiatives for the advancement of this multidisciplinary research field.

Agile governance in ICT has been suggested as an innovative proposal for ICT governance. This type of governance has been suggested as an innovative proposal, but the adoption of agile governance in ICT is still considered a challenge. Agile governance in ICT is multidisciplinary and is still regarded as a recent area.

During the development of this work, it was also observed that software development methodologies (agile or prescriptive) have received support of maturity models ([14], [15], [17], [18]). This support usually aims to promote a systematic and gradual adoption of practices and/or processes. The same has also happened with some models of support for ICT governance [1] [16].

Maturity models seek a unification of a same vision, treating the evolution of maturity as evolutionary stages. In these stages, organizations are evolving and gaining a greater degree of maturity every step forward [11] [12].

According to Chrissis et al. [13], the concept of capability is defined as the ability to predict the process and its results, or the range of expected results that can be achieved by following the given process. On the other hand, the maturity is defined by these same authors as the evolution of process capability, where each maturity level provides a layer for the continuous improvement of the process.

In order to better address the concepts related maturity in this paper, we use the following classification for these models: maturity models for prescriptive software development, maturity models for prescriptive ICT governance, maturity models for agile software development and maturity models for agile governance in ICT.

As maturity models for prescriptive software development, we can cite: CMMI-Capability Maturity Model Integration [14] and MPS.BR – Programa de Melhoria do Processo de Software Brasileiro [15]. As maturity models for prescriptive governance in ICT: PMF-Process Maturity Framework [16] and generic maturity model of the COBIT [1]. Finally, as maturity models for agile software development we can cite: SMM-Scrum Maturity Model [17] [18] and AMM-Agile Maturity Model [18]. Other models have also been investigated and contributed to the design of the proposed model.

This paper aims to present a proposal for a maturity model to systematic and gradual adoption of agile governance in ICT called MAnGve Maturity Model (M3). The proposed model was structured into five levels of maturity, constructed from a set of meta principles identified in an extensive bibliographical study of the area.

The paper is structured as follows: Section 2 describes the research methodology; Section 3 presents the proposed model and Section 4 presents the results of an evaluation of the proposed model with experts. Finally, Section 5 presents general considerations and opportunities for future works.

## 2 Research Methodology

Marconi and Lakatos [21] claim that the instrumental methodological definition must be directly related to the problem being studied. In this way, a research must be rigorously analyzed even before its execution. In order to meet the objective of this paper, some procedures and techniques have been defined according to **Table 1**.

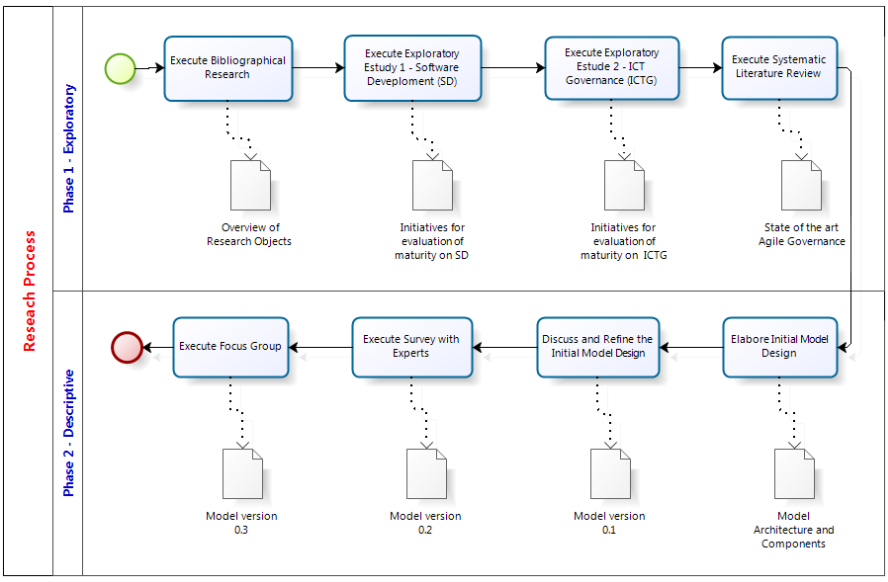
**Table 1.** Summary of Methodological Approaches.

| **Objective** | **Exploratory** |
|---|---|
| **Technical Procedures** | Bibliographical Research;<br>Systematic Literature Review;<br>Survey;<br>Focus Group. |
| **Nature of the Variables** | Quantitative;<br>Qualitative. |
| **Method of Approach** | Inductive. |
| **Methods of Procedure** | Comparative;<br>Structuralist. |
| **Areas of Concentration** | Computer Science (Information Systems);<br>Administration Science (Information Systems). |

### 2.1 Research Process

This research was conducted through a set of activities [28]. These activities were structured into two distinct phases. **Figure 1** presents the phases, activities and results.

**Figure 1.** Research process for the proposed model.



- **Phase 1: Exploratory**

The first phase consists of four steps, is more exploratory and aims to build a consistent theoretical framework for the next phase of research.

In the step first, seeking an overview regarding the objects to be investigated, an initial Bibliographical research was performed. This step generates a consistent theoretical framework involving: ICT governance, agility in software development and maturity models.

Then were executed two exploratory studies. The first study aimed at identifying initiatives for evaluation of maturity in software development. The second aimed at the identification of initiatives for evaluation of maturity in ICT governance. Publications were carried out with the results of these studies [39] [40] [41] [42] [43].

Finally, in order to reinforce the theoretical framework constituted, was performed a Systematic Literature Review (SLR). This SLR presented the state of the art in agile governance in the world. The results of this SLR have been published [35].

- **Phase 2: Descriptive**

The results obtained in the first phase provided the foundation for the development of subsequent steps. This second phase has the main objective to build and improve the proposed model. This phase has a descriptive characteristic.

In a first step was conceived an initial design of proposed model. This initial design has defined the architecture and the components of the model. Then, this initial design was discussed in the Project Management Research Group (GP2[1]) of the Informatics Center of Federal University of Pernambuco (CIn - UFPE[2]). These discussions were extended also to the scientific and industrial community [44] [45] [29]. From these feedbacks, the model was evolved into a first version.

In the next step, a survey with experts was executed. The results obtained from this study formed the basis for the generation of a second version of the model.

Finally, it was then performed an assessment by focus group. This study has generated valuable contributions that are currently being used for the improvement of the proposed model.

## 3 Proposed Model

The proposed model was structured based on inputs identified during the research process. A set of related reference initiatives in ICT governance, agility in software development and maturity models influenced the construction of the model.

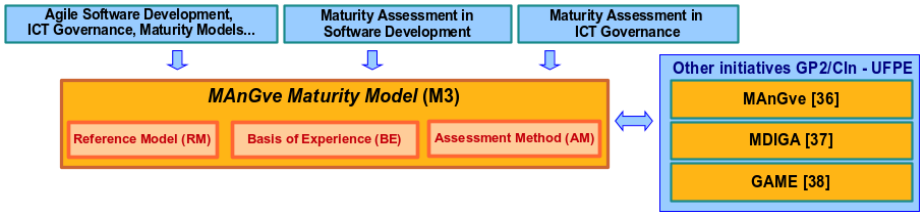
Three components were designed during the construction of the model: an Assessment Method (AM), a Reference Model (RM) and a Base of Experiences (BE). The main objective of the RM is presenting a description of the processes specified.

[1] http://gp2.cin.ufpe.br/
[2] http://www.cin.ufpe.br

The AM aims to guide the execution of conformity assessments. Finally, BE aims to be a repository of record of experience in evaluations performed.

The idealized model (called MAnGve Maturity Model (M3)) allows integration with other initiatives for agile governance developed by GP2 research group. An indicators model (MDIGA [37]), a management model (GAME [38]) and a framework (MAnGve [36]) for agile governance, are also being built. **Figure 2** presents some of the key elements that were considered during the construction of the MAnGve Maturity Model (M3), as well as their respective components and integrations with other initiatives of the group.

**Figure 2.** Architecture, components and integrations of the proposed model.

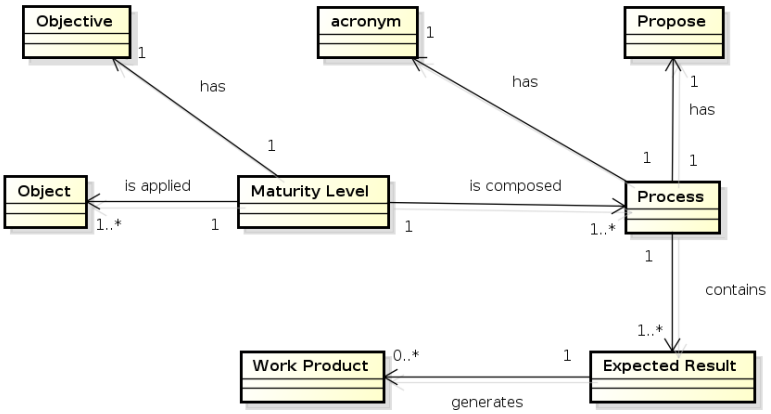



### 3.1 RM Metamodel

A conceptual model is typically used in the design of information systems and intends to demonstrate abstract way relationships among its components. In this work, was built a conceptual model in the metamodel format [34]. This metamodel defines the basic elements of the RM and their relationships. **Figure 3** presents this metamodel describing that:

- Each **"Maturity Level"** has a single purpose, is composed of one or more processes and is applied to one or more objects.
- The **"Objective"** describes the purpose of the level of maturity and is related to a single level of maturity.
- The **"Object"** describes the context to which can be applied the maturity level, and should be applied, at a minimum, a level of maturity. These objects can be, for example, the organization as a whole or even part of it (a sector, a business unit, among others).
- The **"Process"** should contain a set of expected results and a single purpose. A process presents a description of performance from a simple and objective way. In this way, a process can be seen as a set of interrelated actions which are executed in order to generate desired results. A process also has a single acronym.
- The "**Purpose"** is associated with a single process and directs the Organization to evolution through the description of objectives that guide the realization of processes.
- The **"Expected Results"** define the results to be obtained after the execution of the process and can generate a set of work products.

**Figure 3**. RM Metamodel.




### 3.2 Maturity Levels and Processes

The structure of the processes to the MAnGve Maturity Model (M3) was defined as ISO/IEC 12207 [26] and ISO/IEC 15504-2 [27]. Each of these processes has been described in terms of its purpose. In addition, each process has a list of expected results describing what is expected after the execution of each process. These expected results act as performance indicators in organizations [25].

The basic framework for definition of each one of the processes of the model was then structured as follows:

- **Process:** Represents a set of actions that are related to each other. After execution of these actions is generated an expected result (product).
- **Purpose:** Defines the objectives of the process.
- **Expected results:** products obtained after the implementation of the process. A work product or significant change resulting from the execution of a process is evidence of these results.

According to ISACA [1], a maturity model seeks to identify a set of information, such as the company's current performance, its position in relation to the market (benchmarking), the company's goals for its evolution in terms of maturity and the necessary path to go.

For this to be possible, the MAnGve Maturity Model (M3) sought to represent his knowledge on agile governance in ICT through levels of maturity. These levels were structured based on the knowledge acquired during this research.

As a result, the proposed model has been structured into five levels of maturity, ranging from level 1 (Initial) to level 5 (Mature). Are these:

- **Level 1 - Initial:** The organization does not provide clear evidence of initiatives related for agile governance in ICT.

- **Level 2 - Repeatable:** The implementation of processes to support governance in ICT in the organization begins to gain greater prominence in agility. The responsibilities for agile governance in ICT are clear and the processes that support it must be subjected to an initial monitoring and control.
- **Level 3 - Intermediate:** Processes that support the agile governance in ICT become even more priority. The plan and the strategy for agile governance in ICT are followed and updated with great regularity by making the organization more adaptive. The organization works according to a plan, policies and processes through a clear definition of the roles and responsibilities for an agile governance in ICT more effective.
- **Level 4 - Advanced:** The processes to agile governance in ICT are consolidated. At this level, the processes to agile ICT governance become better standardized and diffused in the organization. Furthermore, these processes are clearly documented and constantly evaluated through measurements. The processes to agile governance in ICT are statistically controlled and are constantly undergoing continuous improvement.
- **Level 5 - Mature:** aims to establish continuous improvement. At this level there is a concern in prospect, select and evaluate technologies and new paradigms promoting agile governance in ICT even more effective.

The specified processes to the MAnGve Maturity Model (M3), received major influences of six meta principles for agile governance in ICT (identified from a systematic literature review [35]), of the principles and values of the Manifesto for agile software development [7], of COBIT [28] and ISO 38500 [33]. **Table 2** presents the processes built for agile governance in ICT.

**Table 2.** Levels and Processes for Agile Governance in ICT.

| Levels | Processes for agile governance in ICT |
|---|---|
| 1 | The organization does not provide clear evidence of initiatives related for agile governance in ICT. |
| 2 | Start Environmental Diagnosis and Empower Team (EDE)<br>Identify and Prioritize ICT initiatives (III)<br>Prepare Customer/Supplier Chain (PCC)<br>Prepare Service Level Agreements (PSA)<br>Prepare and Approve Governance Deployment Plan (PAG) |
| 3 | Analyze Organizational Environment (AOE)<br>Align Initiatives with Governance Models (AIG)<br>Perform Team Training (PTT)<br>Detailing Services Customer/Supplier Chain (DSC) |
| 4 | Manage Items in the Deployment Cycle (MID) |
| 5 | Identify and Plan Improvements (IPI) |

## 4 Evaluating the Proposed Model

The proposed model has undergone a research process aiming at its construction and continuous improvement. After construction of the first version, was performed a new evaluation of the MAnGve Maturity Model (M3).

This evaluation was performed through 61 experts. These experts have had direct or indirect participation in initiatives involving governance in ICT, agility and/or maturity in recent years.

The opinions of the participants of the study were recorded through an online questionnaire. This questionnaire has been properly prequalified by three experts with considerable experience in agile ICT governance [22] [23]. The online questionnaire was made available during the period from June through September 2014. The questionnaire was structured based on previous studies developed by the same research group [5].

The main objective of the evaluation was to verify the degree of importance, capacity, reliability and consistency of the purposes and expected results defined for the processes. The MAnGve Maturity Model (M3) as a whole was also evaluated. To this end, we used a strategy based on GQM (Goal Question Metric) [20]. This strategy involved the phases of: planning, definition of the data collection method and interpretation of results. **Table 3** presents an overview of this evaluation strategy based on GQM.

**Table 3.** Strategy to evaluation based in GQM.

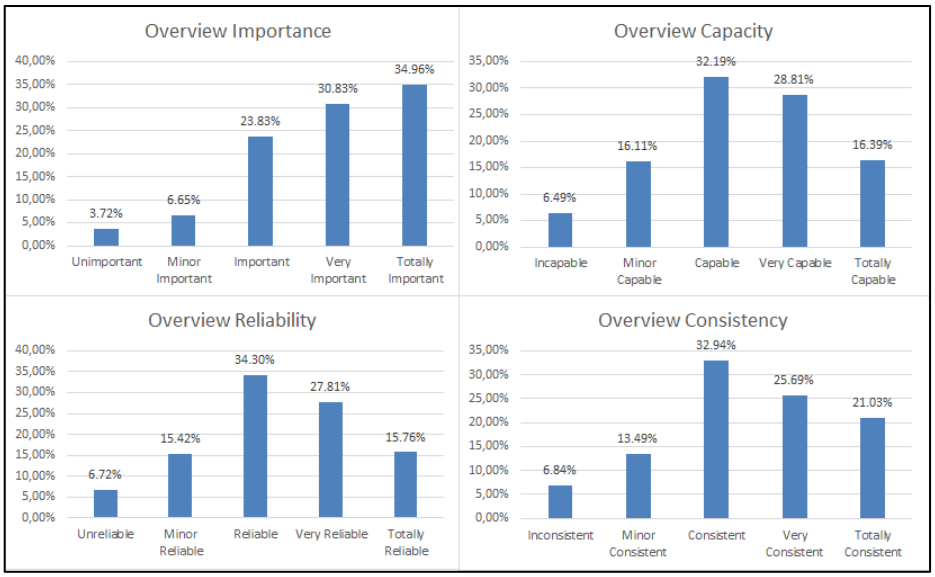
| | | |
|---|---|---|
| **Goal** | Purpose | Have the viability of proposed model evaluated. |
| | Main Question | With respect to the criteria associated with the feasibility of agile governance in ICT (importance, capacity, reliability, and consistency). |
| | Object | From the point of view of knowledge holders in: governance in ICT, agility and/or maturity. |
| **Question** | Q1 | What is the level of importance of the purposes and expected results of the processes? |
| **Metric** | M1<br>M2 | Likert scale (1 to 5);<br>Importance level calculation: ILC = (Total * Total Importance)/100; |
| **Question** | Q2 | Organizations have the capacity to apply the purposes and achieve the expected results of these processes? |
| **Metric** | M1<br>M3 | Likert scale (1 to 5);<br>Capacity level calculation: CLC = (Total * Total Capacity)/100; |
| **Question** | Q3 | The purpose and the expected results of the processes are reliable? |
| **Metric** | M1<br>M4 | Likert scale (1 to 5);<br>Reliability level calculation: RLC = (Total * Total Reliability)/100; |
| **Question** | Q4 | Os propósitos e os resultados esperados destes processos estão coerentes ao contexto de governança ágil em TIC? |
| **Metric** | M1<br>M5 | Likert scale (1 to 5);<br>Consistency level calculation: CLC = (Total * Total Consistency)/100; |

The 61 participants of the study reported a number between 1 and 5 (based on Likert scale) to record their views for each of the model's processes. In addition, participants were able to report criticism and/or suggestions. Finally, were questioned as well as maturity levels proposed by the model.

### 4.1 Analysis of the Results

During the analysis of the data collected, we identified some important findings for the continuous improvement of the proposed model. A general perception of the model was obtained from the previously metrics demonstrated in GQM. **Figure 4** presents global indexes obtained during this evaluation.

**Figure 4.** Global indexes of the proposed model.




In this way, it is possible to observe, based on the largest percentages of responses obtained, which in terms importance the model was considered "very important" or "totally important" by 65.79% of participants. On the other hand, with respect to capacity, the model was considered "capable" or "very capable" by 61.00% of participants.

Analyzing these data, we can affirm that in the opinion of participants, the proposed model presents relevant importance level for agile governance in ICT. In addition, these participants showed considerable capacity in using the model without significant difficulties.

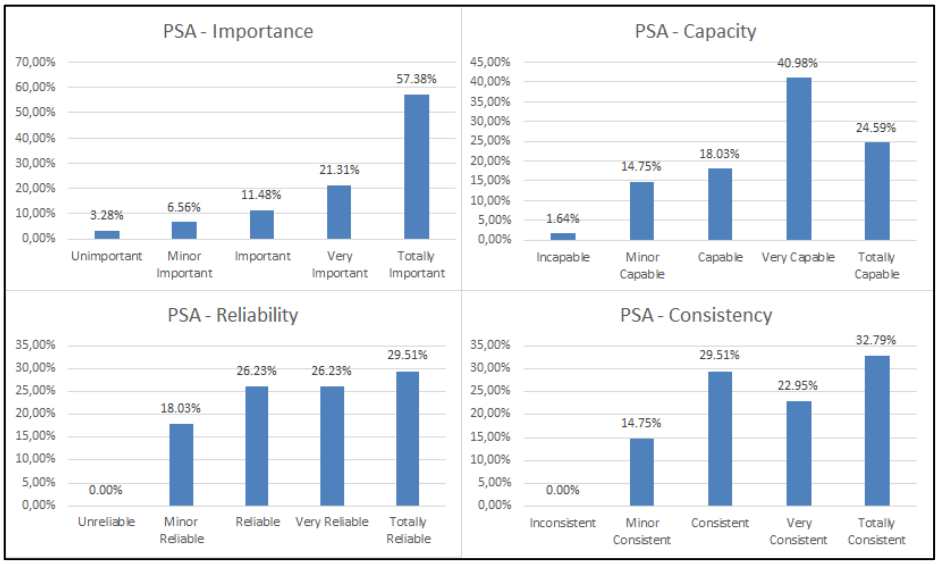
For reliability, the model was regarded as "reliable" or "very reliable" by 62.11% of participants. Finally, for consistency, the model was considered "consistent" or "very consistent" by 58.63% of participants.

We can then conclude that in the view of participants, the model presents considerable levels of reliability and consistency. This indicates that the main goals can be reached through purposes and expected results considerably trusted, and that these same purposes and expected results are specified in a clear and easy to understand.

In addition, purposes and expected results were also evaluated for each process. For example, the **Figure 5** presents data collected for the PSA process.

We can observe that, according to survey respondents, the PSA process has higher concentrations in the following percentage values: “totally important” (57.38%), “totally capable” (24.59%), “totally reliable” (29.51%) and “totally consistent” (32.79%).

**Figure 5.** Individual indexes for the PSA process.




Furthermore, given the results, it is found that, on average, 63.93% of respondents considered this process "very" or "totally" important, capable, reliable and consistent. A similar analysis was also carried out for other processes in the model.

## 5 Final Considerations and Future Works

This article presented a maturity model for agile governance in ICT called MAnGve Maturity Model (M3). This model was constructed from relevant references in the areas of governance in ICT, agility and maturity. The proposed model is adherent to the main standards for building maturity models and was structured from findings identified during the development of this research. Finally, this work describes the results of one of the stages of evaluation and continuous improvement of the proposed model.

This evaluation showed the utmost importance for the process of continuous improvement of the proposed model. Through this evaluation, it was possible to identify aspects to be refined in the very structure of the model, in their maturity levels and in their processes.

We understand that the MAnGve Maturity Model (M3) presents innovative contributions to industry and academia. As a future work, a new version of the model is being designed based on the results obtained in this survey.

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