

USING A SOFTWARE TOOL FOR ASSESSING THE MATURITY LEVEL OF GOOD MANAGEMENT PRACTICES

Extended Abstract

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Abstract

Organizations often use recognized frameworks to assess the capability of their processes. However, the evaluation process is often time-consuming, poorly organized, and expensive for the organizations. Therefore, we propose to implement a software tool to help assessors in determining the capability of a process concisely and efficiently.

This research follows a Design Science Research methodology to design and develop an artefact, to demonstrate its usefulness, and to evaluate if and how it can be used to address the stated problem. We developed a model for the software tool, which was instantiated as a web application. The proposal was evaluated based on a set of interviews with experienced authors.

Overall, supporting an audit process with a software tool seems to improve the auditor on its work, but the proposed artefact is still in a very initial stage, and many improvements are needed before it can be used in a real organization. In the future, the improvements suggested should be implemented, particularly the support for standards that do not follow the structure of the ISO/IEC 330xx family of standard, which does not seem to be used in the industry.

This work proposes a tool that is generic enough to support different frameworks, which was created by following a structured and detailed process, rooted on insights collected with experienced authors.

Keywords: Assessment, Assessment Tool, Capability Frameworks, Maturity Model, International Standard.

1. Introduction

Aiming at delivering products and services while respecting quality, time, and budget requirements, many organizations have been applying well-known and defined frameworks to assess the capability of their organizational processes [1]. Some popular examples include maturity models such as Capability Maturity Model Integration (CMMI) [2] and international norms such as those published by the International Standardization Organization (ISO) [3].

The application of these frameworks can help organizations improving their operational effectiveness and efficiency. Moreover, a certification on an international standard act as a recognition of the organization's commitment to the best practices in the industry. This allows the organization to better position themselves [4].

The process assessment, or audits, are used to examine the compliance between the organizational processes and the frameworks. They generate results that organizations can use to analyze their current practices; identify areas for improvement and plan the steps towards those improvements [5].

Audits are usually conducted by expert assessors to collect evidence; rate process capabilities; and write assessment reports. However, these activities are very complex; time-consuming; and often supported by outdated tools, which makes the audit process expensive, preventing organizations from running these audits [6].

To address this problem, we propose the use of a software tool to assist assessors in conducting audits and determining the capability of a process. With this solution, we intend to provide more support for auditors to perform their work and organize the audit process, thus improving the efficiency and effectiveness of those processes, while reducing associated costs.

This research was conducted by following a Design Science Research (DSR) methodology. We started by conducting an in-depth analysis to establish the problem and the goals for a solution, based on a set of interviews with experienced auditors.

The results of this in-depth analysis were then used to build a model for a software tool, comprising the functionalities that seemed to be more useful to the auditors to improve the audit process efficiency. This model was later instantiated as a web application.

The tool was evaluated during a set of interviews with the same auditors that participated in the problem definition. The outputs of this evaluation activity were important to understand if the proposal can be used to address the research problem and achieve the defined goals.

Overall, we found that supporting an audit process with a software tool can assist the auditor on its work, but it is still in a very initial stage, and many improvements are needed before it can be used in a real organization. Nevertheless, it seems to have potential to address the research problem and achieve the defined goals.

The paper is organized as follows. In Section 2, the research problem and motivation for this work are described. Then, the method followed is described in Section 3, followed by an overview of the ISO/IEC 330xx family of standards. The proposal is described in Section 5, demonstrated by instantiating the model as a web app in Section 6, and evaluated in Section 7. The paper closes with some main conclusions, limitations, and future work.

2. Problem

Audits are a very bureaucratic process often conducted with manual procedures and outdated tools, which represent many challenges for both assessors and organizations. During audits, a large amount of evidence must be collected from multiple sources, which can difficult the analysis of the outputs [1], and makes it harder to achieve an objective evaluation [7].

Additionally, the reliability and precision of the data collected can be compromised [5], particularly due to the bias caused by the participants and assessor's attitudes, experience, and approach, which are often subjective [4]. This issue is amplified by the lack of transparency in the way audits are conducted, where relevant information regarding the process is not visible [7]. All this leads to audits that are inefficient, time-consuming, and expensive to the organizations [8], [9].

To identify the specific challenges underlying the audit processes, and thus improve the understanding of the research problem, we conducted semi-structured interviews with experienced auditors. The goal was to gather feedback about the problems that can occur during audit processes and to understand some aspects of the organizations that hire such services.

The interview was organized in three parts: **warm-up** (to know the profile of the interviewees); **audit process** (to understand their experience and opinion regarding audit processes); and **final remarks** (for them to discuss other topics not mentioned in the interview).

The interviews were held remotely (via Zoom) between January 2021 and March 2021 and took between 30 minutes and one hour. The interviews were recorded (with the permission of the interviewees) and then revised to take notes and organize the results. The participants were selected based on the contacts of the researchers and on LinkedIn (by searching for auditors).

Eight auditors (including four lead auditors) were interviewed. Most interviewees have a computer science background, but their professional experience is more varied. The two most experienced auditors have 31 and 23 years of experience, respectively, as auditors and project managers. The less experienced interviewee worked as an auditor for the last two years. The remaining have between six and 10 years of professional experience.

We found that the tasks performed to prepare an audit differ with the interviewees profile. For example, the two auditors that perform consultancy work in different organizations mentioned the need to know more about the organization that will be audited, mainly because it is important for them to understand how the organization operates in the market and how it is organized. Additionally, they also mentioned the need to assign a responsible for managing the communication between the auditors and employees.

Nevertheless, there are tasks that are commonly mentioned by either internal or external auditors, such as the need to prepare an audit plan and the definition of relevant stakeholders for each process that will be audited.

Regarding how organizations can help the auditors perform their work, the interviewees overall stated that their work would improve if the organization defined the relevant stakeholders that are supposed to be participating in the audit process.

On the other hand, there are some common challenges affecting audits. Some auditees can try to mislead the auditor with false information about the processes that are being audited, to influence the results. Having unorganized information can also negatively impact an audit process. Finally, another common issue is the stress of the employees being audited.

Finally, all auditors agreed that having a software to support audit processes could help them on making assessment. They also proposed functionalities that could be included in such a tool.

The two most mentioned functionalities were the possibility to generate reports and support for evidences management. The latter consists on managing the evidences collected during the audit, so that all evidences that support a requirement of the standard can be easily found.

Two auditors further suggested to have a functionality for the auditors to create forms to collect information outside audit meetings. Other two auditors further suggested that such an application would support an agenda functionality to schedule meetings for an audit, and two suggested supports for continuous improvement (i.e., connect different audits, so that the results of an audit can be considered in a following one).

Overall, we found that auditors work with a wide range of different frameworks, and perform different tasks to prepare for an audit, depending on their profile. Nevertheless, most of the auditors interviewed prepare an audit by creating an audit plan and defining stakeholders for each process that will be audited, which can be easily done with the help of the organization. Moreover, the audit process can be faster if the organization ensures that the relevant information is organized and structured.

We identified some challenges that audit processes may be subject to, namely regarding the employees being stressed and providing false information when their work is being audited. Having information unorganized and non-visible during the audit process can also lead to a lack of transparency.

Finally, there seems to be benefit in having a software tool to support audit processes, which could help addressing some of the challenges and supporting preparation tasks.

Summing up, the problem we are addressing in this research work is **the lack of a structured, transparent, and efficient approach to collect and evaluate evidence during audits.**

3. Method

This research followed a DSR approach, which allows to incrementally design, test, and evaluate a solution that is aligned with the organization and end users' needs [10]. DSR is guided by a set of conceptual principles, practices (in the form of seven guidelines proposed by Hevner et al. [11]) and an iterative process composed by six phases [10], which are mapped to our research in Figure 1.

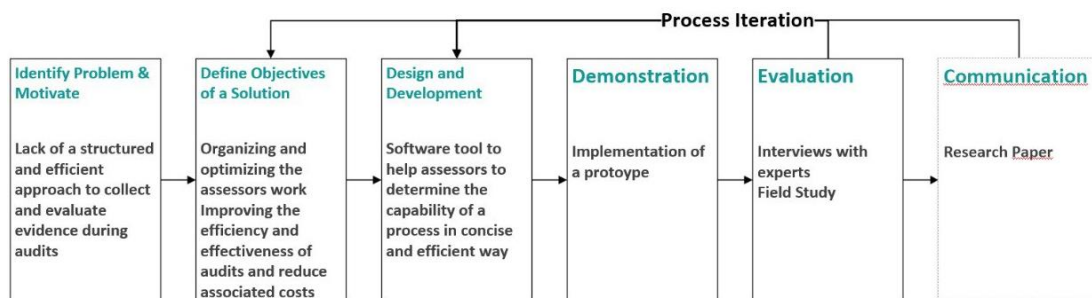


Figure 1. DSR methodology process model (adapted from [10])

The research effort consisted of a single iteration, which started with the identification and definition of the problem that motivated the research, followed by the definition of the objectives for the solution. These activities were supported by the results of a set of interviews with experts.

Based on these results, a model was created to help achieve those objectives and address the research problem. This model was then instantiated as a web app, and evaluated during a field study and a set of interviews with

the same experts that participated in the problem definition and objectives identification. Overall, this allowed us to evaluate the quality of the model and its instantiation to address the research problem.

Based on the results collected, we derived important conclusions.

4. ISO/IEC 330xx

The ISO/IEC 330xx series of standards provides a structured approach for performing assessments, with the intent of guaranteeing that an assessment is objective, consistent, repeatable, and representative of the assessed processes [12].

An important concept in this series of standards is the Process Reference Model (PRM), a set of unifying processes that have each a description of its purpose and the associated outcomes [13]. Also, each process is described by the attributes: **process ID** (the identifier of the process); **name** (a short phrase that summarizes the scope of the process); **context** (a brief overview of the context of process in the main subject); **purpose** (the high-level goal for the process); and **outcomes** (the observable results of a successful achievement related to the process).

The capability of the processes described in a PRM is assessed by applying a Process Assessment Model (PAM), which describes the indicators needed to determine process capability and performance, such as generic practices; resources; and work products. These indicators are the basis for collecting evidence of the goals, which in turn allow the assessor to assign ratings and determine capability [14]. The capability dimensions included in PAMs are a six-point scale ranging from 0 to 5, where each level represents a specific process capability level: Incomplete (0); Performed (1); Managed (2); Established (3); Predictable (4); or Innovating (5).

A PAM is directly related to one or more PRMs since it describes, for each process of a PRM, the fundamental indicators; base practices; and work products.

One of the best-known examples of the implementation of this standard is the ISO/IEC 33052 (PRM) and the ISO/IEC TS 33072 (PAM) which provides a clear implementation for the ISO/IEC 27001, which in turn provides requirements for information security management [15]–[17].

These two standards propose a structure, where each assessment has defined processes and outcomes (as established in the PRM). Furthermore, the PAM describes the inputs and outputs for each outcome.

5. Proposal

In this section, we describe the specific objectives and the proposal that was developed to address the research problem.

The main goals of this research proposal are providing more support for auditors to conduct audits and perform their work; and improving the audit processes using software tools.

To achieve the defined objectives and address the underlying research problem, we proposed the development of two artefacts: a model and its instantiation. More specifically, these artefacts consist of a **software tool that will help an assessor to determine the capability of a process in a concise and efficient way**. The model is described in this section, and its instantiation will be detailed in Section 6.

This software tool centralizes all the main tasks that an assessor does, such as collecting evidence; rating processes' capabilities based on that evidence; and schedule meetings with employees in the organization. Also, this tool was intended to improve the audit processes in the following ways:

- Organizing and optimizing the assessors' work;
- Improving the efficiency and effectiveness of those processes;
- Reducing the associated costs.

The model was created through different phases. The first step was to establish the requirements for the tool, based on the work performed so far (and described in this document). The research team discussed some ideas for the tool based on the insights collected with experienced auditors and the specification of the ISO/IEC 33052 and ISO/IEC 33072 standards [15], [16].

The goal was to create a model that was simple to implement, so that we could validate it as soon as possible. First, we needed to create the base structure to support the audit process, based on the ISO/IEC 330xx family of standards. Then, we further decided to implement the support to schedule meetings and the reporting.

Thus, the following set of relevant and important functionalities were selected for the tool: 1. Create organization and associate employees; 2. Meeting scheduling associated with employees; 3. Creation of a new assessment; 4. Add evidence to an outcome; 5. Evaluate processes based on the rate of outcomes; 6. Evaluate outcomes based on the evidence; 7. Insert frameworks.

Functionalities 1-3 and 7 correspond to the preparation of the audit and functionalities 4-6 to its execution. Functionalities related to inserting and visualizing base practices were left out of this proposal, since they are less relevant to the auditor when compared to the ones listed.

The final requirements of the tool are presented on Table I, grouped into categories, according to the entity related to audits that they are focused on creating and managing: Organization; Framework; Assessment and Meeting Schedule. The requirements in category Users are related to the users' management in the application.

Table I. Tool requirements.

Category	Title	Requirement
Organization	Create organization	The system should allow the users to create new organizations in the system.
	Create employees	The system should allow the users to create new employees and associate them with an organization.
	Edit organization	The system should allow the users to edit an organization already created.
	Delete organization	The system should allow the users to delete an organization already created.
	Search organization	The system should allow the users to search by an organization
Framework	Create a framework	The system should allow the users to create a new framework
	Edit a framework	The system should allow the users to edit all the components of a selected framework (framework information, processes, outcomes, inputs, and outputs)
	Delete a framework	The system should allow the users to delete a framework already inserted.
	Search frameworks	The system should allow the users to search by frameworks.
Assessment	Create new assessment	The system should allow the users to create a new assessment
	Rate processes	The system should allow the users to rate processes of an assessment
	Rate outcomes	The system should allow the users to rate an outcome
	Upload evidence	The system should allow the users to upload evidence to a specific outcome
Meeting Schedule	Create a new meeting	The system should allow the users to schedule a new meeting.
	Associate users to a meeting	The system should allow the users to associate employees of an organization to a specific meeting already created
	Edit meeting	The system should allow the users to edit a meeting already created
	Delete meeting	The system should allow the users to delete a meeting already created.
Users	Create users	The system should allow the administrators to create new users
	Edit users	The system should allow the administrators to edit a user's information
	Delete users	The system should allow the administrators to delete a user
Reports	Report of an assessment	The system should allow the users to be able to retrieve a report that has all activities performed on an assessment
	General reports	The system should allow the users to be able to see reports about the general use of the platform (number of assessments made and for which organizations)

Afterwards, the UML class diagram (shown in Figure 2) was created. This model was created based on the ISO/IEC 33XXX family of standards, so that the application data could be handled [15]. This model also shapes the database structure of the model.

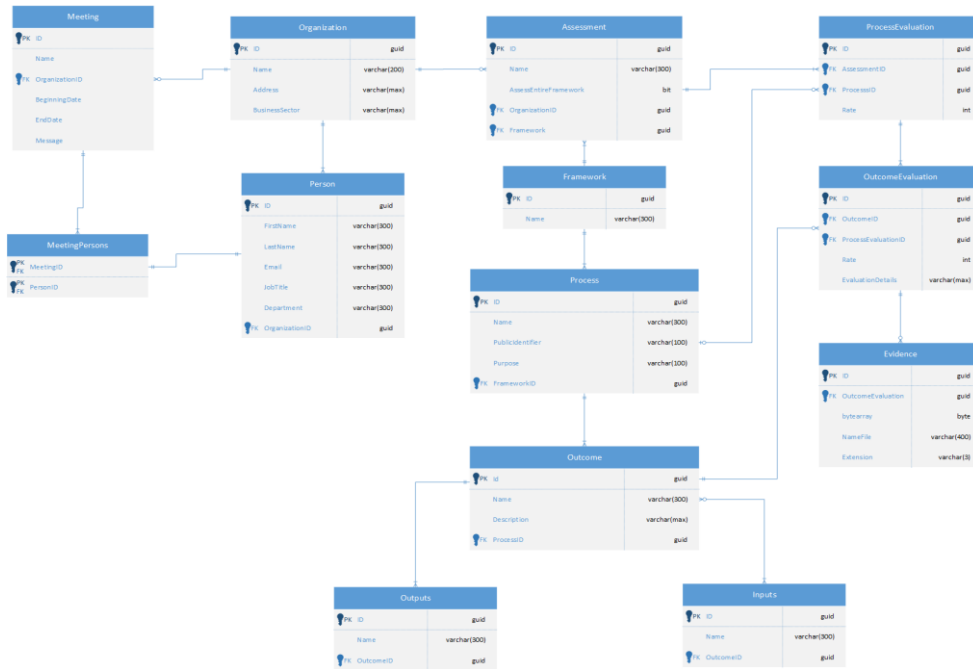


Figure 2. UML diagram of the software tool

6. Demonstration

In this section, which corresponds to the demonstration step of the DSR approach, we show how the proposed solution can be used to address the identified research problem.

The proposed model was instantiated into a prototype using Microsoft Power Apps technologies¹. More specifically, a web application was developed, since the versatility allowed by such tools could ease the auditors’ work, who could use it on desktop computer and/or on a mobile platform.

When creating an app using PowerApps, the login page is created automatically. The auditor can login into the portal using either the internal credentials system (by providing a username and a password) or a Microsoft account. This is possible because the tool was also integrated with Microsoft accounts, taking advantage of the support of the open id connect protocol.

After being authenticated, the tool redirects to the homepage, containing generic information about the tool and details on how it can be used. The top menu allows the user to access different parts of the application (Organization, Assessments, Frameworks, and Scheduling).

The “Organization” menu shows a list of organizations inserted by an user. From here, organizations can be created or edited. An organization contains both general information (name; address; and business sector) and the employees associated to it.

The “Schedule” manager displays a list of all meetings created, each containing basic information (title; start/end dates; organization; and a description) and the employees who must attend it.

The “Assessments” menu displays the list of assessments created. Clicking on the name of assessments allows to edit it, as shown in Figure 3. Additionally to some generic information (such as the framework and organization it corresponds to), the list of processes associated with the assessment is shown, which can be filtered to only display either open or closed processes.

Selecting a specific process allows to edit its information; rate the process; and see the process’ outcomes that are open or closed. Also, new outcomes can be added. When rating the process (functionality 5), one of the following levels can be selected: incomplete (0); performed (1); managed (2); established (3); predictable (4); innovating (5).

For an outcome an user can provide details about the evaluation being conducted; rate the outcome; and upload evidence to support that rate. When rating the outcome (functionality 6), one of the following options can be selected: Not achieved (0-15%); Partially achieved (>15-50%); Largely achieved (>50-85%); Achieved (>50-85%); Fully achieved (>85-100%).

In the Edit Assessment screen, shown in Figure 3, clicking on the button “Final Report” will generate a report for that assessment, listing all the activities conducted in a specific assessment. More specifically, all the processes and associated outcomes (with the rates assigned) are listed, and the user can print the report.

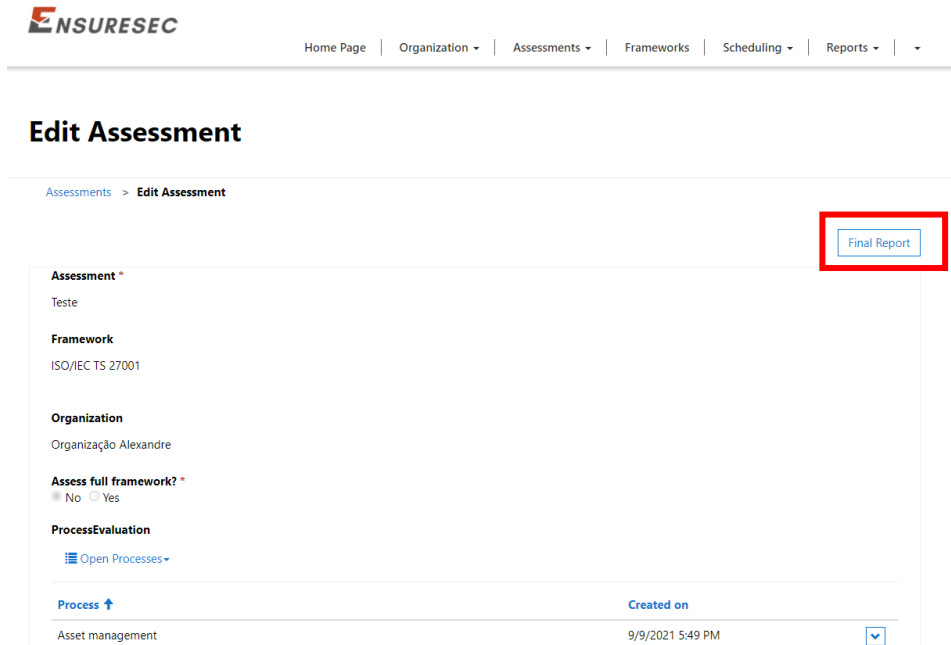


Figure 3. Edit assessment page

Moreover, the general report shown in Figure 4 allows the user to get an overview of the audits conducted in the platform. This report was built using Microsoft PowerBIⁱⁱ, a technology from the PowerApps Suite that allows to create dashboards and reports. The user can see the total number of assessments, and those who were fully or partially conducted. The auditor can also see the number of assessments per business sector in a bar chart.

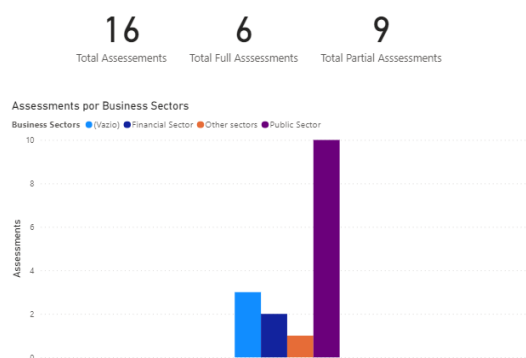


Figure 4. Report on the tool

Finally, the “Frameworks” menu allows to insert any framework that follows the same structure of the ISO/IEC 330xx series of standards to the application. In this way, we can guarantee the flexibility of the tool itself, making it able to be used on multiple use cases. Through multiple and sequential screens, all information regarding the framework is inserted, including generic information (like the name); its processes; and outcomes.

7. Evaluation

This Section corresponds to the evaluation step of DSR, where we evaluated the outcomes of the demonstration activity and confirm if and how the proposal can be used to address the stated problem.

7.1. Field Study

The tool was evaluated in a field study, where an audit was performed with support of the developed tool in a multinational organization working on the rental car business area. The audit was based on a digital transformation maturity model, and conducted by a master's degree student in the context of her thesis' research work

This digital transformation maturity model aims to guide organizations through their digital transformation initiatives and was developed according to the ISO/IEC 330xx family of standards. More specifically, the ISO/IEC 3305 (PRM) and ISO/IEC 33072 (PAM) standards were followed.

After completing the audit, the participant provided feedback regarding its use, so that we could understand the stronger and weaker points of the proposed solution. She said that the audit was performed without facing any major issues. However, some minor improvements were suggested, including ordering the list of processes of an assessment by rate; adding filters to select processes and outcomes that were not audited; and add more options to the list of business sectors.

Also, some minor bugs were reported regarding issues with labels, which were either written in Portuguese instead of English, as the remaining of the app, or wrong, and with usability issues.

7.2. Final Interviews with Experts

The tool was evaluated based on a set of semi-interviews. The interviewees correspond to the same eight experienced auditors who participated in the interviews described in Section 2 for investigating the research problem. As in the previous set of interviews, these sessions were held remotely (via Zoom), and were recorded (with the permission of the interviewees) and then revised to take notes and organize the results. Interviews were conducted between June and September 2021, and took between 45 minutes and one hour.

During the interview, the tool was demonstrated, and for each feature the same three questions were asked: 1) Do you think that this functionality can help improving the auditing process?; 2) Does this functionality pose any limitation? ; 3) Do you have any suggestion on how to improve this functionality?

In the end, the interviewees were asked whether they had additional suggestions for improving the tool. Because we already had interviewed all participants, there were no questions regarding the interviewees' profile, which can be consulted in Section 2.

All interviewees agreed that the proposal was overall good for an initial version of the tool, and would be helpful in clarifying and structuring the audit process. Nevertheless, the auditors proposed some improvements, mostly to address identified limitations.

Regarding the creation of an organization, three auditors suggested to include a field to indicate the size of the organization being created. Moreover, A5 and A6 stated that there are few fields for providing employee information (such as main projects and responsibilities), since department and role are not enough to categorize an employee.

Moreover, A4 suggested to integrate the application with Azure Active Directoryⁱⁱⁱ (AD) is a limitation, given that all software is part of the Power Platform stack. Finally, A7 suggested to replace the Address field with a list of districts for the user to select from, which would help when computing statistics.

When creating an assessment, A1 and A2 suggested that it should be possible to associate the relevant stakeholders to the processes, including people whose work is being audited; top managers that want to receive the results, etc.

A5 and A7 stated that more information should be added regarding the audited, such as the start and end dates. More specifically, A1 and A5 suggested that it should be possible to indicate the areas of the organization and are being audited (e.g. IT, Human Resources; etc.), while A1 also mentioned that physical sites could also be subject to an audit.

When adding evidences to an outcome, A2 and A3 suggested that it should be possible that one evidence could be linked to many outcomes.

Concerning the reporting functionality, all auditors agreed that it should be possible for the auditor to submit a general remark of the audit. Furthermore, A1, A2, A3, and A4 further indicated that having a single field for final conclusions would be enough to address this.

Additionally, four auditors further suggested to create different reports for different stakeholders involved in the audits. For example, the top managers might need to have a report based on graphs and with more direct and concise information. On the other hand, the technical roles would be more interest on the reports already generated by the tool, since it contains more detailed information regarding the technical details of the audit.

Regarding the remaining functionalities (meetings schedule; evaluate processes and outcomes; and inserting frameworks), no limitations or improvements were discussed.

A7 suggested the creation of new functionalities, such as to be possible to cover multiple frameworks in one audit, since it is usual to conduct an audit focused on more than one framework. Another example is to add the possibility to include not only maturity models, but also the standards itself. For example, instead of being able to add the ISO/IEC 27001 maturity model, it should be possible to directly add the ISO/IEC 27001 standard.

Finally, A7 suggested a more advanced feature, where it would be possible for the organization to submit most of the information through the application, so that the auditor would have information organized beforehand. In some cases, the software tool could have automated workflows to validate some simpler requirements.

An interesting output of these interviews is that, when we asked if they could use the tool in a real audit, they all mentioned that they never used a maturity model based on the ISO/IEC 330xx structured approach, or had any knowledge of it being used. Thus, while they were available to test the application, they could not do it unless it supported another standard structure. Consequently, we had no opportunity to test this application in a real-world scenario.

8. Conclusion

Overall, the proposal seems to be helpful in addressing the research problem, because it indeed allows to create a structured approach to collect and evaluate evidence during audits. While the tool is still in a very initial stage, and thus requires more iterations of design and evaluation, it seems to have potential to become very useful in the future.

While being a novel subject, there seems to be some interest in using software tools to improve the efficiency and transparency of the audit's process. Also, while it was not possible to evaluate the tool in a real assessment, by a real auditor, the feedback gathered suggests that using a software tool to support the audit process seems to have a positive impact on the auditors' work, as it allows to gather evidences; create reports; and maintain the history of audits and audit information in a more organized; concise; and efficient way.

Nevertheless, this potential could only be unleashed if the tool supports standards not based on maturity models following the structure proposed in the ISO/IEC 330xx family of standards.

In the future, the tool could be improved by implementing some of the features that were discussed through this research, but never implemented. Some examples are the support to continuous improvement and the improvement of reporting tools.

An important venue for future work is to change the model of the proposal to support other standards that are not based on the maturity model structure defined by the family of standards ISO/IEC 330xx. This would make it easier to find organizations where the tool could be used by an experienced auditor during a real-world audit process.

8.1. Limitations

While we were only able to conduct eight interviews with experienced auditors, we believed that we have reached saturation in the feedback collected. However, we cannot guarantee that these results can be generalized to all auditors. To address this, we tried to describe the interviewees' profile to contextualize their opinion.

Not all the identified functionalities and suggested improvements, which are important to support the auditors' work, could be implemented in the tool.

While the tool was used during a real audit, it was conducted by a master student, with no previous experience as an auditor. This is evident in the feedback received, which was mostly focused on usability issues, which despite relevant are not the focus of an experienced auditor.

However, the tool could not be evaluated by an experienced auditor, in a real organization, because, as we already discussed, the structure of the tool (based on the ISO/IEC 330xx family of standards) is not used in the industry.

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