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IT Governance Enablers for an Efficient IoT Implementation

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ABSTRACT

IoT is considered to be one of the focal points for the 4.0 industry revolution because of the way it is changing the business models of each organization. IT governance is now an increasingly important tool for organizations to align their IT infrastructure with the organization's business objectives. IT governance has been used to help implement new technologies using the best practices such as COBIT, which defines a number of *enablers* that facilitate the implementation, identification and management of IT.

This research aims to explore and define the most suitable *enablers* for an IoT implementation. These objectives will be achieved through the *Design Science Research* methodology, which incorporates two literature reviews, a Delphi method and, finally, a semi-structured interview.

With a first systematic review of the literature, it was possible to identify the main *enablers* to implement IoT. Next, the list was improved using the Delphi method, gathering expert opinion. In the Delphi method, the level of agreement was verified to create exclusion criteria and a level of efficiency in each recommendation. Finally, a specialist was interviewed to demonstrate the applicability and validation of the proposed artifact in the various IoT projects implemented by his organization.

At the end, a final list of enablers for IoT implementation is provided. The results indicate that data privacy, data protection, and data analysis are currently the best recommendations to be considered in an IoT implementation because they increase the efficiency of the solution and increase the credibility of the data obtained. Future work and limitations are detailed in the end.

Keywords: IT governance; IoT; Enablers; COBIT; Implementation; IT.

RESUMO

A *IoT* é considerada como um dos pontos fulcrais para a revolução da indústria 4.0, devido à maneira como está a alterar os modelos de negócio das organizações. A governação das TI é atualmente uma ferramenta cada vez mais importante para as organizações alinharem a sua infraestrutura tecnológica com os objetivos de negócio da organização. A governação de TI tem sido utilizada para ajudar na implementação de novas tecnologias recorrendo à utilização de boas práticas como por exemplo o COBIT, que define vários *enablers* que facilitam a implementação, identificação e gestão das TI.

Esta investigação visa explorar e definir os *enablers* mais adequados para uma implementação de *IoT*. Estes objetivos vão ser alcançados através da metodologia *Design Science Research*, que incorpora duas revisões de literatura, um método Delphi e por fim uma entrevista semiestruturada.

Com uma primeira revisão sistemática da literatura, foi possível identificar os principais *enablers* para implementar *IoT*. De seguida, a lista foi melhorada utilizando o método Delphi, recolhendo a opinião de especialistas. No método Delphi, verificou-se o nível de concordância para criar critérios de exclusão e um nível de eficiência em cada recomendação. Finalmente, um especialista foi entrevistado para demonstrar a aplicabilidade e validar o artefacto proposto nos diversos projetos de *IoT* implementados pela sua organização.

No final a lista de *enablers* para implementar *IoT* é fornecida. Os resultados indicam que atualmente, a privacidade de dados, a proteção de dados e a análise de dados são as melhores recomendações a serem consideradas numa implementação de *IoT*, porque aumentam a eficiência da solução e aumentam a credibilidade dos dados obtidos. Trabalho futuro e limitações são detalhadas no final.

Palavras-Chave: IT governance; IoT; Enablers; COBIT; Implementation; IT.

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LIST OF ABBREVIATIONS AND ACRONYMS

AES	-	Advanced Encryption Standard
COBIT	-	Control Objectives for Information and Related Technologies
DSR	-	Design Science Research
ERA	-	Excellence in Research in Australia
HTTP	-	Hypertext Transfer Protocol
IoT	-	Internet of Things
IPSec	-	Internet Protocol Security
ISACA	-	Information Systems Audit and Control Association
IT	-	Information Technology
ITG	-	Information Technology Governance
LoRa	-	Long Range
LR	-	Literature Review
REST	-	Representational State Transfer
RFID	-	Radio Frequency Identification
SLR	-	Systematic Literature Review
SSH	-	Secure Shell
TAM	-	Technology Acceptance Model
TPB	-	Theory of Planned Behavior
TCP	-	Transmission Control Protocol
TLS	-	Transport Layer Security

CHAPTER 1 - INTRODUCTION

Information Technology (IT) is one of the pillars our society as it changes the way people relate to and interact with each other as well as how business is communicated (Patón-Romero et al., 2018). IT has become an essential asset in operations and business growth, so organizations are becoming completely dependent on IT and this has led them to shift their attention to IT governance (ITG) (Pereira & Mira da Silva, 2012).

The ITG has been demanded by many organizations and high-level ITG models are being used within the organizations and rapidly emerging in IT, thus becoming an important subject to consider (Bartens et al., 2015). Plus, ITG focuses on sustaining value and confidence across the organization and their business with the help of the compliance components (Selig, 2018). Recently, some researchers proposed that ITG is a set of structures, processes and relational mechanisms that work together to guarantee that IT is aligned with the business objectives (Vejseli et al., 2019). ITG consists of the IT organization, where it sustains and extends the organization's strategy and objectives using leadership, organizational structures and processes to help achieve those goals (Bianchi et al., 2017).

Some of the goals established by ITG are (Huygh & De Haes, 2019):

- Align the organization's IT with the needs and business requirements of the organization.
- Measure the IT performance and competitive advantages delivered by IT within the organization.
- Align IT objectives with the overall business strategy.

So far, some ITG frameworks have been developed to guide and assist ITG implementation. The best known is COBIT, developed by the Information Technology Governance Institute of the Information Systems Audit and Control Association (ISACA) (Bernroider & Ivanov, 2011), which defines COBIT5 as the framework for governing and managing IT in a holistic manner in all organizations (ISACA, 2018).

COBIT defines a set of enablers to support the implementation of an ITG system within an organization's IT, which is driven by the goals cascade (ISACA, 2018). Enablers are intended to allow organizations to manage their complex interactions and facilitate successful outcomes.

COBIT framework can be used to control IT operations, strategies and to support legal compliance (Bernroider & Ivanov, 2011). Moreover, COBIT helps organizations implement ITG enablers (Lainhart et al., 2012). COBIT aims to help an organization ensure alignment between IT use and it is business goals (Ridley et al., 2008). This is even more critical when an organization want to adopt novel technologies to win competitive advantage.

IoT was recently considered the next wave of innovation by industry leaders (Kerr & Murthy, 2013) and is becoming very popular in the context of the IT revolution that most are now facing (Lu & Cecil, 2016). Furthermore, IoT is catching everyone's attention because it promises to improve and optimize the day-to-day lives of everyone using smart sensors and smart objects working together (Kerr & Murthy, 2013). According to a McKinsey report (Alur et al., 2015), there will be at least 30 million IoT devices connected and interacting by 2020. Therefore, IoT is considered an important strategic technology trend that will shape business opportunities and competitive advantage (Balaji & Roy, 2017).

Several benefits have been identified with the adoption of IoT, such as marketing automation, cost reduction, access to sales data, and targeted customer services. In addition, an IoT system has the capacity to create knowledge about user history and this, in turn, allows the organizations to meet real-time needs and make better strategic plans in order to achieve its business objectives (Yaqoob et al., 2017) and make better decisions (Zhang et al., 2017). IoT takes domains such as logistics and operations within an organization and facilitates the exchange of commodities, services, and information (Tu, 2018).

1.1. OBJECTIVES AND RESEARCH QUESTIONS

Based on the previous statements and the scarcity of literature related to ITG and IoT domains, this research aims to investigate and further understand the main ITG enablers an organization could use during an IoT implementation in order to increase its efficiency. To fulfill the research objective, the following research question was formulated: Which ITG enablers should be considered by organizations in an IoT implementation?

1.2. METHODOLOGY APPROACH

Four methodologies are used along with this research: Design Science Research (DSR), Systematic Literature review (SLR), Delphi method and Interviews. The SLR and Delphi methodologies are the main research protocols and the Interviews is a research support instruments in this investigation.

The DSR methodology is the main research methodology of the investigation which encompasses the other three methodologies (SLR, Delphi and Interviews). The literature review is achieved through a practical SLR approach in order to collect as much information as possible in literature. Also, inside the DSR methodology, two methods are used to extract valuable information from professionals in the field: Delphi and interviews.

1.3. STRUCTURE AND ORGANIZATION OF THE DISSERTATION

This research has six chapters. The first chapter includes the introduction where the objectives, research questions, and methodological approach are identified. The second chapter is a theoretical background in the areas addressed in the dissertation. The third chapter is the research methodology where the methodologies SLR and DSR and the Delphi method used in the dissertation are specified. The fourth chapter presents the systematic literature reviews elaborated; the Delphi method used in the dissertation. The fifth chapter is the demonstration and evaluation with the results of the interviews and with the reviewer’s comments from the submitted articles. The sixth chapter details the conclusion of the investigation.

CHAPTER 2 – THEORETICAL BACKGROUND

2.1. IT GOVERNANCE

ITG enables IT to sustain and extend business goals, where IT is aligned with the organization's business needs (Vejseli et al., 2019). The ITG applies roles and responsibilities in IT and related technologies to manage and support the functions of the organization, where those roles and responsibilities refer to the IT department, users and management of an organization (Higgins & Sinclair, 2008). On the other hand, management has the responsibility of overseeing the IT department, ensuring that IT goals are aligned with organizational goals, users monitor IT systems and provides input to IT implementation plans (Higgins & Sinclair, 2008).

ITG formalizes IT accountability to ensure more effectiveness and ethical management within the organization, improves planning, integration and performance of the business and IT across departments (Selig, 2018).

ITG and IT management differ since ITG involves making strategic IT and provides IT management with decision-making guidelines. On the other hand, IT management is responsible for making specific IT decisions and supports the objectives defined by the governance bodies (Bart et al., 2018). The ITG can be defined as the structures, processes and relational mechanisms to proceed with IT decision making in an organization and the ITG deals with IT in every organization (Simonsson & Ekstedt, 2006). Moreover, ITG aims to focus on IT objectives of overall business strategy, measure IT performance and gain competitive advantages from the organization's IT department (Higgins & Sinclair, 2008).

For Bowen, et al., (2007), ITG mechanisms enable IT and business executives to formulate policies and procedures and implement them into a number of specific applications and monitor the results. The ITG is a way to involve processes and structures for decision making, to engage people from different governance levels. In addition, ITG can be viewed as a set of authority arrangements and standards of IT strategic activities with the goal of implementing high-level definitions (Wiedenhöft et al., 2018).

2.2. ITG ENABLERS

The COBIT5 enablers have been introduced into the fourth principle, “Enabling a Holistic Approach”, in order to have more efficient and effective governance and management of corporate IT. COBIT5 defines seven enablers to support the implementation of a comprehensive governance and management system for corporate IT (ISACA, 2018).

The COBIT defines the enablers as a tool to build and sustain a governance system to address governance issues by grouping the enablers into governance and management objectives which have the capacity to be managed by required capability levels (ISACA, 2018).

The seven enablers are:

1. Principles, Policies, and Frameworks
2. Processes
3. Organizational Structures
4. Culture, Ethics, and Behavior
5. Information
6. Services, Infrastructure, and Applications
7. People, Skills, and Competencies

These enablers portray the tangible representation of the relational mechanisms to IT resources where they are relevant to the organization, with the end of using enablers in order to leverage stakeholder needs in terms of value creation and resource optimization (Bartens et al., 2015). The enablers are factors that individually and collectively influence whether something will work in this case, governance and management over the IT organization and are driven by goals cascade (ISACA, 2018).

The COBIT defines all enablers as a way to describe which decisions should be taken, by whom and how (ISACA, 2018). The ITG enablers can address issues such as disintermediation of information, privacy, and big data by providing guidance using a governance and management framework. As such, it is necessary to understand the reasons why information needs to be managed and governed appropriately and in a given context (ISACA, 2018).

The enablers can help translate desired behaviors into practical guidelines for everyday management in organizations (Bartens et al., 2015). COBIT5 defines the enablers “Information”, “Services, Infrastructures and Applications” and “People, Skills, and

Competencies" as tangible and intangible resources of an organization (Bartens et al., 2015).

2.3. IOT

The first definition of IoT came from a "things oriented" perspective and evolved into a concept in which devices are connected to other devices over the internet, where they can communicate with each other using technologies such as RFID, Bluetooth by sensors, actuators, etc., in order to reach common goals (Atzori et al., 2010). IoT is a network of interconnected devices, systems, and services using the existing Internet infrastructure to create and achieve more value in an organization (De Cremer et al., 2017; Lu & Cecil, 2016). IoT can be defined as a global network of interconnected devices based on common standards and communication protocols, and also allows the interaction and communication with one another with a data exchange environment about the surrounding environment, thus enabling the creation of services without direct human intervention (Gubbi et al., 2013).

Moreover, IoT can be defined as the paradigm in which everyday things relate to technology that has the capability to sense, identify, network and process information and capabilities, which allows communication with other devices (Balaji & Roy, 2017). IoT brings several benefits through applications in the social sciences and industries (Zhang et al., 2017).

IoT is composed of three components: hardware, middleware, and presentation. The hardware component refers to sensors and actuators. The middleware component refers to on-demand storage and computing tools. The presentation component refers to the visualization and interpretation tools of the exchanged data where it can be accessed by various platforms and applications (Gubbi et al., 2013). IoT can bring more value by creating a more direct interaction between the physical world and computer-based systems by tracking, measuring and creating "smart devices" to benefit individuals, businesses and society (De Cremer et al., 2017).

CHAPTER 3 – RESEARCH METHODOLOGY

3.1. DESIGN SCIENCE RESEARCH

In the literature, it is claimed that design science is concerned with constructing artifacts to achieve goals. It is also assumed that design science has two basic activities: to build and evaluate. Moreover, design science contains four types of products, including constructs, methods, models, and implementations (March & Smith, 1995).

The DSR methodology creates and evaluates IT artifacts to solve identified organizational problems in the research, and it contains three elements: conceptual principles to define what is meant, practice rules and a process to carry out and present the research (Peffers et al., 2008). The motivation behind this methodology is to improve the environment by implementing new and innovative artifacts using processes to build those artifacts. The identification and representation of opportunities and problems of the environment is fundamental in the beginning of this research endeavor (Hevner, 2007).

The DSR is a method which emphasizes the design and development of artifacts, for example, applications, systems, and methods, with the purpose of increasing the efficacy of the information systems inside the organizations (Peffers et al., 2018). The environment contains all the people, organizational systems, technical systems, and problems and opportunities. This method builds and designs the artifacts and processes, where they pass into an evaluation. In order to have a good, solid artifact it is necessary to connect to knowledge-based foundations, which are the scientific theories and methods, the experience and expertise, and the meta-artifacts. The main objective of the DSR methodology is to achieve a clear understanding of the key proprieties of the DSR paradigm (Hevner, 2007).

As mentioned by March and Smith (1995), design science has a type of product which is suitable to address this methodology in our research. DSR has six steps to carry out and below there is a brief explanation of each step (Peffers et al., 2008).

1. **Problem identification and motivation**: Define the specific research problem and justify the value of a solution.
2. **Define the objectives of a solution**: Infer the objectives of a solution from the problem definition of what is possible and feasible.
3. **Design and development**: Determinate the artifact where the research contribution is embedded in the design.
4. **Demonstration**: Demonstrate the use of the artifact to solve one or more instances of the problem.
5. **Evaluation**: Observe and measure the performance of the artifact supporting a solution to the problem.
6. **Communication**: Communicate the problem, the importance, the utility, the rigor and the effectiveness of its design.

Please find below Figure 1 which describes the process model of the DSR methodology for this investigation using Peffers et al. (2008) model as a reference.

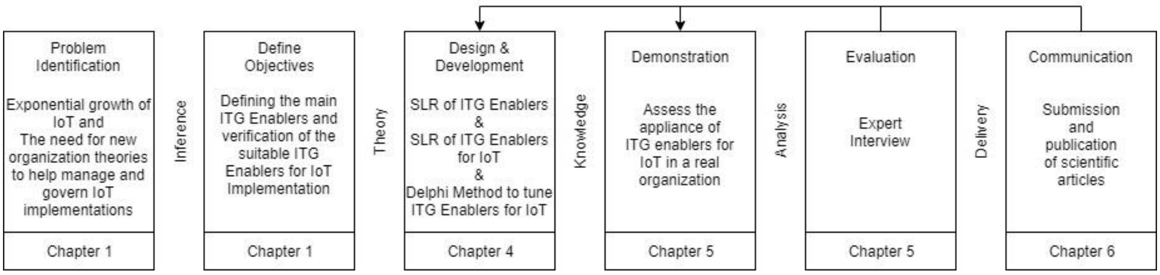

Figure 1 - DSR process model (Peffers et al., 2008)

In the Problem Identification Phase the problem under study is stated. In Define Objectives the main objective and research question for our investigation were identified. In the Design & Development phase, the artifact for the solution will be created using the SLR and Delphi methods. The SLR output will be used as the input for the Delphi research. The Demonstration Phase will be used to verify the artifact output with experts in the area using the interview method. The Evaluation Phase will be used to check if the output from the artifact is consistent and reliable. The Communication Phase will be used to demonstrate the importance of the artifact for the subject areas.

3.2. LITERATURE REVIEW

A literature review is a form of research that reviews, critiques and synthesizes the literature on a specific subject into an integrated document to help create new perspectives on the subject (Torraco, 2005). It helps the researchers develop a good argument based on existing knowledge and provides a good conclusion on the subject in question (Zorn & Campbell, 2006). A good literature review should focus on the concepts, cover relevant literature on the subject, use multiple journals as sources, and is recommended to follow a concept-centric approach (Watson & Webster, 2002). It supports a research proposal and synthesizes information, is a source of research questions where it is possible to explore and provide us with the opportunity to find knowledge gaps for future research (Zorn & Campbell, 2006).

Therefore, this research intends to use systematic literature review (SLR) to address the existing gaps in the literature about the subjects under study. The SLR approach synthesizes the existing work, finds related work that is not supported by the research questions but also finds information to support research questions, is based on a defined search strategy that seeks to detect the maximum amount of the relevant literature, requires an explicit inclusion and exclusion criteria to evaluate each primary study, specifies the information to be collected from the primary studies, including quality criteria to evaluate those studies (Kitchenham, 2004), discover the structure and patterns of existing research, can identify gaps that can be met by future research and differ from traditional reviews because they are formally planned and methodically executed, and can provide a high level of validity on the findings discovered in primary studies during the review process (Staples & Niazi, 2007).

The SLR methodology is defined to aggregate all existing evidence into a research question, supports the development of evidence-based guidelines (Kitchenham et al., 2009), improves the quality of the review process and the outcomes of the research, incorporating a transparent and reproducible procedure (Crossan & Apaydin, 2010). Typically, the SLR has three main phases, which are: planning the review, conducting the review and finally reporting the review. Each of these phases contains a sequence of stages (Kitchenham, 2004; Staples & Niazi, 2007).

An SLR approach in this research is important because this methodology is advisable when dealing with issues that are in the innovation field such as IoT. An SLR is the best approach to gather existing knowledge on the subject, and with that information to develop the basic bases for the research, which in this case will be a set of recommendations to be used by the authors in the Delphi method to obtain a consensus under the questions and research areas.

Since this research includes two SLRs on the ITG Enablers and another relationship between the ITG Enablers and IoT, there was an effort to normalize some steps using Kitchenham (2004) guidelines. It was then decided to create a table which defines the basis of the filtration stages (Table 1). Our SLR approach followed the guidelines from Kitchenham (2004) and will be divided into several sections: Research Method, Results, Discussion and Insights, and Conclusion.

Table 1 - Filtration iterations

Filtration Iterations	Description	Assessment criteria
First filtration	Identification of relevant studies from the selected databases.	Search Category and keywords using the filter “”.
Second filtration	Exclude studies based on titles.	Title = Search terms.
Third filtration	Exclude studies based on abstracts.	Keywords inside the abstract.
Final filtration	Obtain selected relevant articles.	Address the research questions.

This methodology was very useful in our research in order to collect and synthesize information from academia about ITG enablers and IoT. This helped us to define and understand each enabler as well as to better understand their relation with IoT. Which in turn provided us valuable information to be used in the Delphi method.

3.3. DELPHI METHOD

The Delphi method has been a popular tool in information systems research (Okoli & Pawlowski, 2004). The concept was born during an Air Force defense research with Rand Corporation cooperation in the early 1950s with the aim of obtaining the most reliable information from a group of experts (Linstone & Turoff, 2002) with a series of questionnaires with feedback-controlled opinion (Landeta, 2006). The Delphi method is important in studies lacking the definitive method for conducting the research and the lack of statistical support for the conclusions. This method can be characterized as a tool to obtain the most reliable consensus among a group of experts (Okoli & Pawlowski, 2004)., In some research, however, model-based statistical methods are not practical. Thus, it is necessary to consider the input of human judgment and this input should be used efficiently in order for the Delphi method to serve a purpose.

Delphi is a method for structuring a group communication process that effectively allows a group of individuals to deal with a complex problem (Linstone & Turoff, 2002).

This method structures a group communication process (this communication is provided by the feedback of the individuals assigned in the research where they have the opportunity to revise) and is effective in allowing the individuals, as a whole, to deal with complex issues (Okoli & Pawlowski, 2004). The main features of Delphi are based on a repetitive process, where the experts (participants) see the same question at least twice in order to give them the opportunity to reconsider their response after being presented with the new information from the rest of the participants. The participants are kept anonymous (Landeta, 2006). In addition, the Delphi method provides a structured process to solicit participants' opinions on a given subject and allows interaction between participants without a face-to-face encounter (De Haes, 2008). Linstone and Turoff (2002) refer to the importance of selecting a group of experts in the subject under study.

Delphi methodology uses judgment information and as well as a series of questionnaires with controlled feedback. This has the advantage of avoiding direct confrontation of the participants (Okoli & Pawlowski, 2004). The questions that are used in the Delphi could have a lot of uncertainty and speculation, so the general population may not be well-equipped to answer the questions. As such, with the Delphi study you can bring together a group of experts as a "virtual panel" to answer the questions (Okoli & Pawlowski, 2004). There is a tendency in this method of participant attrition where a significant number of participants fail to answer in the first round and subsequently a smaller number of participants answer in each round. This requires a substantial commitment on behalf of the participants and, therefore, preventing participants from withdrawing during the study is identified as a major challenge (Fletcher & Marchildon, 2014; Hill & Fowles, 1975; Skulmoski et al., 2007). It is recommended to have ten to fifteen people for a focused Delphi. The questionnaires need to be created carefully and the rounds orchestrated. Normally the number of rounds tends to be two to four, with a clear goal to achieve (Taylor-Powell, 2002). The duration recommended of a Delphi study is at least 45 days, and a period of two weeks is recommended for each round (Linstone & Turoff, 2002). Typically, the first round of the classical Delphi procedure is unstructured, allowing experts to identify and elaborate on the issues they consider important in the next round. In the literature the use of a five point Likert-type scale is the preferred tool to quantify data in a Delphi study, where the mean for each question item is calculated and the cut-off point is within the score three and four (Birdir & Pearson, 2000; Skulmoski et al., 2017; Murry & Hammons, 2017; Verhagen et al., 1998). The monitor team prepares a structured questionnaire based on the opinions and judgments of the experts from the first round. In the third round, the opportunity to change previous estimates based on feedback provided is given (Rowe & Wright, 1999). The number of rounds is variable, but is usually around one and two iterations (Rowe & Wright, 1999). A good point to bear in mind is, when there are different opinions in the research, to develop a set of alternative future scenarios (Okoli & Pawlowski, 2004). .

In this research, the Delphi method was selected as a good option to proceed with the research due to a stronger methodology in order to obtain accurate information about experts from the subject area. The ITG area is a complex issue that requires a good knowledge of people who understand the subject areas in the research to provide us with sound knowledge.

The use of the Delphi method for the research will give us the opportunity to add, delete, change and validate the initial list of recommendations (Table 15) taken by the SLR. This method will be very useful in the research because it will be possible to rank the recommendations, verify the efficiency of each recommendation from each ITG enabler during an IoT implementation.

3.4. INTERVIEW

According to the literature the interviews can be structured, semi-structured and unstructured (Gill et al., 2008). The qualitative interview method helps the researchers gather information about the world of others (Qu & Dumay, 2011), provides a deeper understanding of social phenomena, and they are more appropriate where little information is known about the study subject and in cases where it is necessary detailed insights from individual participants are necessary (Gill et al., 2008).

CHAPTER 4 – DESIGN AND DEVELOPMENT

This chapter details the use of SLRs and the Delphi method to design and develop the artefact. The research starts with the development of the SLR of ITG enablers and in the end a definition for each ITG enabler is provided. The output from SLR of ITG enablers will be used as an input to develop the SLR of ITG enablers for IoT. The output from SLR of ITG enablers for IoT will be used as input to build the Delphi study. Below, Figure 2, conceptualizes the Design and Development phase.

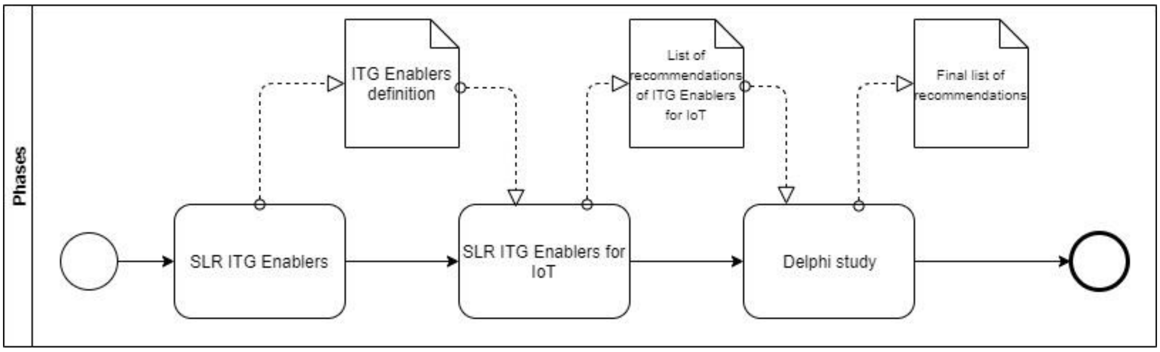

Figure 2 - Design and development phases

4.1. SLR OF ITG ENABLERS

4.1.1. Research stages

This research applied an SLR approach to identify and synthesize the literature published about the ITG enablers. The SLR aims to identify, evaluate and interpret all information research relevant to a specific research question.

This research performed the following distinct stages which were revised under the recommendations from the author (Kitchenham, 2004). On this basis, the creation of the research stages helps us to deliver the most high-quality scientific research to the study performing a selection according to our inclusion and exclusion criteria, filtration stages and, finally, a quality assessment. Figure 3 shows each stage of the SLR.

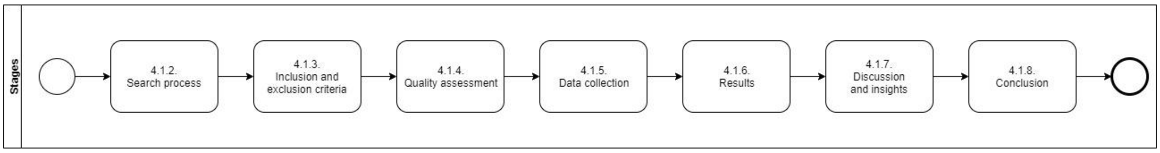

Figure 3 - SLR of ITG enablers - stages

4.1.2. Search process

In the search process of this review, the main sources to search for the articles and proceedings included in the review are Google Scholar and Scopus databases.

The search for this review began on July 12th of 2018 and ended on October 15th of 2018. The selected data source provided enough literature about the review. Data sources were systematically searched using carefully selected search terms or keywords from Table 2.

For example, the term ITG is included along with enablers, as they are very complimentary to one another. The search was separated by categories ("ITG", "ITG enablers", "COBIT enablers"). Within these categories, several keywords were selected and combined using Boolean "AND", e.g.: between IT governance "AND" principles.

Table 2 - Search terms

Search Category	Keywords
ITG	IT governance definition
ITG Enablers	IT governance principles, IT governance culture, IT governance ethics, IT governance information, IT governance people, Governance organizational structures, IT governance skills, IT governance competencies, IT governance applications, IT People
COBIT Enablers	COBIT processes, COBIT principles, COBIT frameworks.

During the research, a filtering process was used in order to reach the 31 articles selected for this review. Table 3 shows the filtration stages and which filters were used to reach the 31 articles.

In the first filtration stage, the search terms described in Table 3 were filtered using "" in bulk mentioned above. In the second stage of the filtration, the search was filtered using the keywords included in the titles of the articles. In the third stage of the filtration, the search terms in the abstracts from the search were checked. For the final stage, the relevant articles were chosen to correspond to the quality and criteria questions mentioned before.

Table 3 - Filtration stages

Filtration Iterations	Description	Assessment criteria	Count
First filtration	Identification of relevant studies from the selected databases.	Search Category and keywords using the filter "".	*35559*
Second filtration	Exclude studies based on titles.	Title = Search terms.	*3327*
Third filtration	Exclude studies based on abstracts.	Keywords inside the abstract.	*359*
Final filtration	Obtain selected relevant articles.	Address the quality and criteria questions.	*31*

Table 4 shows the filtration stages for each term used to select the relevant articles for the review. Some of the search terms rendered few results in the first filtration and reached 0 results in the next results. As such, in those search terms, the relevant articles found in the first filtration or second filtration were used. One of the motivations of this research was to filter the search in maximum towards ITG because the objective was to have only studies that provided useful information regarding the ITG enablers. That is the reason why, for example, in the third filtration stage from Table 4 there are some terms without any result. However, in these cases the results from the second filtration stage were chosen and passed through the final filtration where more valuable information was gathered.

Table 4 - Filtration stages for each search term

Search Terms	First filtration	Second filtration	Third filtration	Final filtration
IT governance	*33900*	*3230*	*342*	*1*
IT governance behavior	*7*	*4*	*1*	*2*
IT governance enablers	*17*	*2*	*0*	*1*
IT governance principles	*309*	*7*	*4*	*2*
IT governance definition	*180*	*6*	*1*	*1*
IT governance culture	*45*	*7*	*0*	*2*
IT governance ethics	*6*	*21*	*0*	*2*
IT governance information	*9*	*25*	*5*	*3*
IT governance people	*35*	*0*	*0*	*3*
Governance organizational structures	*125*	*0*	*0*	*2*
IT governance skills	*14*	*0*	*0*	*1*
IT governance competencies	*16*	*0*	*0*	*2*
IT governance applications	*13*	*0*	*0*	*2*
COBIT processes	*556*	*17*	*4*	*3*
COBIT principles	*82*	*2*	*0*	*2*
COBIT frameworks	*232*	*8*	*1*	*1*
COBIT enablers	*20*	*2*	*2*	*1*
Total	*35566*	*3331*	*360*	*31*

4.1.3. Inclusion and exclusion criteria

The inclusion and exclusion criteria for this review were guided by the following criteria questions:

IE1: Was the article released in a journal with a classification of Q1, Q2?

IE2: Was the article released in conference proceedings with an ERA classification of A or B?

IE3: Are the article findings valuable insights to define one or more ITG enablers?

These questions were used to guide our study in order to synthesize the material found in the journals and conferences via the Internet, with the purpose of gathering the correct information about ITG enablers. This review included only articles published in English with a year range between 1999 to 2018. The window selected provided sufficient coverage in order to gather an appropriate amount of literature on the topic at hand related to the terminations that stand out as ITG enablers. The articles that did not provide the information to address the identified research question(s) were excluded from this review.

4.1.4. Quality assessment

For the quality assessment, several questions were employed in order to ensure the relevance and quality of the selected articles. The assessment criteria were developed (Table 5) and applied to ensure the quality, relevance, and credibility of the articles included in this review. The first quality criteria question was to filter only studies that were related to the ITG area in order to not go beyond the scope of this investigation. The second quality criteria question is to understand if the article chosen contains at least one of the enablers from ITG mentioned. The third quality criteria question is designed to verify if the study itself brings more value into our investigation with useful information regarding at least one ITG enabler to guarantee more accuracy.

Table 5 - Quality criteria

Quality Criteria
QC1. Is the article context related to ITG?
QC2. Is the description of the article related to the research context?
QC3. Do the findings found in the articles bring value to the creation of the concepts?

Table 6 shows which articles are aligned with the quality criteria questions applied to this literature review. This table shows that all articles are more focused on providing information on building the concepts from each ITG enabler, as well as showing that some of the articles are not necessarily related to ITG or the description of the selected article is not related to the research context which in this case is the information technology sector.

Table 6 - References according to the quality criteria

Questions	References
QC 1	(Ali & Green, 2012) (Bernroider, 2008) (Bernroider & Ivanov, 2011) (Bin-Abbas & Bakry, 2014) (De Haes, 2008) (De Haes & Van Grembergen, 2008) (Fink & Ploder, 2008)(Garsoux, 2013) (Heier et al., 2007) (Heier et al., 2008) (Huang et al, 2010) (Joshi et al., 2018) (Kerr & Murthy, 2013) (Higgins & Sinclair, 2008) (Kude et al., 2017) (Othman et al., 2014) (Prasad et al., 2012) (Simonsson et al., 2010) (Simonsson & Ekstedt, 2006) (Spremić, 2009) (Tallon et al., 2013) (Wu et al., 2017)
QC 2	(Ali & Green, 2012) (Bernroider & Ivanov, 2011) (Bin-Abbas & Bakry, 2014) (Bowen et al., 2007) (De Haes, 2008) (De Haes & Van Grembergen, 2008) (Fink & Ploder, 2008)(Garsoux, 2013) (Heier et al., 2007) (Heier et al., 2008) (Huang et al., 2010) (Joshi et al., 2018) (ISACA, 2018) (Kude et al., 2017) (Kerr & Murthy, 2013) (Higgins & Sinclair, 2008) (Prasad et al., 2012) (Simon et al., 2007) (Simonsson & Ekstedt, 2006) (Simonsson et al., 2010) (Spremić, 2009) (Tallon et al., 2013) (Weill & Ross, 2005) (Wu et al., 2017)
QC 3	(Ali & Green, 2012) (Bernroider, 2008) (Bernroider & Ivanov, 2011) (Beyer & David Niñ, 1999) (Bin-Abbas & Bakry, 2014) (Bin-Abbas & Bakry, 2014) (Cram et al., 2016) (De Haes, 2008) (De Haes & Van Grembergen, 2008) (Fink & Ploder, 2008) (Garsoux, 2013) (Heier et al., 2007) (Heier et al., 2008) (Joshi et al., 2018) (Huang et al., 2010) (ISACA, 2018) (Lockwood et al., 2010) (Kerr & Murthy, 2013) (Kude et al., 2017) (Higgins & Sinclair, 2008) (Othman et al., 2014) (Bowen et al., 2007) (Prasad et al., 2012) (Queiroz et al., 2018) (Spremić, 2009) (Simon et al., 2007) (Simonsson & Ekstedt, 2006) (Simonsson et al., 2010) (Tallon et al., 2013) (Tsoukas & Vladimirou, 2001) (Weill & Ross, 2005) (Wu et al., 2017)

4.1.5. Data collection

The data extracted from each study were:

- The source name (journal or conference) and the full reference.
- The classification of the article according to the Scimago Journal Rankings.
- The classification of the proceedings according to the Excellence in Research in Australia (ERA).
- The total number of citations and articles according to each classification.
- How many primary studies were used to perform the SLR.

4.1.6. Results

The ITG enablers, according to this review, should be further explored and more studies that are directly related to the enablers are needed.

Annex A presents the Journal and Conference of each selected article and the respective classification. To increase the scientific rigor of our research only journals Q1 and Q2 (according to the Scimago classification) were considered. Following the same logic, only conferences A and B (ERA) were considered in this research.

Figure 4 shows the distribution of the 28 articles selected for the research, according to the selection criteria, by year. The conclusion reached by this distribution is the fact that in the year 2007 the ITG enablers started to receive more interested from the scientific community.

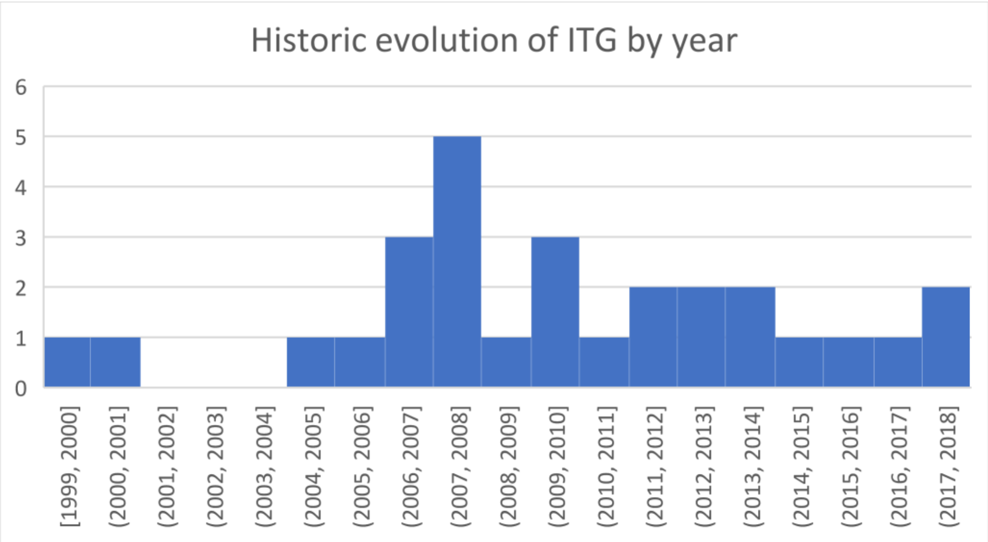

Figure 4 - Historic evolution of ITG by year.

Annex B presents the total articles for each journal classification (Q1 and Q2) and conferences (A and B), identifying which articles are in each classification. In addition, the sum of citations received from the articles for each classification was calculated. To establish the classification of the journals, the source Scimago Journal & Country Rank (www.scimagojr.com) was used in order to check the classification of each identified journal. For conferences, ERA is used by the source (www.conferenceranks.com) to check the classification of each conference identified.

Table 7 shows the articles selected during the research that are inserted in each ITG enabler.

Table 7 - References selected for each ITG enabler

ITG enablers	References	Total
Principles, Policies, and Frameworks	(Bernroider & Ivanov, 2011) (Bin-Abbas & Bakry, 2014) (Bowen et al., 2007) (Fink & Ploder, 2008) (Garsoux, 2013) (Kerr & Murthy, 2013) (Kude et al., 2017) (Lockwood et al., 2010) (Higgins & Sinclair, 2008) (Othman et al., 2014) (Prasad et al., 2012) (Spremić, 2009) (Simonsson et al., 2010) (Weill & Ross, 2005) (Wu et al., 2017)	*14*
Processes	(Bernroider, 2008) (Cram et al., 2016) (Garsoux, 2013) (Kude et al., 2017) (Higgins & Sinclair, 2008) (Spremić, 2009) (Tallon et al., 2013) (Tsoukas & Vladimirou, 2001)	*8*
Culture, Ethics, and Behavior	(Garsoux, 2013) (Heier et al., 2007) (Huang et al., 2010) (ISACA, 2018) (Higgins & Sinclair, 2008) (Othman et al., 2014) (Tallon et al., 2013) (Tsoukas & Vladimirou, 2001)	*8*
Services, Infrastructure, and Applications	(Beyer & David Niñ, 1999) (Bin-Abbas & Bakry, 2014) (Garsoux, 2013) (Heier et al., 2008) (Simonsson et al., 2010) (Wu et al., 2015)	*7*
People, Skills, and Competencies	(Garsoux, 2013) (Joshi et al., 2018) (ISACA, 2018) (Kude et al., 2017) (Queiroz et al., 2018) (Simon et al., 2007) (Simonsson & Ekstedt, 2006)	*7*
Organizational Structures	(De Haes & Van Grembergen, 2008) (Garsoux, 2013) (Higgins & Sinclair, 2008) (Tallon et al., 2013) (Tsoukas & Vladimirou, 2001)	*5*
Information	(Ali & Green, 2012) (Garsoux, 2013) (ISACA, 2018) (Higgins & Sinclair, 2008)	*4*

4.1.7. Discussion and insights

In the next sub-sections, there is a description of each ITG enabler according to various articles selected for this literature review.

4.1.7.1 Principles, Policies, and Frameworks

Principles are the channel to translate desired behavior into practical guidance for day-to-day management (Garsoux, 2013) and serve as a platform for the development of governance monitoring and evaluation tools (Lockwood et al., 2010). Principles for Bin-Abbas and Bakry (2014) and Weill and Ross (2005) consist of high-level decisions about the strategic role of IT in the business.

The ITG principles must emphasize the sharing and reuse of processes, systems, technologies, and data (Bin-Abbas & Bakry, 2014). Fink and Ploder (2008) say that the goals of principles are to provide IT alignment to business objectives. According to Othman et al. (2014), the application of the principles shows the difference between governance and management as two separate issues and he further says that ITG principles are based on common sense and are goal-focused. For Lockwood et al. (2010) principles are normative statements that claim how governance or steering must take place and in what direction, when it refers to management. This is how governance actors exercise their powers in meeting the objectives.

Bin-Abbas and Bakry (2014) states that the principles are associated with six basic issues: “responsibility, strategy, acquisition, performance, conformance, and human behavior” and for him, ITG consists of five main principles: “continuous development, integration of key requirements, simplification, knowledge management, and assessment measures” (Bin-Abbas & Bakry, 2014). The governance framework is designed to meet its purpose or mission, size, context, people and traditions (Othman et al., 2014), and should emphasize needs assessment, direct decision-making and monitor organizational goals performance (Othman et al., 2014). According to Higgins and Sinclair (2008), the framework indicates that IT resources are managed by IT processes in order to achieve IT goals that meet business requirements.

For Othman, et al. (2014) a good governance framework should provide a clear link between the ITG enablers and should be motivated by the content and context in which it is embedded. The frameworks should be used as a guide for the formation of domains, objectives, processes, information resources and decision-making rights (Othman et al., 2014). According to Bernroider and Ivanov (2011), the framework is guided by ITG objectives that play an important role in the success of the IT project, but if an organization adopts frameworks without investing time and substantial resources in order to verify the validity of the constructs and dimensions, the rate of success in the project may decrease.

Kerr and Murthy (2013) visualizes the framework as various IT security and control processes that are used to improve the achievement of the organization’s business objectives and to improve internal controls. The COBIT framework is focused on IT management and control and is the tool which provides IT standards and guidance (Kerr & Murthy, 2013). The frameworks provide structures and metrics to measure system performance and control and provide information about the effectiveness and efficiency of management processes (Bernroider & Ivanov, 2011). Meanwhile, for Simonsson et al. (2010) a framework provides the definition of ITG as consisting of four domains and 34 processes.

A framework should provide models that can guide people in designing ITG structures and processes, and should rely on industry practices and should not elucidate the background or implication of the ITG (Kude et al., 2017). Policies in ITG provide direction, stability, control, flexibility and business alignment (Bowen et al., 2007). Policies document how post-implementation review information is passed on to decision makers and how their feedback is essential to improving business processes (Bowen et al., 2007).

Huang et al. (2010) see policies put in place to guide decision-making processes, but policies for Tallon et al. (2013) are seen as intended to produce mutually agreeable results between the principal and the agent. (Bowen et al., 2007) sees policies being used to implement specific applications and to monitor the results and provide a connection between corporate and business unit governance. According to (Spremić, 2009), policies provide a method for calculating the level of IT risk that must be set to help the senior staff approve it.

4.1.7.2 Processes

Processes describe an organized set of practices and activities to achieve objectives and produce a set of outputs to support overall IT-related goals (Garsoux, 2013). The aim of processes is to direct and control an organization and help it achieve its goals by adding value and balancing risks over IT and its processes (Higgins & Sinclair, 2008). According to Cram et al. (2016) processes are defined in the project and non-project categories based on where he highlights the importance of considering controls in both categories. Meanwhile, (Kude et al., 2017) considers processes as the “formalization and institutionalization of strategic IT decision-making or monitoring procedures”, and for him, the processes clarify accountabilities, decision rights, and decision procedures to encourage desirable behavior in IT to use. For Higgins and Sinclair (2008) the processes must be consistent across applications, so they can be reused and employ technologies that meet growing demands. In another point of view, the Cram et al. (2016) considers that processes are defined as a collection of practices influenced by the organization policies and procedures which receives inputs, manipulates inputs and produces outputs.

The framework COBIT is a continuous development process and links its governance guidelines to basic needs and management requirements (Bin-Abbas & Bakry, 2014). Simonsson et al. (2010) it points out that a process contains some ITG maturity indicators such as activities, documents, metrics, and support for role and responsibility assignments. Processes are referred to the formal processes of strategic decision making, planning, and monitoring to ensure that IT policies are consistent with business needs (Wu et al., 2017). In addition, Wu (2015) sees the formal processes as a tool to ensure IT alignment with organizational policies.

According to Prasad et al. (2012) processes are factors that can help determine organizations distinctive competence and dynamic capabilities and, for him, the coordination of internal-process contributes to the value of the business at the enterprise level. It is important to consider that in ITG controls there are non-project based and project-based processes (Cram et al., 2016).

4.1.7.3 Organizational Structures

Organizational structures are the key decision-making entities in an organization (Garsoux, 2013). According to Wu (2015), organizational structures contribute to outstanding performance through IT-related capabilities which improve the effectiveness and efficiency of internal business processes, and the implementation of these structures enables business and IT people to meet their responsibilities in accordance with the business/IT alignment. The organizational structures produce the desired behaviors that support the organization’s strategy and objectives (Wu et al., 2015).

The ITG organizational structures provide a better platform for understanding and the effective use of IT resources, while defining roles, responsibilities and a set of IT/business committees such as IT steering committees and business strategy committees (Wu et al., 2015). For Prasad et al. (2012) organizational structures are forms of ITG methods to ensure that information flows well and establishes control objectives, and says that the ITG places organizational structures around how organizations align IT strategy with the business. Higgins and Sinclair (2008) agree that organizational structures sustain and extend the organization’s strategy objectives. Within the organizational structures, there is formal structures and mechanisms to connect and enable contact between business and IT management functions (De Haes & Van Grembergen, 2008).

4.1.7.4 Culture, Ethics, and Behavior

The culture of individuals and of the organization is often underestimated as a success factor in governance and management activities (Garsoux, 2013). Wu (2015) considers that culture has a great preponderance in the individual dimensions of ITG mechanisms. Culture shapes ITG decisions in the form of IT function power (Tallon et al., 2013). A culture organization should support risk transparency and risk-awareness (Othman et al., 2014). Culture for Othman et al. (2014) is important in identifying cultural and political factors in order to have a successful implementation in risk mitigation measures.

According to Tallon et al. (2013), the level of IT knowledge found in culture has significance during the exchange of IT vision and/or ideas and says that culture in IT is influential for key decision making and promotes the IT use in an organization. As stated by Tallon et al. (2013), IT culture can affect information governance practices within an organization. Having a transparent culture and participation is an important focus in an organization (ISACA, 2018). Tallon et al. (2013) recommends that an IT culture should promote the strategic use of information which bring the adoption of ITG in an organization. According to Beyer and David (1999), there is a question of managing cultures because managers should not consciously shape them, but instead instill a culture of ethics which centers itself on goals and values.

The acceptance of governance by managers and workers will allow the identification of threats and reduce risk as a critical success factor for the organization, thus making the adoption of a risk culture an asset (Higgins & Sinclair, 2008). Ethics refers to "all the beliefs, values, rituals and behavior patterns that people in an organization share" (Ali & Green, 2012). In an organization that has a sustained pattern of ethical behavior trust is engendered among employees and customers, leading to long-term commitment, innovation and business success (Beyer & David Niñ, 1999). For Ali and Green (2012) the lack of ethics and compliance culture has an adverse impact on the organization's existence.

According to Beyer and David (1999), an organization should promote ethical practices such as voluntary business association and voluntary social activities to disseminate good practice. They say that in order for an organization to have an ethical form, the managers must have ethical and behavioral beliefs. When ethical and legal employee awareness increases, they tend to ask questions correctly, do the right thing when faced with dilemmas and tend to report violations to management, thus contributing to better organizational decisions (Ali & Green, 2012).

For Ali and Green (2012) an ethical approach increases employee commitment by creating a sense of pertinence and says that ITG promotes ethics or culture of compliance within an organization to achieve a high level of effective governance. It is essential in an organization that top management has a sense of leadership in promoting ethical awareness of compliance requirements within the organization (Ali & Green, 2012). Such behavior enhances a business IT strategic alignment in an organization (Wu et al., 2015). According to Tallon et al. (2013), behavior can inhibit or undermine the adoption of ITG practices since organizations must first educate their employees. Behavior is an important part of improving the relationship between IT and business and promotes and implements continuous improvement in business and IT activities (ISACA, 2018). For Prasad et al.

(2012) behavior relates to the form of leadership that ensures the organization's IT sustainability and extends the strategies and objectives. ITG has the goal to encourage a desirable use of IT within an organization (Kude et al., 2017).

4.1.7.5 Information

Information is a fundamental resource for all organizations (Garsoux, 2013). According to Tsoukas and Vladimirou (2001), information is a flow of messages and a context-based arrangement of items whereby relations between them are shown (e.g. the subject index of a book). For Garsoux (2013) information is created, used, retained, disclosed and destroyed, but it also says that information is disseminated in any organization, for example: it deals with all the information produced and used and necessary to keep the organization functioning and well governed, but at the operational level, information is often the key product of the organization itself.

At ITG, information items are essential to improving the relationship between IT and business, for example, documented requirements; documented change requests; business expectations; satisfaction analysis and information strategy (ISACA, 2018). COBIT extends that information is required for investments in IT assets and procedures and is used to assess the benefits of these assets as well as to predict the value in relation to the organization's goals (Higgins & Sinclair, 2008).

4.1.7.6 Services, Infrastructures, and Applications

Services include the infrastructure, technology, and applications that provide the organization with the processing information technology (Garsoux, 2013). According to ISACA (2018) services are relevant to overcome the mismatch between IT and business. The organizations for (Spremić, 2009) should actively identify services where customers need and focus on planning and delivering those services to meet availability, performance, and security requirements.

The IT infrastructure consists of hardware, software, databases, networks and the people that perform operations on these layers (Higgins & Sinclair, 2008). The infrastructure consists of coordinating and sharing IT services that provide the foundation of the organization's IT capability (Weill & Ross, 2005). Infrastructure management is associated with maximizing the return on computing assets and controlling infrastructure (Spremić, 2009).

The ITG infrastructures should turn services into a well-defined business output to facilitate future business models (Bernroider, 2008). To develop IT applications, there is the need of having business application needs which are detected by business requirements (Weill & Ross, 2005). For Heier et al. (2007), applications have an positive effect on ITG processes as they create business value through IT and because their responsibilities are often split across IT domains. An ITG business application is deployed per individual business unit and this ITG application has the aim to enforce the ITG processes (Heier et al., 2007).

In ITG the applications must provide automation and digitization. They have an impact on the operational processes and the outcomes of the strategic value of the business (Heier et al., 2007). According to Heier et al. (2008), the ITG applications offer monitoring features to ensure agreed-upon mechanisms are followed and they state that ITG applications should be investigated more in order to decrease the rate of failure during implementation.

4.1.7.7 People, Skills, and Competencies

This ITG enabler is required for the successful completion of all activities, to make correct decisions and take corrective actions (Garsoux, 2013). According to Simonsson and Ekstedt (2006), ITG people are included in the relational architecture of an organization in which its roles and responsibilities are defined. They state that people are given less attention to processes and goals. People at the ITG are on a tactical or strategic level within an organization (Simonsson & Ekstedt, 2006).

For Joshi et al. (2018) IT people execute their responsibilities in supporting business IT alignment and are responsible for creating business value from IT-enabled business investments. Skills and competencies requirements are needed to improve the relationship between IT and business (ISACA, 2018). For Kude et al. (2017) skills capabilities are needed in order to make use of assets to create value. But according to Simon et al. (2007) IT skills are essential to meeting the organization’s needs and IT skills are a vital and critical part of in-house retainment.

Most organizations tend to choose people with a mix of technical and business-centric skills (Simon et al., 2007). In ITG competencies the process research tends to focus on the implementation success (Heier et al., 2007). According to Queiroz et al. (2018) competencies in IT have an entrepreneurial, adaptive and agility effect and facilitate the relationship between agility and performance in an organization. In Table 8 the definition of ITG enablers is presented based on the information gathered for the literature review.

Table 8 - ITG enablers definition

ITG Enablers	Definition
Principles, Policies, and Frameworks	Principles are a tool to get the best practices to help high-level management make better decisions according to the business strategy. The principles are intended to share processes, systems, technologies, and data among employees within organizations and help guide people in meetings or steering them in the right direction in order to meet business objectives. A framework focuses on IT management and/or governance and provides standards for the organization. It uses IT resources to manage processes to achieve the business requirements. In addition, it provides a link between the other enablers and is context oriented. The policies provide guidance, control and business alignment for the organization and document how information should be delivered and passed on to decision makers. In addition, it provides guidance to decision processes and provides a connection between corporate and business unit governance.
Processes	Processes are a set of practices and activities to achieve objectives and produce a set of outputs to support the achievement of IT goals. They direct and control an organization to achieve business goals. The processes are used to monitor the decision procedures and should be influenced by the policies and principles of the organization. The processes aim to verify that IT policies meet the business needs. In addition, it is possible to consider them as factors that help organizations to have dynamic capabilities and be attainable to achieve business value.
Organizational Structures	The organizational structures are a basis for decision-making entities in an organization and improve the effectiveness and efficiency of internal processes. The organizational structures must be aligned with the organization's strategy and objectives, they define roles, responsibilities and set the IT/business committees. They are intended to ensure that information flows smoothly within the organization.
Culture, Ethics, and Behavior	Culture should establish a set of ideas and visions to influence key decision-making and promote IT use. An organization should have a transparent and participatory culture where it can promote the use of information to bring about the adoption of the ITG. Ethics is a set of values, beliefs, and behavioral patterns concepts to increase commitment, innovation and business success of the organization. Ethics should promote good practices among employees. Behavior enhancements for strategic business-IT alignment and adoption of ITG practices in an organization. Behavior promotes and executes a continuous improvement of the business and encourage a desirable use of the IT.
Information	Information is created, used, retained and destroyed, and passed on by a flow of messages. The information contains value and is one of the important assets of a business. The information must be predictive and provide feedback on the organization's goals.
Services, Infrastructures, and Applications	Services include the infrastructure, technology, and applications that deliver business value in an organization. They should focus on planning and delivering availability, performance, and security to customers. The infrastructure is all hardware, software, databases, networks, and people who perform operations above these structures. Applications must conform to business requirements and they must apply ITG processes. Applications should focus on automation and digitization to deliver outcomes of strategic business value.
People, Skills and Competencies.	People in an organization have their own role and responsibility in creating business value, for the ITG people on a tactical and/or strategic level within an organization. Skills are capabilities used to create value and play an important role for people. There is a link between people's skills and competencies, where organizations tend to pick people with a mix of business-centric, technical skills, and an entrepreneurial, adaptive and agility mentality.

4.1.8. Conclusion

This research presented an SLR regarding the ITG enablers proposed by COBIT5 framework. Along the SLR process 28, high-quality articles were selected from scientific databases and subsequently analyzed. To improve the value of this research and the relevance of our findings the concept-centric approach advised by (Watson & Webster, 2002) was followed. From the analysis of the articles, several conclusions can be withdrawn:

- The enablers "processes, principles, frameworks and policies" is the most investigated in the literature. This makes sense since many researchers have focused their efforts evolving and investigating the existing ITG frameworks as well as their possible variations in different organizational contexts.
- The enablers "people, skills and competencies" and "information" are the less explored. Because information is currently pointed out as one of the main organizational assets and employees are pointed as one of the main sources of security breaches, this finding is worrisome.
- The body of knowledge is now enhanced with a more detailed description of each ITG enabler which may help future researchers and practitioners.

This research aimed to provide clarity about ITG enablers given the scarce information provided in COBIT5 official documentation despite their relevance. In the end, the authors argue that the research objective was achieved and the ITG enablers are now easier to understand. During this research some limitations which created difficulties in providing stronger results were encountered. Among such difficulties was the lack of studies related to ITG enablers under the classification used for the research. As such, one may draw the conclusion that this topic is not widely dealt with by nor discussed in the scientific community.

Having identified this research limitation, it was possible to recognize the opportunity to create a basis for further research in which our findings may help further researchers in defining their scope, problems or even proposals in relation with ITG enablers.

4.2. SLR OF ITG ENABLERS FOR IOT

4.2.1. Research stages

This research applied an SLR based on the original guidelines proposed by (Kitchenham, 2004). In this case, the aim of the review is to identify and summarize the knowledge published about IoT and ITG enablers defined by the COBIT 5 framework. The stages detailed in Figure 5 were constituted using Kitchenham (2004) as a reference.

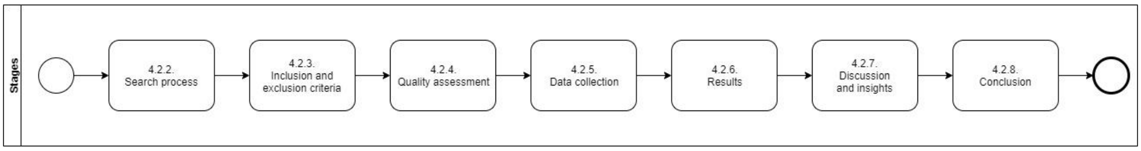

Figure 5 - SLR of ITG enablers for IoT - stages

4.2.2. Search process

The databases consulted during this research were Google Scholar, Taylor & Francis and Scopus, which was used to retrieve the articles and the proceedings included in the review.

The selected data sources provided sufficient literature coverage in relation to the subject of the review. The search for this review began on October 10th, 2018 and finished on January 15th, 2019. The data sources were systematically searched using carefully selected search terms or keywords (see Table 9). For instance, it was included the term IoT along with enablers. It was separated the search by categories ("IoT", "IoT Enablers"). Inside of these categories it was selected several keywords which were combined using Boolean "AND", e.g., between IoT "AND" principles. Some other keywords were also used in order to reinforce the search in several enablers.

Table 9 - Search terms

Search Category	Keywords
IoT	IoT definition, IoT adoption
IoT Enablers	IoT principles, IoT adoption principles, IoT frameworks, IoT frameworks standards, IoT policies, IoT processes, IoT processes governance, IoT processes cobit, IoT organizational structures, IoT structures, IoT culture, IoT ethics, IoT behavior, IoT information, IoT services, IoT infrastructures, IoT applications governance, IoT people, IoT people roles, IoT people responsibilities, IoT skills, IoT competencies

For the research process, a filtration process was used that brought us to 44 articles which were selected for the literature review. In Table 10 below is the description of each filtration iteration to help select the relevant articles.

In the first filtration iteration, "" (quotation marks) were used to filter the search terms described in Table 9. In the second filtration iteration, "-title" was used to filter title keywords in order to only retrieve results which contained the keywords in the title. In the third filtration iteration, “-abstract” was used to check if the keywords appeared within the abstract of the article. For the final filtration iteration, the relevant articles were chosen for the literature review, checking the articles that matched the research questions mentioned before.

Table 10 - Filtration stages

Filtration Stages	Description	Assessment criteria	Count
First filtration	Identification of relevant studies from the selected database.	Search Category and keywords using the filter “”	*12315*
Second filtration	Exclude studies based on titles	Title = Search terms	*9965*
Third filtration	Exclude studies based on abstracts	Keywords inside the abstract	*2347*
Final filtration	Obtain selected relevant articles	Address the quality and criteria questions.	*44*

In Table 11 are the filtration stages for each term used to search the relevant articles selected for the literature review.

Table 11 - Filtration stages for each search term

Search Terms	First filtration	Second filtration	Third filtration	Final filtration
IoT principles	*176*	*149*	*29*	*3*
IoT applications governance	*207*	*178*	*32*	*2*
IoT adoption	*393*	*318*	*43*	*1*
IoT definition	*374*	*292*	*52*	*2*
IoT frameworks	*510*	*463*	*45*	*2*
IoT frameworks standards	*293*	*252*	*28*	*1*
IoT policies	*81*	*63*	*9*	*2*
IoT processes	*111*	*88*	*17*	*5*
IoT processes governance	*20*	*17*	*4*	*2*
IoT organizational structures	*3*	*3*	*3*	*1*
IoT structures	*70*	*72*	*4*	*0*
IoT culture	*29*	*24*	*3*	*2*
IoT ethics	*22*	*19*	*3*	*3*
IoT behavior	*50*	*44*	*8*	*1*
IoT information	*1900*	*1280*	*186*	*5*
IoT services	*6890*	*5670*	*713*	*3*
IoT infrastructures	*1070*	*958*	*1010*	*3*
IoT people	*188*	*157*	*161*	*2*
IoT people roles	*50*	*37*	*10*	*1*
IoT people responsibilities	*30*	*11*	*6*	*1*
IoT skills	*51*	*44*	*12*	*1*
IoT competencies	*4*	*4*	*1*	*1*
Total	*12315*	*9965*	*2347*	*44*

Although there is a great number of articles in the previous filtration iterations this review had the intention to check only articles that were related between ITG enablers and IoT and matching the inclusion criteria. It is possible to observe that only 44 articles were selected to enter in the review with valuable information for the study, but this information was not simple and direct about the relation between ITG enablers and IoT, so it was necessary to perform an interpretation and make a connection between the subject areas. These obstacles found during the search make us conclude that the relation between ITG enablers and IoT is scarce which gives more importance to the study.

4.2.3. Inclusion and exclusion criteria

The inclusion and exclusion (IE) criteria for this review guide the following research questions:

IE1: Was the article published in a journal with a classification of Q1, Q2?

IE2: Is the article selected for the review from a conference ranked in ERA with A or B, or ranked in Qualis with A1, A2 or B1?

IE3: Are the article findings valuable insights to define one or more ITG enablers for IoT?

4.2.4. Quality assessment

In the quality assessment, some questions are formulated to guarantee the relevance and quality of the selected articles. The assessment criteria were developed and applied to ensure the quality, relevance, and credibility of the articles included in this review (Table 13).

In Table 12 there are the quality criteria questions that were used to filter the selection of articles during the search process, making the selection itself more consistent.

Table 12 - Quality criteria

Quality Criteria
QC1. The article context is related to ITG?
QC2. The article context is related to IoT?
QC3. The description of the article is related to the research context?
QC4. The findings found in the articles bring value to the creation of the concepts?

Table 13 details which articles are aligned with the quality criteria questions applied to this literature review. It verifies selected articles to provide more information on compiling points to consider in each ITG enabler with IoT.

Table 13 - References according to the quality criteria

Questions	References
QC 1	(Abobakr & Azer, 2017)(Almeida et al., 2015)(Almeida et al., 2017)(Baldini et al., 2015)(Buyya & Vahid Dastjerdi, 2016)(Cao et al., 2016)(Cervantes-Solis & Baber, 2017)(Chatfield & Reddick, 2018)(De Cremer et al., 2017)(Derhamy et al., 2015)(Ding, et al., 2013) (Jayashankar et al, 2018)(Bowen et al., 2017)(Lainhart & Oliver, 2012)(Neisse et al., 2015)(Pereira et al., 2013)(Piccialli & Chianese, 2017)(Shen et al., 2018)(Shin, 2014)(Shin & Jin Park, 2017)(Van Deursen & Mossberger, 2018) (Weber, 2009) (Weber, 2013) (Wirtz et al, 2018) (Wortmann & Flüchter, 2015)
QC 2	(Abobakr & Azer, 2017) (Almeida et al., 2015) (Almeida et al., 2017) (Baldini et al., 2015) (Buyya & Vahid Dastjerdi, 2016) (Cao et al., 2016) (Carretero & García, 2014) (Cervantes-Solis & Baber, 2017) (Chatfield & Reddick, 2018)(Dautov et al., 2018)(De Cremer et al., 2017) (Derhamy et al., 2015) (Gubbi et al., 2013)(Jayashankar et al., 2018)(Keoh et al., 2014) (Lainhart et al., 2012)(Neisse et al., 2015)(Pasquier et al., 2018) (Pereira et al., 2013) (Piccialli & Chianese, 2017) (Roman et al., 2013)(Ruggieri et al., 2013) (Shen et al., 2018) (Shin, 2014) (Shin & Jin Park, 2017) (Suo et al., 2012) (Truong et al., 2015) (Van Deursen & Mossberger, 2018) (Verdouw et al., 2018) (Weber, 2009) (Weber, 2013) (Wen et al., 2017) (Wirtz et al., 2018) (Wortmann & Flüchter, 2015) (Zhang et al., 2017) (Zdravković et al., 2018)
QC 3	(Abobakr & Azer, 2017) (Almeida et al., 2015) (Almeida et al., 2017) (Almeida et al., 2018) (Baldini et al., 2015) (Bowen et al., 2017) (Bowen et al., 2007) (Cervantes-Solis & Baber, 2017) (Chatfield & Reddick, 2018) (Dautov et al., 2018) (De Cremer et al., 2017) (Derhamy et al., 2015) (Keoh et al., 2014) (Jayashankar et al., 2018) (Lainhart et al., 2012) (Neisse et al., 2015) (Pereira et al., 2013) (Piccialli & Chianese, 2017)(Shen et al., 2018) (Shin, 2014) (Shin & Jin Park, 2017) (Soro et al., 2017) (Van Deursen & Mossberger, 2018) (Verdouw et al., 2018) (Vlahogianni et al., 2016) (Yao et al., 2015) (Weber, 2009) (Weber, 2013) (Wen et al., 2017) (Wirtz et al., 2018) (Wortmann & Flüchter, 2015)
QC 4	(Abobakr & Azer, 2017)(Almeida et al., 2015) (Almeida et al., 2017) (Almeida et al., 2018) (Baldini et al., 2015)(Buyya & Vahid Dastjerdi, 2016) (Cao et al., 2016) (Chatfield & Reddick, 2018) (Carretero & García, 2014) (Cervantes-Solis & Baber, 2017) (Dautov et al., 2018) (Derhamy et al., 2015) (Ding et al., 2013) (Shin & Jin Park, 2017) (Shin, 2014) (De Cremer et al., 2017) (Gubbi et al., 2013) (Jayashankar et al., 2018) (Bowen et al., 2017) (Keoh et al., 2014) (Linger & Hevner, 2018) (Mendhurwar & Mishra, 2019) (Neisse et al., 2015) (Pasquier et al., 2018) (Pereira et al., 2013)(Piccialli & Chianese, 2017) (Roman et al., 2013) (Ruggieri et al., 2013)(Shen et al., 2018) (Soro et al., 2017) (Suo et al., 2012) (Truong et al., 2015)(Van Deursen & Mossberger, 2018) (Vlahogianni et al., 2016) (Verdouw et al., 2018) (Zhang et al., 2017) (Yao et al., 2015) (Weber, 2009)(Weber, 2013) (Wen et al., 2017) (Wirtz et al., 2018)(Wortmann & Flüchter, 2015) (Zdravković et al., 2018)(Buyya & Vahid Dastjerdi, 2016)

4.2.5. Data collection

The data extracted from each study were:

- The source name (journal or conference) and the full reference.
- The classification of the article according to the Scimago Journal Rankings.
- The classification of the proceedings according to the Excellence in Research in Australia (ERA) and Qualis.
- The total number of citations and articles according to each classification.
- How many primary studies were used to perform the SLR.

4.2.6. Results

It was verified that the terms "ITG Enablers and "IoT" were not used in the same way in the scientific papers consulted during our research, which makes it more difficult to create a direct correlation between ITG enablers and the IoT. As such, in this case, there was a need of performing a broader search in each subject area and then interpret the articles' information in order for a correlation between them to be possible.

Annex C presents the journals and conferences of each article selected and what the classification consists of. The classification of the journals selected for this review is between Q1 and Q2 classification, and for the conferences, the classification is between A (ERA), B (ERA), A1 (Qualis), A2 (Qualis) and B1 (Qualis), according to the inclusion criteria mentioned above.

In Annex D there is a separation of the references by classification. How many citations each classification has was checked and at the end there is a count to check which classification has more articles and which rank has more citations. Table 14 shows the articles selected for the literature review by each ITG enabler related to IoT.

Table 14 - References selected for each ITG enabler

ITG enablers	**References**	**Total**
Principles, Policies, and Frameworks	(Almeida et al., 2017) (Buyya & Vahid Dastjerdi, 2016) (Chatfield & Reddick, 2018) (De Cremer et al., 2017) (Derhamy et al., 2015) (Jayashankar et al., 2018) (Neisse et al., 2015) (Roman et al., 2013) (Ruggieri et al., 2013) (Suo et al., 2012) (Weber, 2009) (Weber, 2013) (Wirtz et al., 2018)	*13*
Processes	(Carretero & García, 2014) (De Cremer et al., 2017) (Ruggieri et al., 2013) (Truong et al., 2015) (Zhang et al., 2017) (Pasquier et al., 2018) (Zdravković et al., 2018)	*7*
Organizational Structures	(Shen et al., 2018)	*1*
Culture, Ethics, and Behavior	(Almeida et al., 2015)(Abobakr & Azer, 2017) (Baldini et al., 2015) (Cervantes-Solis & Baber, 2017)(Shin, 2014)(Bowen et al., 2017) (Pereira et al., 2013)	*7*
Information	(Almeida et al., 2018)) (Linger & Hevner, 2018) (Mendhurwar & Mishra, 2019) (Vlahogianni et al., 2016) (Verdouw et al., 2018) (Yao et al., 2015)	*6*
Services, Infrastructure and Applications	(Almeida et al., 2015) (Cao et al., 2016) (Dautov et al., 2018) (Shin, 2014) (Gubbi et al., 2013) (Piccialli & Chianese, 2017) (Wen et al., 2017) (Wortmann & Flüchter, 2015)	*8*
People, Skills and Competencies	(De Cremer et al., 2017) (Shin, 2014) (Shin & Jin Park, 2017) (Soro et al., 2017) (Van Deursen & Mossberger, 2018)	*5*

Figure 6 presents the historical evolution of the articles selected for this review. It is possible to verify that in 2012 interest began to grow. After 2012 interest increased and reached a peak in 2017. The authors are convinced that while adopting IoT, organizations realized that governance was an important issue and more studies relating to IoT and ITG began to appear. This explains the increase in the number of studies in 2017 and 2018. Since the study occurred during the beginning of 2019 it is normal to have few articles from 2019.

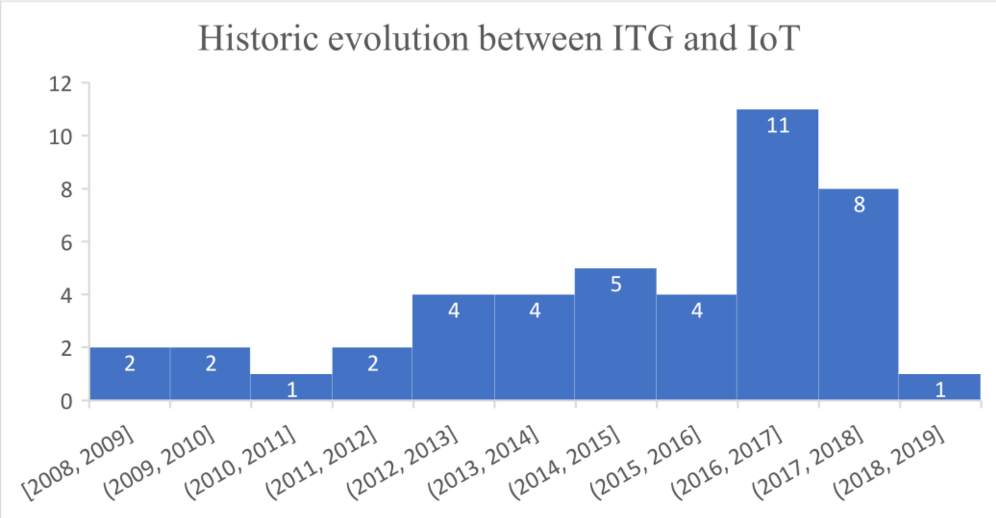

Figure 6 - Historic evolution of studies relating ITG and IoT

4.2.7. Discussion and insights

In the next sub-sections, there is a description of each term of the ITG enabler with IoT, for example: "IoT AND IT governance principles", which has been decided on in order to define as "IoT principles". Information was collected from the various articles selected for this literature review.

4.2.7.1. Principles, Policies, and Frameworks

In IoT according to Roman et al., (2013) the collaboration between several organizations to achieve common goals is considered to be a principle. In IoT, according to Buyya and Vahid (2016), transparency should exist despite the heterogeneous environment of the IoT system. The ability to have mechanisms for policy generation enforces governance in IoT. For Weber (2009) the principles in IoT are related to architecture with decentralized management. Proportionality in IoT should be included by governance to help make decisions, and such decisions must maximize the overall state of the IoT system (Buyya & Vahid Dastjerdi, 2016).

The outcomes of the principles should reflect stakeholder values and accountability would be necessary to keep a record of decisions and factors to contribute to the decisions of the past (Buyya & Vahid Dastjerdi, 2016; Weber, 2009). The principles need to contribute to the contextualization of IoT as part of global resources (Almeida et al., 2017). The authors Ruggieri et al., (2013) says that the perceived risk associated with IoT technology when we are making an IoT adoption within an organization should be considered as a principle. The relationship between perceived risk, technology adoption, purchasing decisions, and behaviors should be verified (Jayashankar et al., 2018). It is recommended by Weber (2013) to create principles and operational procedures in IoT. The authors Buyya and Vahid (2016) and Almeida et al., (2017) are in agreement that transparency is an important factor to exist in an IoT system, enforcing the need of principles where the outcomes will reflect those principles.

The authors Suo et al., (2012) says countries should implement new IoT-specific legislation to promote the development of IoT. IoT policies are associated with privacy mechanisms to guarantee safe authentication (Neisse et al., 2015). According to Almeida et al., (2017) the principles in IoT must bring together different interests in an environment that must be effective and constitute a legitimate governance framework. The IoT devices in an IoT system must manage and deploy privacy policies to control the flow of data to service providers (Neisse et al., 2015). According to Chatfield and Reddick (2018) at IoT, public policies consist of cybersecurity policies and digital technology policies and should behave as complements to each other. For industry 4.0, industries such as smart manufacturing, operations require the development of guidelines, strategic policies in order to enhance the adoption (Chatfield & Reddick, 2018). It is possible to verify an agreement by Neisse et al., (2015) and Chatfield and Reddick (2018) in privacy and security policies for IoT where these policies should complement them in order to build stronger public policies.

For Weber (2013) IoT should consider the requirements of cooperation, policy, coordination, standards, and laws to create rules to extend governance among the IoT's structural issues. In the IoT business, it is necessary to have harmonized standards. For example, in Europe, there are organizations that join forces to create such harmonization of standards (Weber, 2013). A framework in IoT is a set of principles, protocols, and standards through which the implementation of IoT in an organization is enabled (Derhamy et al., 2015). The frameworks in IoT have the possibility to accelerate the implementation, interoperability, maintainability, and security of the system (Derhamy et al., 2015). For Wirtz et al., an IoT framework provides an overview of the elemental and central aspects of the IoT concept, where it contributes to a better understanding and helps to organize and structure the system.

A framework in IoT must materialize governance structures and needs to be driven by stakeholder requirements (Wirtz et al., 2018). The authors De Cremer et al., (2017) defends that a framework should be holistic, and process-oriented to provide a useful checklist for managers through the iterations of the IoT implementation. A framework in IoT should help the organizations develop and expand IoT-related policies and procedures and ensure openness and transparency (Almeida et al., 2017).

4.2.7.2. Processes

The governance processes in an IoT system can bring elasticity strategies needed to provide more coordination throughout the system (Truong et al., 2015). The processes in IoT enable the capabilities of the IoT entities and the implementation of software in these entities (Truong et al., 2015). The data obtained by the IoT system, if managed locally by the IoT nodes, will make the processes more feasible to be managed by the users (Carretero & García, 2014). According to De Cremer et al., (2017) it is critical to identify the main strategic processes in IoT in the organization.

The processes in IoT when they have a holistic approach can help guide organizations to a more enlightened practice (De Cremer et al., 2017). The processes in IoT must take into account the business process models that exist in the organization, the governance decomposes and decentralizes the existing business processes, increases scalability and performance, thus allowing better decision-making to create more business value (Ruggieri et al., 2013). IoT processes can accelerate the services of scalability, which avoids inconsistencies from the system, where the models are the focus in the event-driven process (Zhang et al., 2017). The authors Zhang et al., (2017) and Ruggieri *et al.*, (2013) are in an agreement regarding the IoT processes must enforce the scalability to bring more effectiveness and to increase the performance of the processes in the IoT system.

The IoT applications tend to work within silos, which are defined by the vendors, service providers, making the interoperability of systems and the establishment of standards more difficult. Therefore, a need to constitute IoT processes is necessary in order to embrace a broad vision within the organizations (Pasquier et al., 2018). The implementation of IoT systems needs to consider the evolution of the conventional enterprise processes in their IoT processes and this evolution should take into account maturity models and validation processes (Zdravković et al., 2018).

4.2.7.3. Organizational Structures

The organizational structures can provide a framework for activities and interactions, defining roles, tasks, groups, standards, and relationships within the IoT system (Shen et al., 2018). As the search demonstrated, there was only one article according to our criteria that provided information regarding the enabler organizational structures, which only has one reference.

4.2.7.4. Culture, Ethics, Behavior

An organization should have a level of micromanagement of activities to spread social culture during the implementation of IoT (Shin, 2014). IoT culture and complexities are related parts in terms of diversity characteristics, with the aim of increasing people’s adoption of new services (Shin, 2014). Ethics in IoT refers to the enforcement of social behavior standards, information privacy, access to information, information integrity and property rights (Abobakr & Azer, 2017). According to Bowen et al., (2017) ethics should focus on how organizations will use personal data and how they will access it. In terms of ethics, attention much is paid during IoT implementation to the policies used, to the diffusion and access to IoT technology (Pereira et al., 2013).

The operations from complex IoT systems demands a piece of complete and dependable information to develop decision support systems that guarantee the correct decision-making, therefore, the systems must be built towards this engineering thinking no matter what unexpected operational events may occur (Linger & Hevner, 2018). The increased amount of big data solutions across IoT is increasing potentially the rich information collected for decision-support within the organizations, but this process must consider the information integrity as a critical component of the IoT system (Mendhurwar & Mishra, 2019).

IoT ethics should separate privacy from ethical issues because privacy is widely regulated by law and ethics in IoT needs to focus on identity, autonomy, trust as specific concerns and treated separately (Baldini et al., 2015). There is a consensus from the authors Bowen et al. (2017) and Baldini (2015) about ethics should enhance the information privacy and information integrity in IoT to assure the identity of the customers remains intact. In addition, it is possible to observe an agreement regarding information integrity where must be an integral part from the IoT system to deliver reliable information in order to help the decision-making. The IoT system needs to enhance IoT’s “smart” behaviors to provide better interfaces and interaction experiences

(Cervantes-Solis & Baber, 2017). IoT ethics must be aligned with human rights in order to ensure privacy safety (Almeida et al., 2015). Regarding behavior, it is important that the IoT system has human behavior recognition, modeling, and representation (Shin, 2014).

4.2.7.5. Information

The IoT system is a way of accessing, exchanging and manipulating information between digital and physical items and, to process this amount of information, the data must flow synchronously (Yao et al., 2015). IoT networks delivered real-time information to improve and support the organization’s operations (Vlahogianni et al., 2016). The authors Yao et al. (2015) and Vlahogianni et al. (2016) have a consensus regarding the importance of the exchanging information must be made in real-time and synchronous to help the organizations deliver more accurate information. According to Almeida et al., (2018) it is crucial to have good information retrieval and search techniques in an IoT system to deal with a large amount of data exchanged. For Almeida et al., (2018) the information processed through IoT will help organizations make better and more transparent decisions if all stakeholders are involved in the decision-making processes. The demand for intensive information exchange in IoT systems is high and complex making the use of standards requirements to guarantee reliable information in a timely manner in the systems. The organizations that engage in a large amount of information exchange must take into account quality parameters and organization conditions for the market segment inserted it (Verdouw et al., 2018).

4.2.7.6. Services, Infrastructures, and Applications

IoT services are composed of sensors, devices, compute resources and aim to improve the quality of life by improving the efficiency of services to meet business needs (Wen et al., 2017). According to Wen et al., (2017) IoT services should be built according to robust standards and protocol to reach a global ecosystem of interconnected devices. The authors Wen et al., (2017) argues that IoT services need to be able to evolve and dynamically change the workflow composition. For Cao et al., (2016) IoT services are smart services that enhance the IoT’s sensing of data in order to present better results from the data collected by the services.

IoT services play a major role in developing a sustainable society and improving people’s living conditions (Cao et al., 2016). In an IoT system, infrastructures must include data management, processing, and analytics to deploy large-scale independent platforms (Gubbi et al., 2013). An IoT infrastructure should be thought of as an interoperable ecosystem which is capable of interacting with other infrastructures regardless of the underlying hardware and software (Dautov et al., 2018). In addition, the authors Keoh et al, (2014) say the IoT infrastructure should be built under several protocol stacks Transmission Control Protocol (TCP), the Transport Layer Security (TLS) the Hypertext Transfer Protocol (HTTP) to increase the security under the IoT interoperability. There is a consensus regarding the IoT infrastructures should focus in the interoperability of the systems. According to Gubbi et al., (2013) the infrastructures in IoT should be centralized in order to support storage and analysis requirements.

According to (Shin, 2014) continuity of investment in the core of IT infrastructure is recommended. IoT applications should explore various possibilities to provide meaningful information about the data collected from the system (Almeida et al., 2015). IoT application can be a platform that allows the development and execution of new IoT applications, helps to define, execute and monitor all the data exchanged by the IoT devices and is software that guides the interaction between people, systems and devices in the context of the IoT system (Wortmann & Flüchter, 2015). For IoT applications, it is very important, according to Wortmann and Flüchter (2015) to have a set of application-independent functionalities to be used to build IoT applications. The authors Almeida et al., says that IoT applications increase vulnerabilities in software and hardware, so he defends that IoT applications should draw attention to security and privacy protection. For Piccialli and Chianese (2017) the applications aim to provide useful and contextualized information about business needs. There is an agreement about IoT applications should endorse the correct contextualized information for the organizations in order to fulfill the business needs.

4.2.7.7. People, Skills, and Competencies

People in IoT are not only end-users but also an integral part of the system, so it is important to pay attention to improving human interaction in the IoT system (Shin, 2014). It will be important in an IoT system that is carefully implemented in relation to the acceptance of the system by the people who will benefit from it (Shin, 2014). According to Soro et al., (2017) during the IoT conceptualization, there is a lack of human-oriented vision. People’s attitudes and motivation toward IoT are important for a successful implementation, during which there must be incentives for socio-technical literacy (Shin

& Jin Park, 2017). It is possible to verify a consensus about the people should be an integral part of IoT acceptance to increase the success of the implementation.

According to Van Deursen and Mossberger (2018), it is necessary to have strategic skills in order to decide what kind of data is applied and shared. Information skills are also necessary in order to be able to visualize the data collected by the IoT system. Moreover, communication skills are needed to share the data for the purpose of creating knowledge. Organizations should develop managerial skills to improve the IoT implementation focusing on strategic orientation (De Cremer et al., 2017).

4.2.8. Conclusion

This research proposed to investigate what the suitable ITG enablers are to assist organizations in IoT implementations. From 44 articles selected in the Google Scholar and Scopus databases, several recommendations to each enabler, which may help organizations in IoT implementations were withdrawn (Table 15). Such recommendations can work as guidelines during the process of IoT implementation, increasing the success rate.

Our attention was drawn to the fact that the information regarding ITG enablers for IoT adoption is at an early stage in the literature. The information is scarce despite its relevance to the field. IoT is a recent field of study which may in part justify the scarcity of information in the literature. For instance, little or no information exists about organizational structures, culture, behavior, and competencies enablers.

The ITG enabler "Principles, Policies, and Frameworks" is having more attention by the academics where it could be proof by the numbers of references and the ITG enabler with less attention by the academics is "Organizational Structures". It is expectable in two or three years to exist more studies regarding this theme because IoT is getting more attention by the academics and by the industry where is creating new ways to deliver services to the customer.

This research makes an important contribution to the scientific community and addresses new ways to use ITG directly in IoT, using the specific ITG enablers defined by COBIT, in order to retrieve better results from an IoT implementation by the organizations.

In addition, the literature demonstrates that most of the studies regarding IoT are focused on a technology approach instead of business and strategy perspectives. Technology may not exist without a business. As such, future research is necessary.

Future researchers should make an effort to investigate the implications of IoT technology and respective application to business. Moreover, enablers with less information must be researched further in order to increase awareness and knowledge about the topic. The authors will continue this research by using the elicited list of recommendations in ITG enablers for IoT implementation as a baseline for a Delphi study with several IoT experts to delete and/or add more recommendations in the list also with experts' knowledge.

4.3. SLR OUTPUT

After gathering the information related to IoT and the ITG enablers a list of recommendations was achieved to be considered during the IoT implementation, as shown in Table 15.

Table 15 - Initial list of recommendations between ITG enablers and IoT

Enablers	ID	Recommendations	References from literature
Principles, Policies, and Frameworks	F1	Promote interoperability via decentralization.	(Buyya & Vahid Dastjerdi, 2016)
	F2	Promote collaboration between organizations.	(Roman et al., 2013)
	F3	Implementation of trust.	(Derhamy et al., 2015)
	F4	Implementation of transparency.	(Derhamy et al., 2015)
	F5	Implementation of data privacy and data protection.	(Derhamy et al., 2015)
	F6	Implementation of accountability.	(Derhamy et al., 2015)
	F7	Interiorization of risk management.	(Jayashankar et al., 2018)
	F8	Cooperation between organizations in building policies.	(Weber, 2013)
	F9	Governance framework application.	(Almeida et al., 2017)
	F10	Strategic policies to promote innovation.	(Weber, 2013)
	F11	Include users' privacy issues in IoT policies.	(Neisse et al., 2015)
	F12	Operational principles are aligned with IoT procedures.	(Weber, 2013)
	F13	Include cybersecurity and digital policies in IoT policies.	(Chatfield & Reddick, 2018)
	F14	Governance framework guides the management team in IoT implementation.	(Derhamy et al., 2015)
Processes	P1	Strategy processes to coordinate IoT processes.	(De Cremer et al., 2017)
	P2	Business processes to align the IoT process with business models.	(Ruggieri et al., 2013)
	P3	Governance processes to decompose and decentralize the business processes.	(Ruggieri et al., 2013)
	P4	Information processing towards business decisions.	(Yao et al., 2015)
	P5	Implementing a sound data management process.	(Gubbi et al., 2013)
	P6	Implementation of data analytics process.	(Gubbi et al., 2013)
	P7	Implementing application management process to promote scalability.	(Almeida et al., 2015)
	P8	Implementing application monitoring process to guarantee business continuity.	(Wortmann & Flüchter, 2015)
	P9	Implementation of application security management in development process.	(Almeida et al., 2017)
Organizational Structures	O1	Attribution of roles, responsibilities, and tasks in IoT.	(Shen et al., 2018)
Culture, Ethics, and Behavior	B1	Spread social culture in IoT implementation.	(Shin, 2014)
	B2	Organization's culture aligns with identity, autonomy and trust protection of IoT users.	(Almeida et al., 2015)
	B3	Organizations implement his culture and values in IoT acceptance.	(Shin, 2014)
	B4	Ethics integrates social behaviors, privacy, and integrity in IoT implementation.	(Abobakr & Azer, 2017)
	B5	Implementation of awareness in people's attitude and motivation.	(Shin & Jin Park, 2017)
Information	I1	Information research techniques for IoT support.	(Vlahogianni et al., 2016)
Services, Infrastructures and Applications	S1	IoT services promotes sustainability.	(Cao et al., 2016)
	S2	IoT services are built on top of strong standards and protocols.	(Wen et al., 2017)
	S3	IoT infrastructures it is aligned with continuity of investment.	(Shin, 2014)
	S4	Ensure IoT services improve the organization's efficiency by being aligned with business needs.	(Wen et al., 2017)
People, Skills, and Competencies	C1	Integration of people in IoT.	(Shin, 2014)
	C2	Socio-technical skills to promote automation.	(Shin & Jin Park, 2017)
	C3	Implementation of strategic skills for goals guidance.	(Van Deursen & Mossberger, 2018)
	C4	Implementation of information skills for requirements analysis.	(Van Deursen & Mossberger, 2018)
	C5	Implementation of organization skills to improve decision making.	(Van Deursen & Mossberger, 2018)
	C6	Implementing people as an important role in IoT acceptance.	(Shin, 2014)

4.2. DELPHI METHOD

To proceed with this investigation the Delphi method was used to tune the ITG enablers elicited from the literature with professionals' opinions. This method will take the output information from the SLR of ITG Enablers for IoT implementation, which is the initial list of recommendations, as an input. As advised in literature (Section 3.2), the selection of participants was made carefully to increase the quality and accuracy of responses during the Delphi method. Therefore, the following criteria were used in the participant selection process:

- Work domain: IoT project and IoT implementation.
- Work position: high-level management positions in IoT domain.
- Work experience: minimum 4 years' experience in IoT domain.

After the selection process eleven experts matched the criteria and they were invited to participate in this research with a 37 percent drop off rate. The Delphi method was divided into three rounds. With the end of the third round it was possible to verify that all participants did not withdraw from the start of the study, which serves a valuable point to consider in this study because, according to the literature, the tendency is to reduce the number of participants throughout the rounds (Fletcher & Marchildon, 2014; Hill & Fowles, 1975; Skulmoski et al., 2007). Another point to mention is the Delphi study took more than the 45 days which is recommended in the literature (Linstone & Turoff, 2002). In this Delphi study a five point Likert-type scale was used in order to quantify the data, where the mean for each question item was calculated and the cut-off point was 3,5 as recommended in the literature (Birdir & Pearson, 2000; Skulmoski et al., 2017; Murry & Hammons, 2017; Verhagen et al., 1998).

The first round was used to validate the initial list of recommendations extracted in the literature review from section 4.2 using a degree of concordance between 1 and 5, and to create a definition for each recommendation according to the comments from the participants. The second round was used to determine the level of efficiency from each recommendation on each ITG enabler in IoT and identify a top 10 most important recommendations for an IoT implementation. The third round was used to increase consensus of concordance and efficiency within the group about the recommendations. Table 16 shows the Delphi stages which it is presented the time duration of each stage, the input and output of each stage, and how many participants in each stage.

Table 16 - Delphi stages

Phase	Date		Input	Output	Participants	
	Begin	End			Invited	Respondants
Round 1	01/02/2019	28/02/2019	Initial list from SLR ITG Enablers for IoT	New List of recommendations and their definition	11	7
Round 2	19/03/2019	06/04/2019	List recommendations from round 1	Top 10 recommendations and efficiency level on each recommendation.	7	7
Round 3	12/04/2019	06/05/2019	List of recommendations from round 2	Consensus in the efficiency level and top 10 recommendations	7	7

4.4.1. First round

The first round was sent out on the 1st of February of 2019 to the 11 participants with a deadline of two weeks to complete the questionnaire. As previously stated, the first round aimed to get comments regarding the initial list of recommendations taken in the literature review (Section 4.2), to rate them on a degree of agreement, and to receive more detail on each recommendation according to the comments left by the participants. The results were quite important in terms of the rating of the recommendations which made it possible to delete some and to add new ones. A sample of the questionnaire used for round one is the Annex E.

During the analysis of the first round, an exclusion criterion was created in order to exclude the weakest recommendations of the initial list. The exclusion criteria selected is: if the average rate of the recommendations is equal or below 3,5. With these criteria, it was possible to exclude eight recommendations from the initial list (F8, F11, F14, P3, B1, I1, C3 and C5). In addition, recommendation F11 was merged into F5 (Table 16), because based on the participants' comments, they represent the same objective. In order to get a better view from the results, a graph was created (Figure 7).

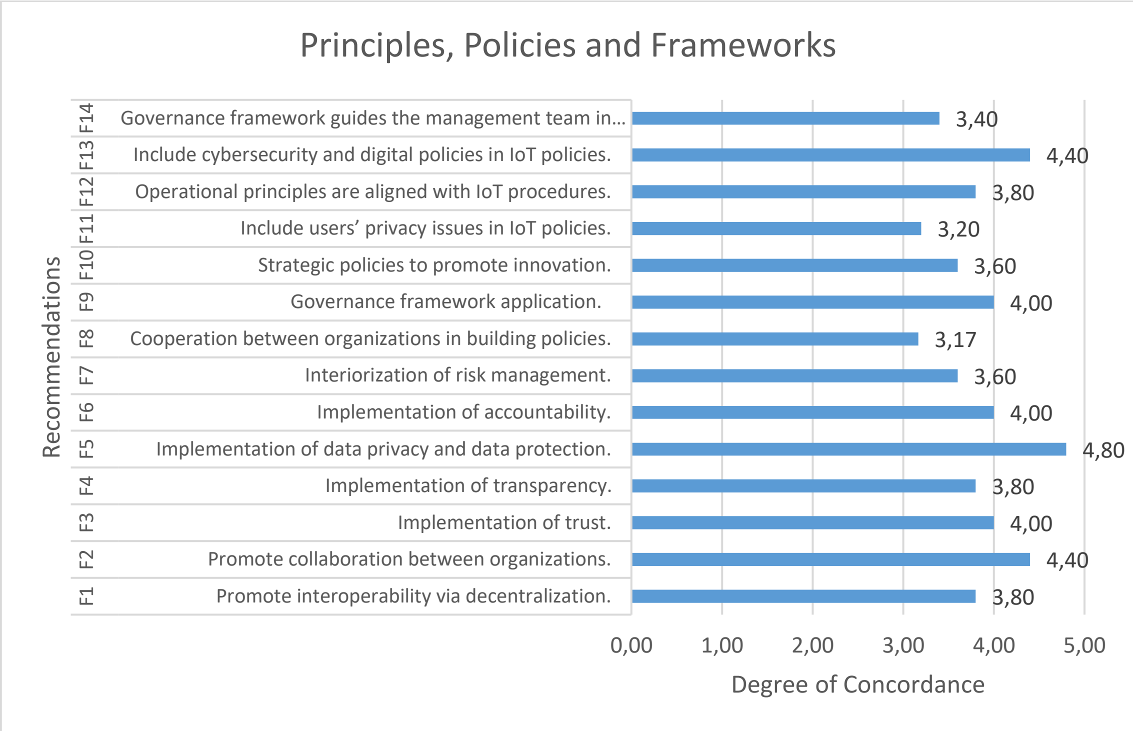

Figure 7 - Results of the first round - principles, policies, and frameworks

Figure 7 details the results from the ITG enabler "Principles, Policies, and Frameworks", where three recommendations (F8, F11, and F14) are below 3,5. The F8 recommendation is about the cooperation from the organizations to build policies to improve the implementation of IoT, the F11 was a recommendation that was similar in the objective from F5, and the participants felt that it was more relevant to have the F5 in IoT. Finally, the F14 is related to the governance framework being a guideline to the management team during an IoT implementation, therefore the participants showed us these recommendations were not necessarily important to have in an IoT implementation. The recommendation F5 got a score of 4,80 which refers to the implementation of data privacy and data protection in an IoT implementation. The participants concluded that this recommendation is vital in IoT and should not be undermined by the organizations.

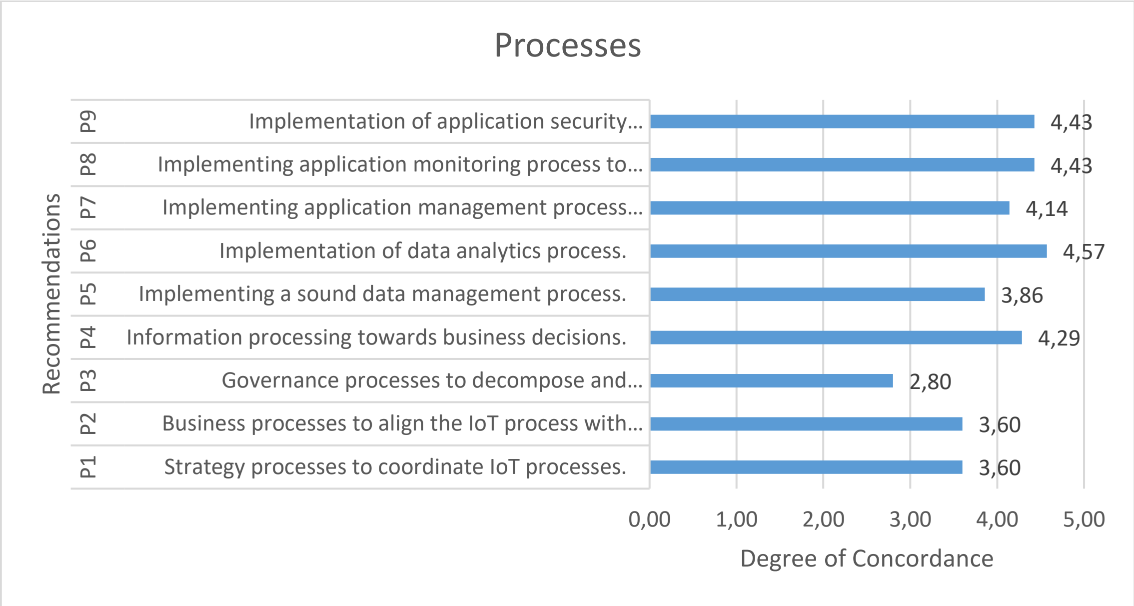

Figure 8 - Results of the first round - processes

Figure 8 shows the results from the ITG enabler "Processes", where one can see that only P3 did not reach the 3,5 threshold. P3 refers to the governance processes being used to decompose and decentralize the business processes. The recommendation P6 marks as the most relevant with a 4,57 score and this one talks about data analytics and for the participants is a major process to exist during an IoT implementation.

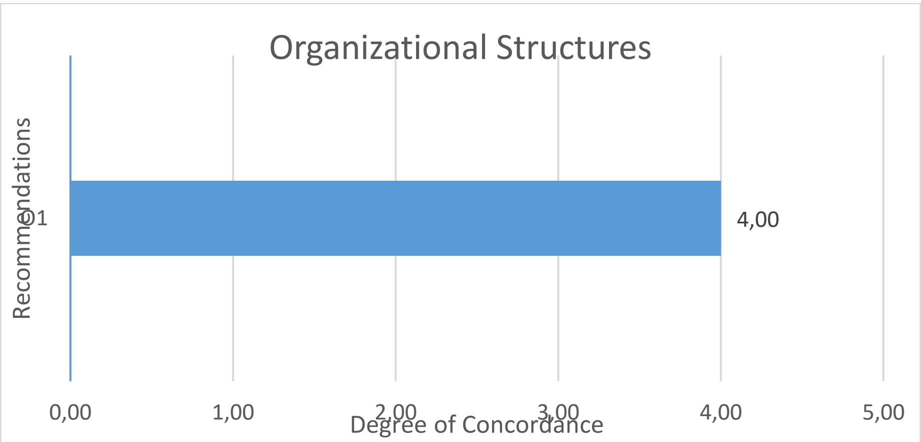

Figure 9 - Results of the first round - organizational structures

Figure 9 shows the results from the ITG enabler "Organizational Structures" it is possible to see that the participants agree that the single recommendation provided from the literature review about the attribution of roles, responsibilities, and tasks is useful during an IoT implementation.

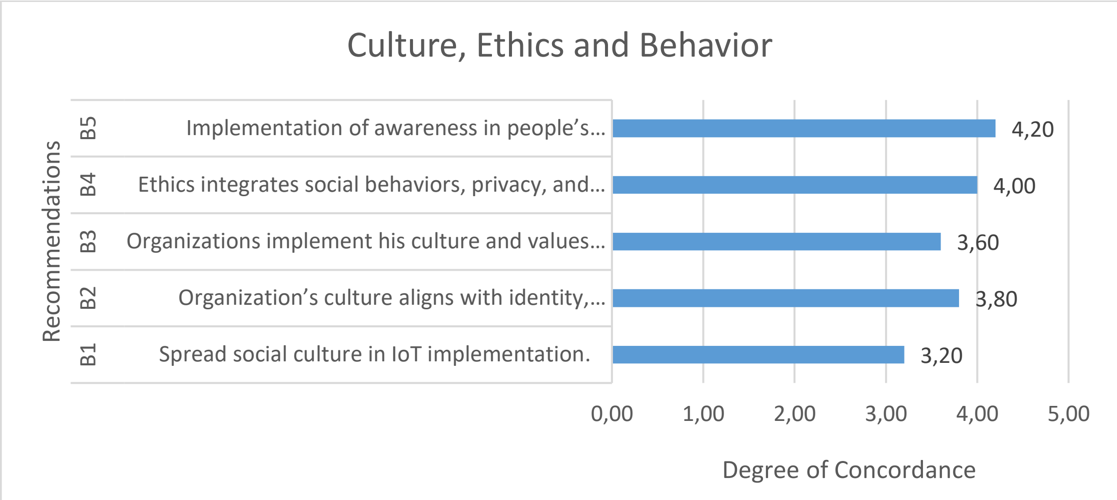

Figure 10 - Results of the first round - culture, ethics, and behavior

Figure 10 shows the results from the ITG enabler "Culture, Ethics, and Behavior" and it is possible to see that just one recommendation is below the threshold 3,5 and it is the B1. This recommendation talks about spreading a social culture that should be used during an IoT implementation. The recommendation B5 is the highest ranked and refers to the implementation of awareness in people's attitude and motivation is an integral part to have in an IoT implementation.

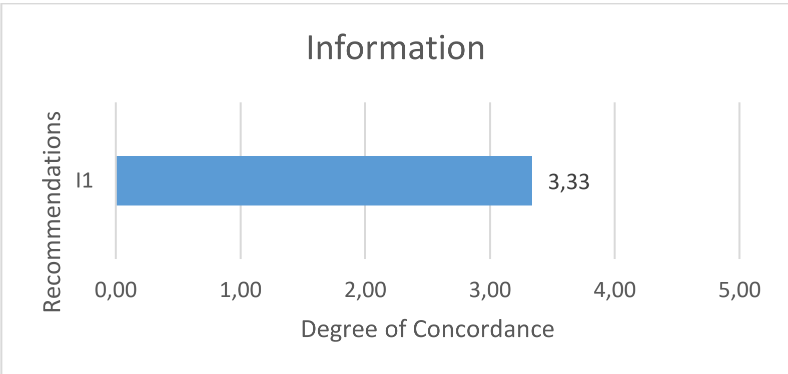

Figure 11 - Results of the first round - information

Figure 11 shows the results from the ITG enabler "Information". It is possible to verify that the recommendation made in the literature review was not approved by the participants making this one of the deleted ones. As already mentioned before there is a lack of information regarding using this enabler during an IoT implementation in order to get better results. This recommendation was related to research techniques to support IoT and the participants showed us that is not a relevant tool to have during an IoT implementation.

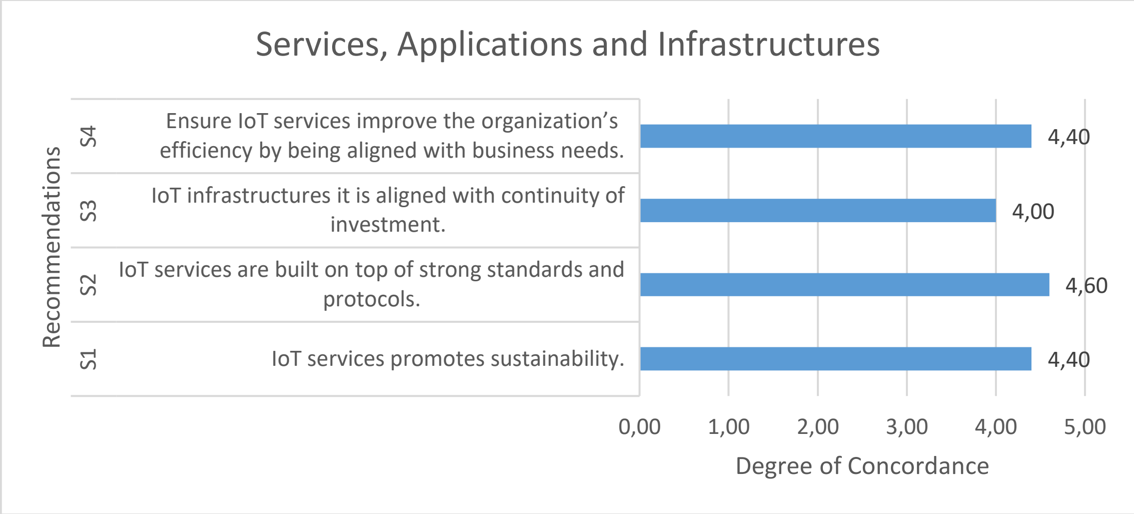

Figure 12 - Results of the first round - services, applications, and infrastructures

Figure 12 shows the results from the ITG enabler "Services, Applications, and Infrastructures" and it is possible to verify that none of the recommendations was deleted demonstrating that the literature review has good support information regarding this enabler for an IoT implementation. The recommendation S2 which regards the standards the IoT services should be built on top to bring out better applications and use for the users.

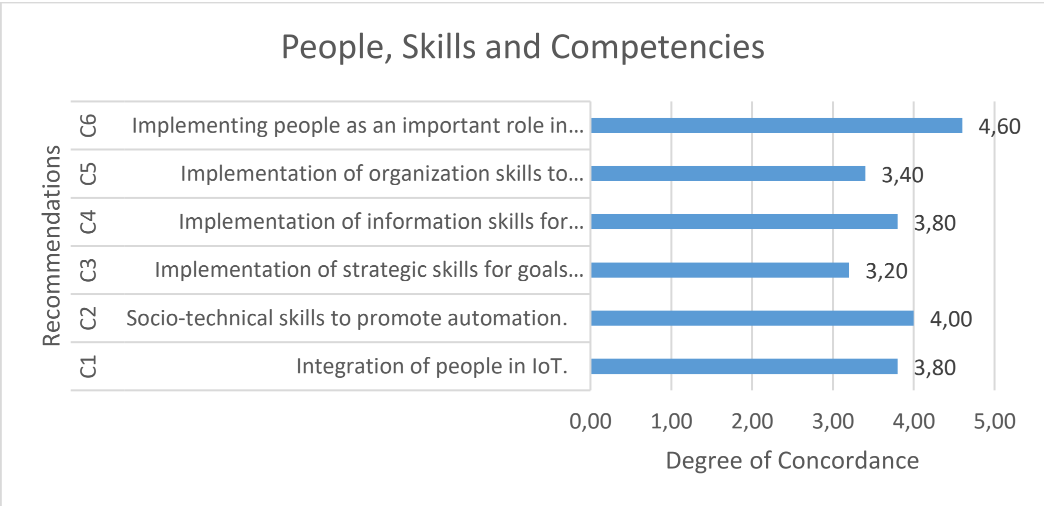

Figure 13 - Results of the first round - people, skills, and competencies

Figure 13 shows the results from the ITG enabler "People, Skills and Competencies" and it is possible to verify that two recommendations didn't pass the criteria and they were deleted. These were the C3 and C5. The C3 recommendation is about the strategic skills that people should have during an IoT implementation and the participants came to the conclusion that it is not an important skill to have during an IoT implementation phase. The C5 recommendation is about organizations skills where the participants again concluded that it is not important to have during an IoT implementation. On the positive side, the recommendation C6, which talks about people playing an important role in increasing the success rate of IoT acceptance, appears with a result of 4,6. The participants concluded that this recommendation is one of the most important in this enabler.

After the first round, it was possible to define the recommendations presented in Table 17, using the comments of the participants during the first round. The detail of each recommendation is presented in Table 17 and this table includes the new recommendations elicited from participants comments, which are: F6; F11; P3; P10; O2; I1; S5; S6; C3. It must be noted that the new recommendations (when possible) took the IDs of the removed ones.

Table 17 - Recommendations details

ID	Recommendations	Details
F1	Promote interoperability via decentralization.	Decentralization between interoperable systems via IP standards will aid modularity in all areas of the business, promote innovation, lower costs to implement IoT and will support decision makers.
F2	Promote collaboration between organizations.	This aims towards the collaboration of ideas, needs, strategic outcomes and known risks, reducing obstacles during IoT implementation. It also improves data utilization because the real potential of data collection is only possible to be achieved in large scales between different players.
F3	Implementation of trust.	Trust is related to corporate behavior, more precise and updated data, and builds a positive culture within the organization.
F4	Implementation of transparency.	Transparency is essential in trust, privacy, and security during the data gathering, data management.
F5	Implementation of data privacy and data protection.	Data privacy and data protection should be the foundation of IoT project in order to bring more clarity and confidence in the data collected and presented to the users.
F6	IoT agile principles.	The agile principles in IoT will aid to bring more agility in the operational processes.
F7	Interiorization of risk management.	With this option the risks can be interiorized or transferred depending on the data being held and managed. This also brings more capacity to anticipate risks.
F8	Governance Framework Application	This is an essential part of accountability. It facilitates the implementation of strategic policies based on IoT data. A key tool to build interoperability and standards between systems. In addition, they are useful in the Technology Acceptance Model (TAM) and Theory of Planned Behavior (TPB) because will focus on the evaluation of the potential adoption of emerging technologies.
F9	Strategic policies to promote innovation.	These policies are helping the organizations to respond in real-time to competitive markets using the data collected by IoT.
F10	End-to-End security principles.	The entity that has the solution must guarantee the security of the system end-to-end.
F11	Data audit principle.	This principle will help to have an ambient with updated data on a regular basis to increase the trust of the data collected.
F12	Operation Principles are aligned with IoT procedures.	Operation principles should be embedded by design to facilitate IoT operations after implementation.

F13	Include Cybersecurity and digital policies in IoT policies.	Cybersecurity and digital policies should be embedded in IoT policies to fight the culture of "ease of use" and bypass authentication security.
P1	Strategy processes to coordinate IoT processes.	These processes are focused to coordinate the IoT outcomes and they must include the IT process implementation.
P2	Business processes to align IoT processes with business models.	These processes are a tool to create new business models, business decisions.
P3	Problem identification processes.	Integral part from change management in IoT processes.
P4	Information processing towards business decisions.	Processing information gathered in IoT to improve business decisions.
P5	Implementing a sound data management process.	Processes to know how the organization will store and use data gathered by IoT.
P6	Implementation of data analytics processes.	Analytics to improve the recognition of new trends in the market using IoT data.
P7	Implementing application management process to promote scalability.	Processes to ensure the applications are working properly and verification of scalability upgrade which adds more users.
P8	Implementing application monitoring process to guarantee business continuity.	Processes to know the status of the applications in real time with a notification system to guarantee business continuity.
P9	Implementation of application security management in development process.	Processes to guarantee security at all levels of the development process.
P10	Digitalization processes.	To reduce workload, improve the resilience from new markets to engage IoT.
O1	Attribution of roles, responsibilities, and tasks in IoT.	Defines organizational efforts, responsibilities, structures, and ownership. An integral part of governance and accountability.
O2	Implementation of accountability.	Defines the organizational structures to be implemented in IoT services with clear accountable people.
O3	Responsabilization assignment matrix.	To define the responsibilities and organizational efforts.
B1	Organization's culture aligns with identity, autonomy and trust protection of IoT users.	Method to build trust among employees and users, to reinforce the culture of cybersecurity, data sharing between project owners, competitive environments.
B2	The organization implements his culture and values in IoT acceptance.	Embrace IoT will lead to more "data" decisions, which enforces culture in future services.
B3	Ethics integrates social behaviors, privacy, and integrity in IoT implementation.	Ethics integration in business behaviors across all ITs organization.
B4	Implementation of awareness in people's attitude and motivation.	To motivate people to automate and digitize processes in order to perform new activities, integration in culture management.

I1	Data exchange between organizations.	Creates great potential to collect a great amount of data if existing data sharing between organizations.
S1	IoT services promote sustainability.	Promotion of sustainability to collect data to mitigate risks, increase productivity, creation of more knowledge. An integral part of service delivery.
S2	IoT services are built on top of strong standards and protocols.	Assure the success of a technology where it must be compliant with global standards and accepted by IoT manufacturers.
S3	IoT infrastructures it is aligned with continuity of investment.	Creates innovation and bring new business opportunities.
S4	Ensure IoT services improve the organization’s efficiency by being aligned with business needs.	Helps to understand the motivation and priorities of the organization beyond the services to increase acceptance and, autonomy wherein the end creates more efficiency.
S5	Predictive technologies to support decision makers.	Use predictive technology to create new intelligent layers of data to support the decision makers.
S6	Service delivery management to improve scalability.	Improves scalability, repetition tasks which help to produce positive ROI in IoT.
C1	Integration of people in IoT.	Integrate people in IoT highlighting that the benefits of IoT will increase the success of integration.
C2	Socio-technical skills to promote automation.	An important recommendation in people that develops solutions, giving them more time to create activities using automation.
C3	User experience to improve effectiveness.	Demonstrates the effectivity of the IoT service.
C4	Implementation of information skills for requirements analysis.	Data management and information technology skills to set up the IoT architecture and basic requirements.
C5	Implementing people as an important role in IoT acceptance.	An integral part of change management.

4.4.2. Second round

The second round was sent out on the 19th of March to the participants with a deadline of two weeks to fill in the questionnaire. This round aimed to obtain a rate in terms of efficiency of each ITG enabler recommendation validated in the first round, using a score between one (not efficient) and five (very efficient). In addition, participants were requested to elaborate their top 10 recommendations that organizations should implement during an IoT implementation. After gathering all answered questionnaires, a criteria was established in order to choose the final top 10 from all participants, using ranking points to each position, where top 1 gets 10 ranking points and top 10 gets 1 ranking point. A sample of the questionnaire used for round one is Annex F.

In the next figures, the results of each ITG enabler recommendation according to efficiency in an IoT implementation are shown.

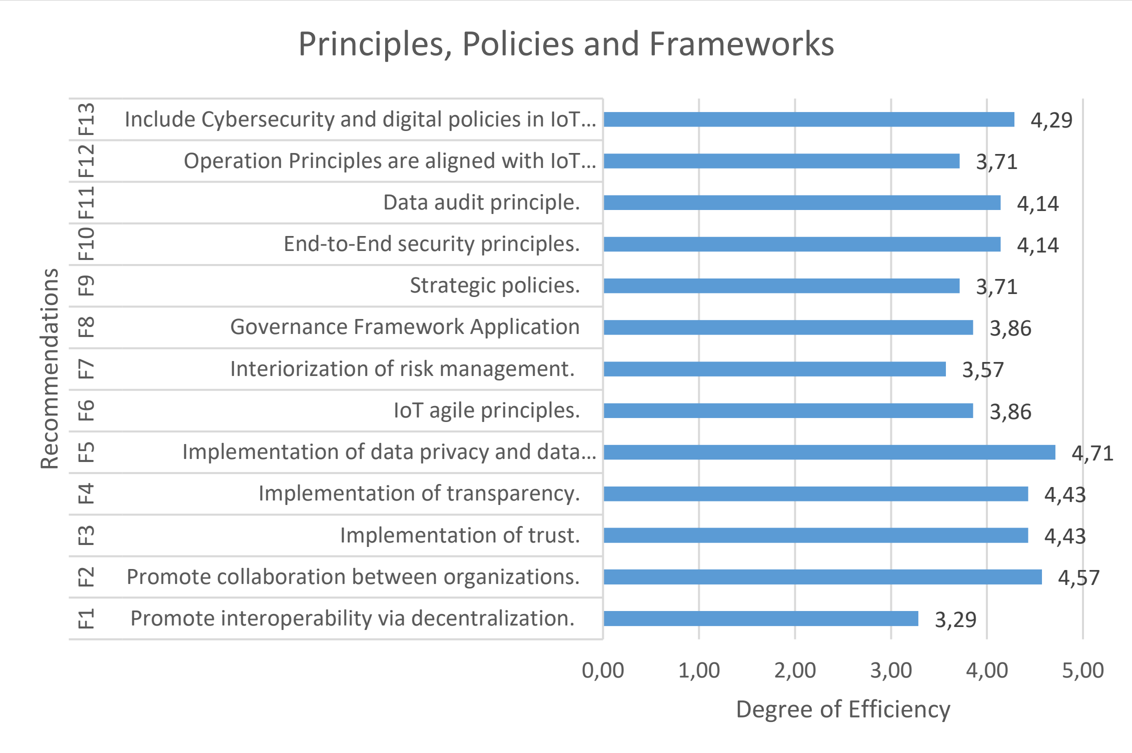

Figure 14 - Results of the second round - principles, policies and frameworks

Figure 14 depicts the results in terms of efficiency for each recommendation in the ITG enabler "Principles, Policies and Frameworks". From the results it is possible to reach various conclusions, such as the recommendation F5, which is the "Implementation of data privacy and data protection" for the participants, is the most efficient recommendation to have in an IoT implementation as this recommendation guarantees a better IoT solution when it is implemented, thus bringing more efficiency to the solution itself. The second most efficient recommendation in this ITG enabler is F2, which is the “Promote collaboration between organizations”, and it is very interesting to have this recommendation as one of the most efficient because it speaks to why the collaboration between organizations and especially in IoT is so important in the business world as several organizations can use the data of the solution to perform better business decisions, rendering a more efficient solution.

The less efficient recommendation is F1, which is the “Promote interoperability via decentralization”. With this conclusion, it is possible to verify that this recommendation is one of the most complicated jobs to be implemented in an IoT implementation. Interoperability is a necessary point in an IoT solution, but via decentralization it is more difficult to obtain a good result.

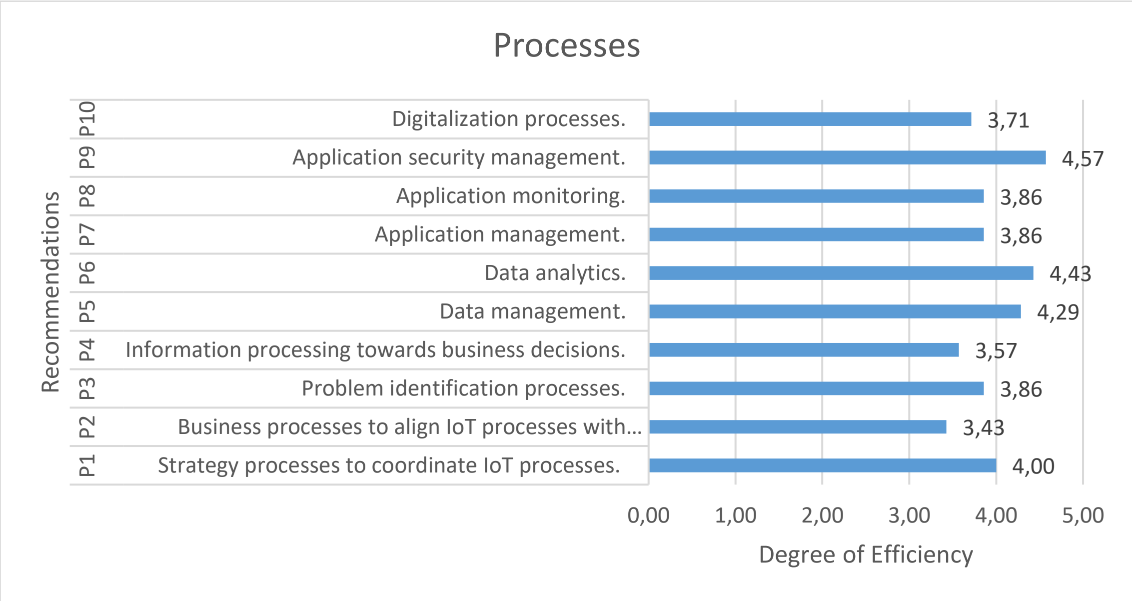

Figure 15 - Results of the second round - processes

Figure 15 shows the results in terms of efficiency for each recommendation in the ITG enabler “Processes”. From the results it is possible to reach several conclusions, such as the recommendation P9, which is the “Implementation of application security management in development process”, and it is the most efficient recommendations according to the participants to have in an IoT implementation because this process will guarantee a safer IoT solution to be implemented in the organization. The recommendation P6, which is the “Data analytics”, is the second most efficient recommendation to exist in an IoT implementation. This brings us to the attention that the organizations must consider having tools in the IoT solution to collect and analyze data from the IoT devices.

The less efficient recommendations considered by the participants is P2 which is the “Strategy processes to coordinate IoT processes”, due to the fact that it is complicated to integrate the strategy processes into the IT process implementation.

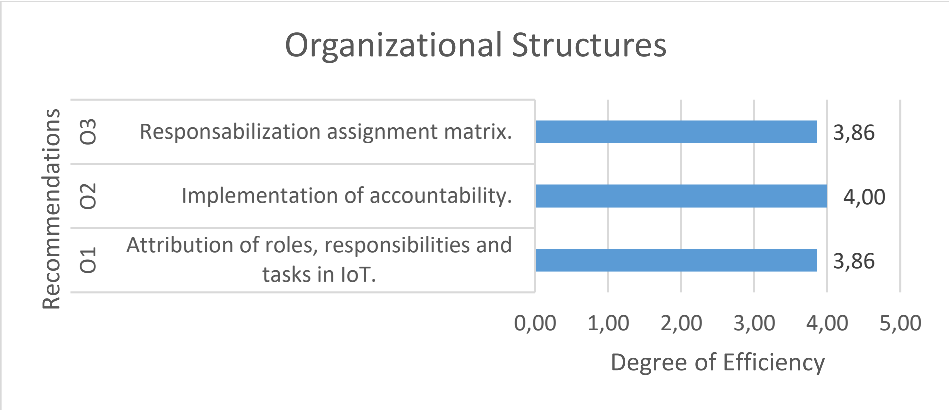

Figure 16 - Results of the second round - organizational structures

Figure 16 shows the results in terms of efficiency for each recommendation in the ITG enabler “Organizational Structures”. From the results it is possible to verify that the recommendation O2 is the most efficient according to the participants. This O2 recommendation is the “Implementation of accountability”. The participants consider this recommendation as one of the most efficient in an IoT implementation because it is essential to have organizational structures implemented in the IoT solution in order to guarantee a good success rate of the solution, making clear who the accountable people are.

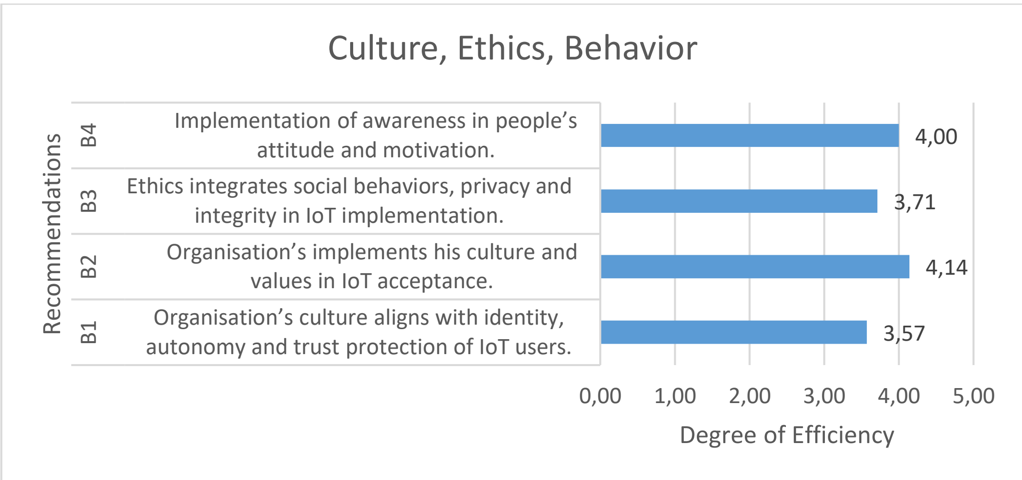

Figure 17 - Results of the second round - culture, ethics, and behavior

Figure 17 shows the results in terms of efficiency for each recommendation in the ITG enabler “Culture, Ethics, and Behavior”. From the results, it is possible to conclude that the most efficient recommendation to have in an IoT implementation is B2, which is the “Organization implements its culture and values in IoT acceptance”, because this will help to perform better business decisions according to the organization’s vision of the IoT solution.

The less efficient recommendation to have on an IoT implementation is the recommendation B1, which is the “Organization’s culture aligns with identity, autonomy and trust protection of IoT users”, due to the fact that it may not be so easy to interpret the organization’s culture and insert that information into the identity of the IoT users.

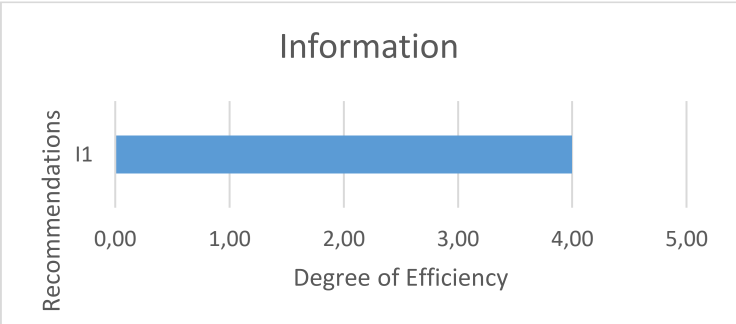

Figure 18 - Results of the second round - information

Figure 18 shows the results in terms of efficiency for each recommendation in the ITG enabler “Information”. From the results, it is possible to verify that this ITG enabler only has one recommendation, which is the I1 “Data exchange between organizations” and obtained a good result in terms of efficiency from the participants of the research. The participants consider this recommendation efficient to have on an IoT implementation because an IoT solution can be used by several organizations and this recommendation will increase the interaction during the exchange of information between organizations, in turn increasing the success of the solution in the business.

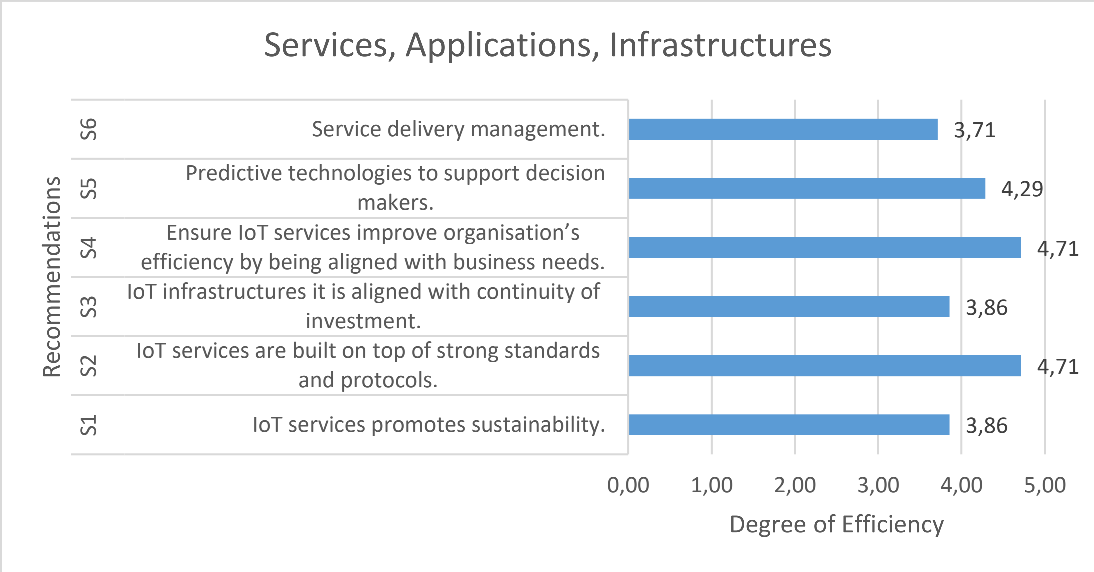

Figure 19 - Results of the second round - services, applications, and infrastructures

Figure 19 shows the results in terms of efficiency for each recommendation in the ITG enabler "Service, Applications and Infrastructures". From the results, it is possible to conclude that recommendation S2 and S4 are the most efficient to have on an IoT implementation according to the participants. The recommendation S2 is the "IoT services are built on top of strong standards and protocols". The participants consider this very efficient to have in an IoT implementation because a junction of strong standards and protocols will render the interoperability of the systems inside the IoT solution easier and, in addition, will facilitate the understanding of the wanted outcomes of the solution as it is more aligned with the business outcomes. The other recommendation with a good efficient level is S4, "Ensure IoT services improve the organization's efficiency by being aligned with business needs". It is very interesting that achieved a good result because it is possible to see a connection between this recommendation and the recommendation S2, because this recommendation will help the alignment the outcome of the IoT solution with the business needs and this is performed with the help of the strong standards and protocols.

The less efficient recommendation in this ITG enabler to exist in an IoT implementation is the S6, "Service delivery management to improve scalability". This leads to the conclusion that is not so important during an IoT implementation to consider this recommendation as essential in order to increase the success of the IoT solution. By definition of this recommendation, it makes more sense to have this recommendation after the implementation because it will improve the scalability of the tasks.

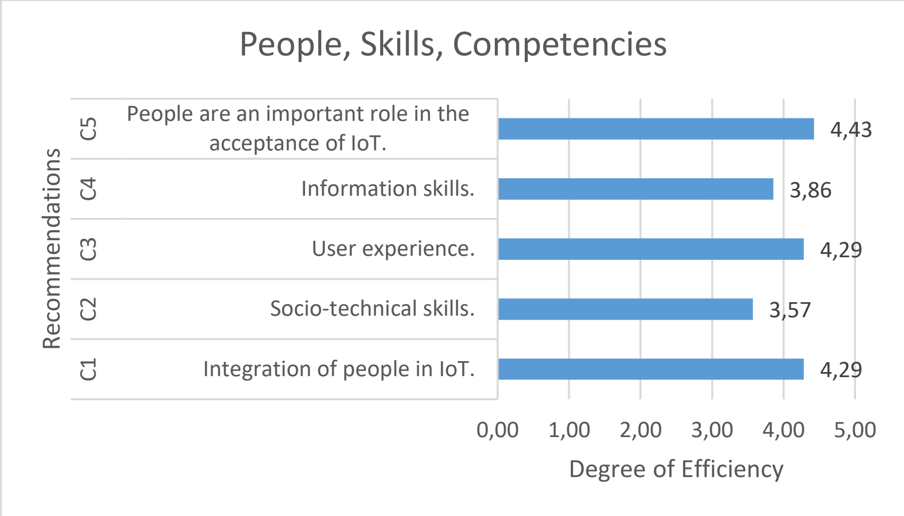

Figure 20 - Results of the second round - people, skills, and competencies

Figure 20 shows the results in terms of efficiency for each recommendation in the ITG enabler “People, Skills, and Competencies”. From the results it is possible to verify that the most efficient recommendation is C5, “People are an important role in the acceptance of IoT”, because this recommendation will increase the IoT acceptance by the people. As such, organizations must take into account having people as an integral part of the IoT solution because only when people accept the solution and see the benefits can the desired outcomes be achieved, aligning them with the business needs.

The less efficient recommendation in this ITG enabler is the C2 “Socio-technical skills” because for the participants this recommendation is not essential to have during an IoT implementation as these skills are more focused on the development of people and not for all people included in the implementation process.

During the second round the participants were also requested to create their Top 10 recommendations to be considered in an IoT implementation. Table 18 presents the Top 10 recommendations from the participants. The results were created by using a ranking point at each level from 1 to 10, where the 1st most important gets a score of 10 and the 10th most important gets a score of 1. The second round results were very interesting because from ten recommendations three of them (F5, P6, S2) were considered very efficient, the 10th most important recommendation for the participants is the least efficient in the ITG enabler “People, Skills, and Competencies”. Therefore, it is possible to conclude that, although the recommendation is not so efficient in an IoT implementation, the participants still consider this recommendation to be an important part.

The first most important recommendation is F5 “Implementation of data privacy and data protection”, which allows one to confidently conclude that the participants consider the safety and protection of data collected, created by the IoT solution as the main priority in an IoT implementation.

Table 18 - Top 10 recommendations in the second round

Top10	ID	Recommendations	Ranking Points
1	F5	Implementation of data privacy and data protection.	49
2	P5	Implementing a sound data management process.	36
3	P6	Implementation of data analytics processes.	33
4	S2	IoT services are built on top of strong standards and protocols.	31
5	F10	End-to-End security principles.	18
6	F8	Governance framework application	17
7	P2	Business processes to align IoT processes with business models.	16
8	F2	Promote collaboration between organizations.	14
9	C2	Socio-technical skills to promote automation.	14
10	O1	Attribution of roles, responsibilities and tasks in IoT.	13

4.4.3. Third round

In the third round, participants were asked to review their answers from round two according to the group’s average. The objective of this round was to deliver more consensual results by giving the participants the opportunity to review their answers according to the group’s average in terms of efficiency and in the top 10 recommendations. Thus, it was decided to not include the review of the results from first round since that round was used to validate the initial list of recommendations made in the literature review and, after the analysis of the data, some recommendations were deleted and new recommendations. This validated list was used in the second round as a final list of recommendations, representing the proper list to continue the research. The sample of the questionnaire used for round one is Annex G.

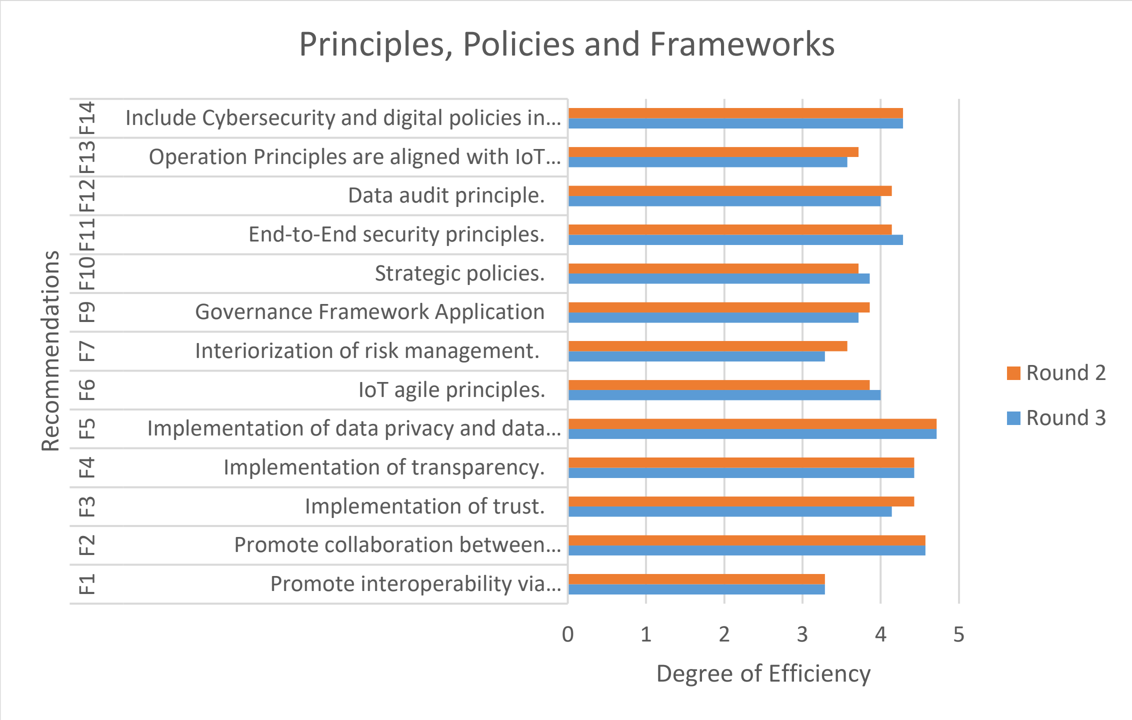

Figure 21 - Results of the third round - principles, policies, and frameworks

Figure 21 the most efficient recommendation in the ITG enabler Principles, Policies and Frameworks is F5 “Implementation of data privacy and data protection”. The participants agreed on this the most efficient recommendation to consider in an IoT implementation. It is also possible to see that data security is one of the most important aspects to consider in IoT. Therefore, if the IoT project successfully implements data privacy and data protection of all data generated and collected in IoT, this will increase the efficiency of the IoT solution. Another recommendation that obtained a good score in terms of efficiency was F2, “Promote collaboration between organizations”. The participants are in agreement as they considered this recommendation very important because in an IoT implementation there will exist various platforms, teams, structures, which work together in order to achieve common business goal and to use the data collected from the IoT solution. It is only possible to collect a large size of data with the cooperation between organizations, therefore this collaboration between organizations is a step forward in order to increase the efficiency of the IoT solution. On the downside, the participants considered the recommendation F1, “Promote interoperability via decentralization”, and F7, “Interiorization of risk management”, the least efficient recommendations to have in an IoT implementation.

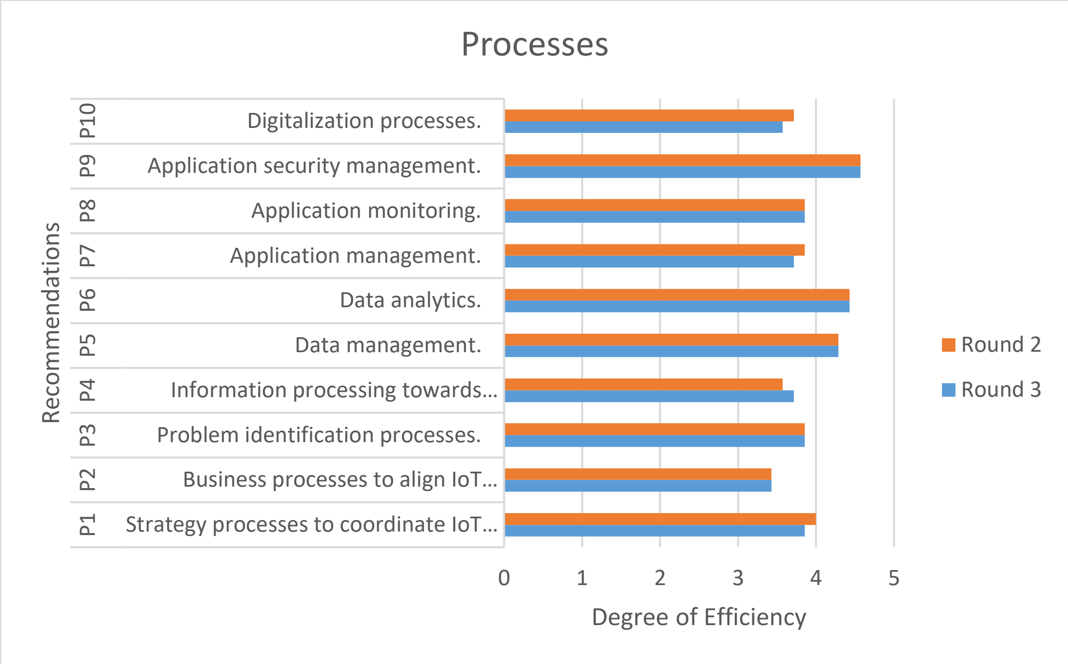

Figure 22 - Results of the third round - processes

Figure 22, the participants of the research considered the most efficient recommendation from the ITG enabler “Processes” the P9 “Application security management” to have in an IoT implementation. It is possible to verify a pattern between the ITG enabler “Principles, Policies, and Frameworks” and “Processes”, where the participants consider security as the focus for an IoT solution, making this a priority from the start of the project until the final solution. Recommendation P9 will allow for an increase in the efficiency in an IoT implementation because these processes will include security aspects from the beginning of the development of the solution, rendering it a priority. Another recommendation that obtained a good score in terms of efficiency was the P6, “Implementation of data analytics processes”. The participants consider this recommendation to be an integral part in order to increase the efficiency of an IoT implementation and also from the IoT solution, because the focus of IoT is the data collected from the devices and making decisions based on new trends to benefit the organization business. The less efficient recommendation in this ITG enabler is the P2, “Business processes to align IoT processes business models”.

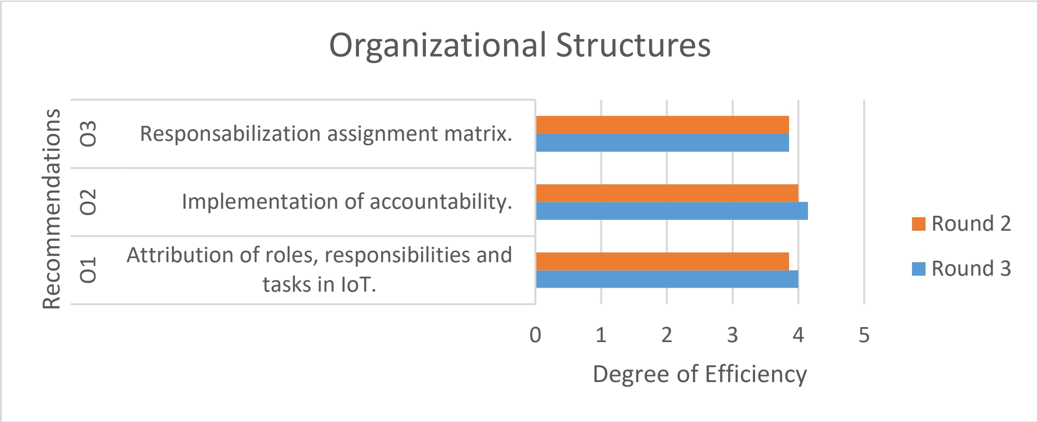

Figure 23 - Results of the third round - organizational structures

Figure 23, the most efficient recommendation in the ITG enabler "Organizational Structures" is the O2 "Implementation of accountability". This recommendation will help to increase the efficiency in an IoT implementation, defining the responsibilities, organizational roles, and ownership of the people involved in the implementation. With clear accountability, the communication between structures within the organization will become easier and this will provoke an increase in the success rate of the IoT implementation. The least efficient recommendation in this ITG enabler is O3 "Responsibilization assignment matrix". From the data collected from the participants, they made clear that this recommendation is difficult to define the responsibilities and organizational efforts in order to increase the efficiency of an IoT implementation.

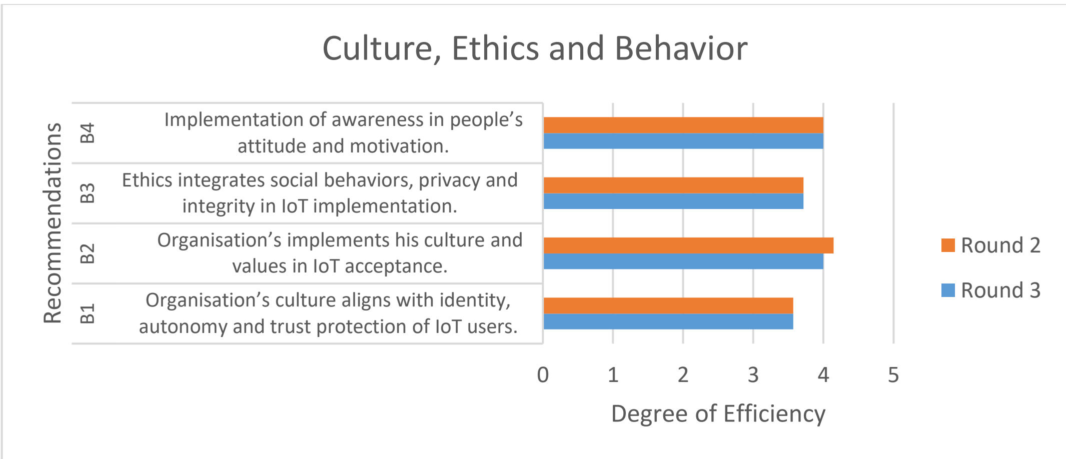

Figure 24 - Results of the third round - culture, ethics, and behavior

Figure 24 the most efficient recommendation in the ITG enabler "Culture, Ethics, and Behavior" is the B2 "Organization implements his culture and values in IoT acceptance" and B4 "Implementation of awareness in people's attitude and motivation". The participants concluded that these recommendations increase the efficiency of an IoT implementation by embracing IoT into more data decisions, thus enforcing this culture in future services and by motivating the people to automate and digitize the processes to perform new activities and embed this into culture management.

The least efficient recommendation in this ITG enabler is B1 "Organization's culture aligns with identity, autonomy and trust protection of IoT users", as the participants consider the least efficient because it could represent a complex method of building trust among employees and users.

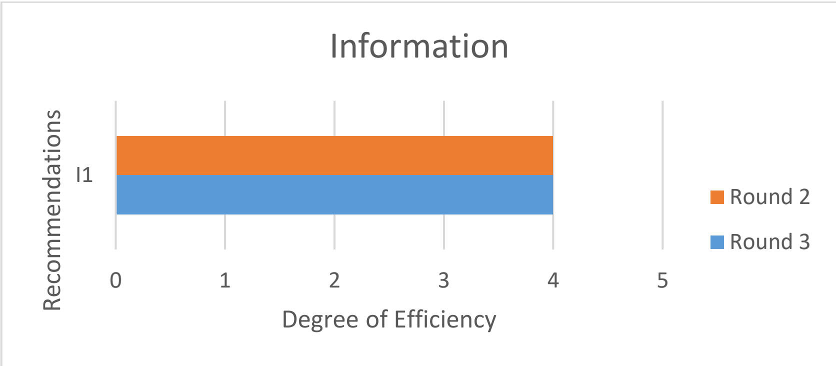

Figure 25 - Results of the third round - information

Figure 25 there exists only one recommendation "Data exchange between organization" and this obtained a good score in terms of efficiency, making this recommendation one to consider in an IoT implementation, because this can create great potential to collect a large amount of data and share them between organizations. This promotes a good alignment with the recommendation from "Principles, Policies and Frameworks" the F2.

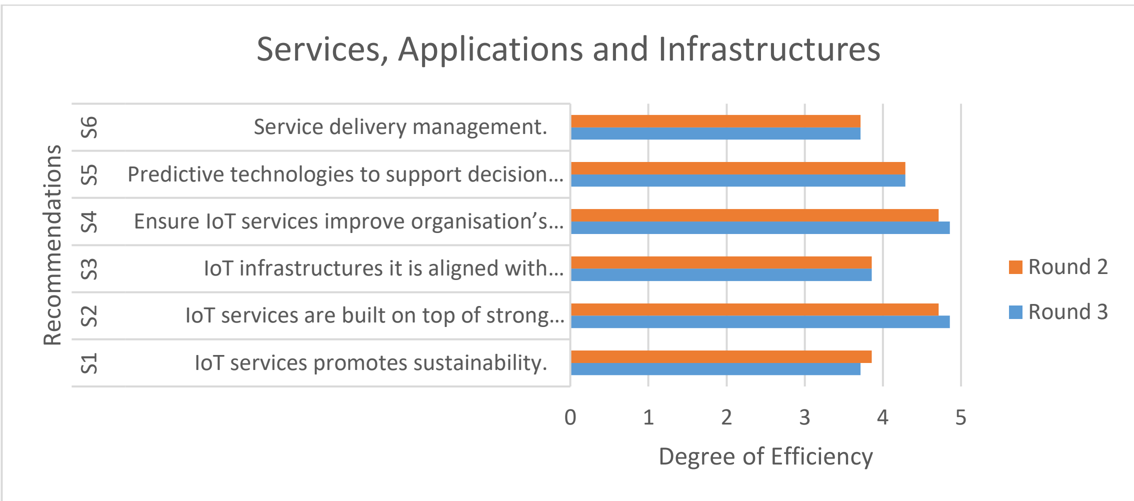

Figure 26 - Results of the third round - services, applications, and infrastructures

Figure 26 shows the most efficient recommendation in this ITG enabler which is the S2 "IoT services are built on top of strong standards and protocols" and the S4 "Ensure

IoT services improve organization's efficiency by being aligned with business needs". The participants came to a consensus that these two recommendations are the most efficient from this ITG enabler to have in an IoT implementation, because the S2 will assure that the services are built in compliance with the global standards in order to facilitate the acceptance by the IoT manufacturers, IoT security and the S4 will help to understand the priorities of the organization beyond the IoT services and this will lead to an increase in acceptance and autonomy.

The recommendation S1 "IoT services promotes sustainability" is the least efficient recommendation according to the participants because it is a complex model to integrate as part of service delivery which makes it less efficient to have in an IoT implementation, but, if implemented, it will help to mitigate risks and increase productivity.

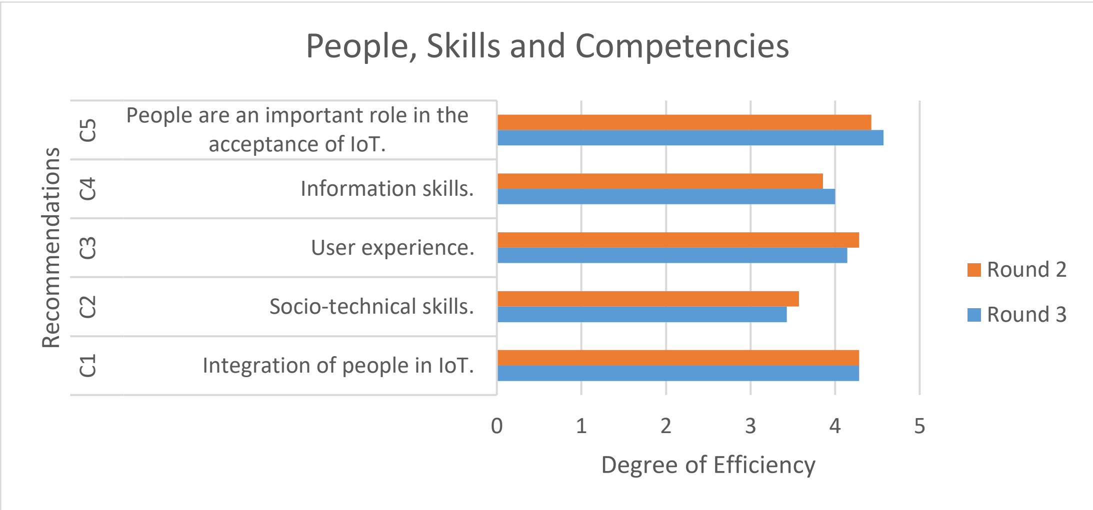

Figure 27 - Results of the third round - people, skills, and competencies

Figure 27 shows the most efficient recommendation in this ITG enabler is the C5 "People are an important role in the acceptance of IoT". It is possible to verify by the results that this recommendation will increase the efficiency of an IoT implementation by making people an integral part of change management, being part of the IoT solution because this will increase the awareness of people of the benefits of using the IoT solution. The recommendation C2 "Socio-Technical skills to promote automation" was considered less efficient by the participants.

Table 19 - Final top 10 recommendations

Top 10	ID	Recommendation	Ranking Points Round 2	Ranking Points Round 3	Delta	Position
1	F5	Implementation of data privacy and data protection.	49	59	+10	---
2	S2	IoT services are built on top of strong standards and protocols.	31	45	+14	↑+2
3	P5	Implementing a sound data management process.	36	42	+6	↓-1
4	P6	Implementation of data analytics processes.	33	40	+7	↓-1
5	F10	End-to-End security principles.	18	30	+12	---
6	F8	Governance Framework Application	17	27	+10	---
7	O1	Attribution of roles, responsibilities, and tasks in IoT.	13	18	+5	↑+3
8	P2	Business processes to align IoT processes with business models.	16	17	+1	↓-1
9	F2	Promote collaboration between organizations.	14	10	-4	---
10	O2	Implementation of accountability.	10	10	0	New

Table 19 shows the ten most important recommendations by the participants involved in the Delphi research. It is possible to verify that some of the recommendations chosen in the top 10 are also the most efficient recommendations chosen by the participants, allowing for an interesting observation of an alignment/consensus between the top 10 and the efficiency results. The most important recommendation for the participants F5 is also the most efficient, which means the data privacy and data protection from the IoT solution is a critical aspect to consider from the beginning of every IoT project. The recommendation S2 is the second most important and it is also the most efficient recommendation in the ITG enabler "Services, Applications, and Infrastructures". This recommendation creates more compliance in terms of data security/privacy and this feature aligns with the recommendation F5 to bring more efficiency to the IoT implementation.

The recommendations regarding data are also considered the most important to have during an IoT implementation in order to increase the success rate of the project. Therefore, it is possible to conclude that the organizations are making an effort to retrieve new ideas and solutions by using the IoT data collected. An interesting point is that the eighth most important recommendation P2 was considered the least efficient in the ITG enabler "Processes", therefore even though the process itself doesn't bring more efficiency into the implementation, the participants consider it to be a good tool to have during the implementation in order to create new business models and business decisions.

Comparing the top 10 results from the second and third round it is possible to verify some differences between them. For example, the recommendation P5 fell one position from second to third, the recommendation S2 stated in fourth in the second round but in the third round the participants considered it as the second most important. In the third round, there were new entries from the recommendations O1 and O2 of the ITG enabler "Organizational Structures" which makes an interesting point, considering the third round was used for the participants to review their answer using the group's average.

From this top 10, it is possible to observe that the most important ITG enablers for an IoT implementation are the "Principles, Policies and Frameworks", "Processes", "Services, Applications and Infrastructures" and "Organizational Structures". The ITG enablers "Culture, Ethics, and Behavior", "Information" and "People, Skills, and Competencies" didn't reach the top 10. Table 20 shows the most efficient recommendation by each ITG enabler.

Table 20 - Most efficient recommendation on each ITG enabler

ITG Enablers	ID	Recommendation
Principles, Policies, and Frameworks	F5	Implementation of data privacy and data protection.
Processes	P9	Implementation of application security management in development process.
Organizational Structures	O2	Implementation of accountability.
Culture, Ethics, and Behavior	B2	Organizations implement his culture and values in IoT acceptance.
Information	I1	Data exchange between organizations.
Services, Applications, and Infrastructures	S2	IoT services are built on top of strong standards and protocols.
People, Skills, and Competencies	C5	Implementing people as an important role in IoT acceptance.

In order to achieve a better vision of the consensus from the third round Table 21 was created, in which the group's average on each recommendation from the second round with the third round is compared.

Table 21 presents most of the recommendations decreased the average between the second and third round, but this decrease was minor in the majority of them which renders it a non-relevant point. A good observation is recommendation F5, which is the most important recommendation and obtained a good consensus between the second and third round. Recommendation P9 is the second most efficient recommendation given in the research. Recommendation F2 obtained a good consensus between rounds and this recommendation is in the list of the top 10.

The recommendations O1 and O2 which entered in the top 10 from the third round experienced an increase in the score between the second and third round, which concludes that the participants reached a consensus after having reviewed their own answers and comparing them with the group's average. This increased the relevance regarding these recommendations.

It is possible to verify that recommendations C4, C5, S4, S2, P3 F10, F11, and F6 experienced an increase in the score between the second and the third round, which concludes that the participants verified that these recommendations after a second analysis are more important during an IoT implementation.

Recommendations F3 and F7 were the two which experienced the biggest decrease in score between the second and the third round, which leads to the interesting conclusion that these recommendations could be explored further in the subsequent investigations in order to understand why they experienced such a decrease.

Table 21 - Comparison results from the 2nd and 3rd round

ID	Recommendations	2nd round	3rd round	Delta
F1	Promote interoperability via decentralization.	3.29	3.28	-0.01
F2	Promote collaboration between organizations.	4.57	4.57	0
F3	Implementation of trust.	4.43	4.14	-0.29
F4	Implementation of transparency.	4.43	4.42	-0.01
F5	Implementation of data privacy and data protection.	4.71	4.71	0
F6	IoT agile principles.	3.86	4	0.14
F7	Interiorization of risk management.	3.57	3.28	-0.29
F8	Governance Framework Application	3.86	3.71	-0.15
F9	Strategic policies to promote innovation.	3.71	3.85	0.14
F10	End-to-End security principles.	4.14	4.28	0.14
F11	Data audit principle.	4.14	4	-0.14
F12	Operation Principles are aligned with IoT procedures.	3.71	3.57	-0.14
F13	Include Cybersecurity and digital policies in IoT policies.	4.29	4.28	-0.01
P1	Strategy processes to coordinate IoT processes.	4	3.85	-0.15
P2	Business processes to align IoT processes with business models.	3.43	3.42	-0.01
P3	Problem identification processes.	3.86	3.85	-0.01
P4	Information processing towards business decisions.	3.57	3.71	0.14
P5	Implementing a sound data management process.	4.29	4.28	-0.01
P6	Implementation of data analytics processes.	4.43	4.42	-0.01
P7	Implementing application management process to promote scalability.	3.86	3.71	-0.15
P8	Implementing application monitoring process to guarantee business continuity.	3.86	3.85	-0.01
P9	Implementation of application security management in development process.	4.57	4.57	0
P10	Digitalization processes.	3.71	3.57	-0.14
O1	Attribution of roles, responsibilities, and tasks in IoT.	3.86	4	0.14
O2	Implementation of accountability.	4	4.14	0.14
O3	Responsabilization assignment matrix.	3.86	3.85	-0.01
B1	Organization's culture aligns with identity, autonomy and trust protection of IoT users.	3.57	3.57	0
B2	The organization implements his culture and values in IoT acceptance.	4.14	4	-0.14
B3	Ethics integrates social behaviors, privacy, and integrity in IoT implementation.	3.71	3.71	0
B4	Implementation of awareness in people's attitude and motivation.	4	4	0
I1	Data exchange between organizations.	4	4	0
S1	IoT services promote sustainability.	3.86	3.71	-0.15
S2	IoT services are built on top of strong standards and protocols.	4.71	4.85	0.14
S3	IoT infrastructures it is aligned with continuity of investment.	3.86	3.85	-0.01
S4	Ensure IoT services improve the organization's efficiency by being aligned with business needs.	4.71	4.85	0.14
S5	Predictive technologies to support decision makers.	4.29	4.28	-0.01
S6	Service delivery management to improve scalability.	3.71	3.71	0
C1	Integration of people in IoT.	4.29	4.28	-0.01
C2	Socio-technical skills to promote automation.	3.57	3.42	-0.15
C3	User experience to improve effectiveness.	4.29	4.14	-0.15
C4	Information skills for requirements analysis.	3.86	4	0.14
C5	Implementing people as an important role in IoT acceptance.	4.43	4.57	0.14

CHAPTER 5 – DEMONSTRATION AND EVALUATION

In order to demonstrate and evaluate our artefact an experienced IoT organization with several IoT projects was used as a validation case. In this case was used a semi-structured type for the interview where existed a questionnaire predetermined with the opportunity to give a comment if the recommendation was applied or not and if it worked and this facilitates the clarification of the questions. The aim of this demonstration is to verify if the organization used the proposed recommendations in their IoT projects as well as to validate if these recommendations improved their efficiency.

The questionnaire included fifteen questions to check if the organization used the recommendations mentioned in Table 20 and Table 21 during an implementation process of IoT. It was established a criteria to help the selection process of the interviewee which brings more value into this phase of the investigation.

- Work experience: Minimum 5 years working in the IoT domain.
- Size of the organization: Minimum 500 employees.
- Work domain: Project management.
- Knowledge domain: Deep understanding of the IoT domain and market.
- IoT experience: Work in several IoT implementation projects.

These criteria helped us to select the best interviewee for this assessment where it was possible to validate both the top 10 and the most efficient recommendations using the experience of an organization involved in several IoT projects. Table 22 lists the questions used in the interview to demonstrate and assess the recommendations collected from the Delphi phase.

Other tool that was used to demonstrate and evaluate the information from the research was the reviewer’s comments in the literature reviews which they were submitted as articles in journals. The comments from the journal reviewers were used in this chapter also because they validate and evaluate the information of the research in the scientific community which is very important to create ground bases for future researches in these domains. Further details regarding this validation are given later in the chapter.

Table 22 - Demonstration questionnaire

ID	Recommendation	Question
Q1	F5	Do you consider implementation of data privacy and data protection the most important to have in an IoT implementation?
Q2	F5	During an IoT implementation your organization paid attention to implement in the solution data privacy and data protection?
Q3	S2	During an IoT implementation your organization applied standards and protocols, and in what level?
Q4	C5	During an IoT implementation your organization considered the people as an integral part for IoT acceptance?
Q5	P5, P6	During an IoT implementation your organization had in account the data management and data analytics?
Q6	F2	During an IoT implementation you had to interact with other organizations and in what level?
Q7	F8	During an IoT implementation your organization used any governance framework?
Q8	P2	During an IoT implementation your organization tried to align the IoT processes with the business models?
Q9	O1	In the initial phase of the implementation it was made an attribution of roles, responsibilities and tasks to the people involved in the project?
Q10	F5, P9, O2, B2, I1, S2, C5	Do you consider that the recommendations from Table 20 help to increase the efficiency of an IoT implementation?
Q11	F10	Are end-to-end security principles used in the final solution?
Q12	O2	During an IoT implementation do you made an attribution of responsibilities between the people and the structures involved? Did increase the efficiency?
Q13	P9	Your organization did use application security management in an IoT implementation?
Q14	B2	During an IoT implementation did you try to introduce the culture and values of the organization to increase the acceptance and the efficiency?
Q15	I1	During an IoT implementation it was made an exchange of information obtained by IoT with other organizations? How it was done? Did increase the efficiency?

In the end of the interview the opinion of the interviewee was solicited regarding whether the most important recommendations and the most efficient recommendations obtained in the research made sense and if they were useful in an IoT implementation. The answer from the interviewee said “All recommendations mentioned in the top 10 recommendations are useful in an IoT implementation in order to bring more effectiveness of the solution and to meet the requirements requested by the customer during the implementation, also the recommendations mentioned as most efficient, our organization uses them all except B2 because the acceptance does not depend on meeting the culture and values”.

Table 23 includes the comments on each question from Table 22 made by the expert during the interview to perform the demonstration and validation of the Delphi results.

Table 23 - Questionnaire comments

ID	Recommendation	Comments
Q1	F5	“It is essential that this recommendation exist during an IoT implementation and after the implementation and our organization implements from the beginning of the implementation until the end solution.”
Q2	F5	“There is a constant worry and care to have this during an implementation.”
Q3	S2	“In our IoT implementations we normally use protocols in the levels of encryption, access and in data formatting and some example of protocols are AES, LoRa, IPSec, SSH, SHA and REST protocol.”
Q4	C5	“People are essential during the implementation and after the solution is implemented. In addition, it is important to consider that people and processes must be adaptive based on the solution. Therefore, we tried to include the stakeholders during the implementation process to leverage acceptance.”
Q5	P5, P6	“Yes, we use these recommendations and we put more emphasis on data identification and data validation because there is uncertainty in data obtained by the solution, so there must be several ways to test the data and to validate the data using data harmonization.”
Q6	F2	“If an organization desires to be alone in the IoT sector, it will not be successful. Thus, a partnership is essential during an IoT implementation. The interaction was made at the same level between organizations (IoT and data levels).”
Q7	F8	“Our organization didn’t use any governance framework during an IoT implementation, therefore this recommendation, in my perspective, is not useful.”
Q8	P2	“Yes, we tried to implement this recommendation, but the trend for the future is the opposite, because if the organization’s only focus is to align the IoT processes to the business models, it will lose scalability in IoT where, in the long term, it will not bring many benefits in terms of business to the organization.”
Q9	O1	“Normally the people already have their roles in the organization, we only make the adaption of processes and people only change tasks and not functions.”
Q10	F5, P9, O2, B2, I1, S2, C5	“The organization in the IoT implementation use all of the recommendations to bring more efficiency into the solution and we put more focus on the S2 recommendation “IoT services are built on top of strong standards and protocols”. In addition, the organization focused on the use of open standards in their IoT solutions.”
Q11	F10	“The organization implements this recommendation in all IoT solutions, rendering this principle native using IPv6.”
Q12	O2	“The organization tries to implement this recommendation but there is a flaw in the attribution of responsibilities which makes the IoT implementation less efficient due to a lack of responsibility in the new tasks of the people.”
Q13	P9	“The organization does not apply this recommendation in particular because the solution already has security tools that applied security management process.”
Q14	B2	“Any implementation of values and culture was not made in the IoT solution because the acceptance does not depend on meeting the culture and values, but instead depends on the effectiveness of the solution, therefore we do not implement this recommendation.”
Q15	I1	“We use this recommendation, but this exchange of information did not increase efficiency. It instead increases the credibility, due to the validation of data to support the decision makers in getting the right decisions for the business. Also, it increased the speed of acceptance and the priority level of IoT. This exchange of information between organizations always brings new ideas and new solutions.”

The artifact of this research was demonstrated and validated with success, because during the demonstration phase the recommendations from the Delphi were acknowledged by the interviewee and implemented by your organization showing that they are applicable and useful during an IoT implementation. The only recommendation that was stated as not applicable by his organization was B2, which is interesting to have this comment on the part of the interviewee saying that your organization does not implement its culture and values in the process of IoT acceptance.

The evaluation by the interviewee made it possible to state that the most efficient recommendations from Delphi study are all applicable and useful in an IoT implementation to increase the efficiency of the project and to create better IoT solutions. In addition, it was also verified that the top 10 recommendations are applicable and useful during an IoT implementation, except the recommendation F9 where the interviewee has no knowledge that the organization uses any governance framework application during an IoT implementation, therefore for the interviewee this recommendation is not necessary to be in the top 10.

In addition to give more relevance to the knowledge created in the research it was published three articles. These articles served to validate the research information among the scientific community. The information regarding the articles name, journals, the ranking of each journal and the status of each publication it is presented in Table 24.

The first publication is:

- **Article Name**: A systematic literature review - IT governance enablers
- **Journal**: Foresight and STI Governance
- **Ranking**: Q2
- **Status**: Accepted

The second publication is:

- **Article Name**: IT governance enablers in relation to IoT implementation: a systematic literature review
- **Journal**: Digital Policy, Regulation and Governance
- **Ranking**: Q2
- **Status**: Accepted

The third publication is:

- **Article Name**: IT governance enablers for an efficient IoT implementation
- **Journal**: Technology Analysis & Strategic Management
- **Ranking**: Q2
- **Status**: Submitted

The Annex H contains the reviewer's comments and the modifications made in the article by the researchers according to the reviewer's comments. The Annex H is regarding the SLR of the ITG enablers for IoT. It was very relevant having the first knowledge created in the first literature review being accepted by a journal in the scientific community, because gave us a ground base to continue the research using that knowledge.

The Annex I is about the SLR on the ITG enablers defined by the COBIT framework and contains the reviewer's comments and the modifications made in the article according to the reviewer's comments. It was very relevant having the first knowledge created in the second literature review being accepted by a journal in the scientific community, because gave us the validation to continue the research using that knowledge.

The comments (Annex H and Annex I) made by reviewers from each journal are a validation source for the research, because sustains the relevance of the information from this investigation in these domains under the scientific community. The comments made by reviewers demonstrated and validated with success the knowledge created in this research, because the articles were accepted in the respective journals. This concludes that this research brings added value into the literature where complements and gives a ground base for future researchers to continue the investigation in these domains.

CHAPTER 6 – CONCLUSION

This investigation aims to explore which ITG enablers are more suitable to be considered in an IoT implementation. Considering the seven ITG enablers mentioned by COBIT, an investigation was performed to explore how those enablers can help an IoT implementation project. The DSR methodology was followed including two SLRs, one Delphi study, and one interview. The main conclusions of this investigation are:

- The less relevant ITG enablers are “Culture, Ethics, and Behavior” and “Information”.
- “Principles, Policies and Frameworks” are pointed as the most important ITG enabler.
- The second most important ITG enabler is “Processes”.
- Focus from organizations in data from IoT devices.
- Implementation of roles and responsibilities in the persons assigned to the project.
- The most efficient recommendation is F5 “Implementation of data privacy and data protection.
- Collaboration between organizations is critical in IoT implementation
- IoT acceptance from people is important and should be enforced.

At the end, two ITG enablers are pointed out as being less relevant in an IoT implementation project: “Culture, Ethics, and Behavior” and “Information”. Such a conclusion is based on the absence of recommendations of those enablers in the defined top 10. and according to the rate of efficiency the maximum score in the group’s average was four in the Delphi results.

On the other hand, the most important ITG enabler that an organization should consider is “Principles, Policies and Frameworks”, since, considering four out of ten recommendations chosen by the participants and in terms of efficiency it also had the best score (4.71 out of 5) in the group’s average in the F5 recommendation. Overall, the more highly-scored recommendations in the ITG enabler “Principles, Policies and Frameworks” were data privacy and data protection, and the collaboration between organizations during an IoT implementation process.

According to the results, the second most important ITG enabler to be considered is “Processes” with three out of ten recommendations, because, it is possible to verify that two of these recommendations are co-related with the recommendation F5 about data from the ITG enabler “Principles, Policies, and Frameworks”, in how the organizations will work the data obtained by IoT. This co-relation is essential to producing good results in IoT because the processes of data management and data analytics are essential to identifying and validating the information from the data and the implementation of data privacy and data protection is absolutely necessary in order to increase the levels of credibility of the data.

Another key finding obtained from the results of the investigation is that it is very important for an organization to implement a clear attribution of roles and responsibilities to the people involved in the project, making individuals understand that is necessary to adapt their tasks to the IoT implementation and adapt the already existing processes in the organization in order to increase the efficiency of the implementation. In addition, the S2 recommendation, which obtained the second best score in the top 10 of recommendations will help organizations increase the efficiency of the implementation, taking a change in direction towards the use of open standards and protocols in the IoT solutions to bring more interoperability of the systems and also to ease the exchange of information between organizations.

Another conclusion that is observed during the investigation and validated in the final stage by the interview is the collaboration between organizations as mentioned in the F2 recommendation. It is essential that this exist in an IoT implementation and inside of an IoT solution. These collaborations in an IoT implementation are being more focused on the level of data where multiple organizations can access and use the data in order to retrieve valuable information and expand the necessary knowledge for their business. In addition, the organizations which have desire to work in silos, in the long term will not succeed, because the collaboration and, creation of partnerships between organizations increase the success rate of the IoT implementation.

The last key finding that is possible to take from this investigation is the people pose a considerable barrier to increasing the acceptance of IoT and it is suggested in the C5 recommendation to include people as part of the IoT acceptance, because after the IoT implementation according to the results of the interview they always create problems due to the data obtained by the IoT devices being abnormal to the patterns that they are used to dealing with in the past. This is a key point on which organizations should focus their attention towards the people and include them during the implementation process, to enable them to understand that these abnormal patterns always bring new ideas and new solutions into their business.

6.1. CONTRIBUTIONS

6.1.1. Implications for academics

This investigation obtained a clear vision where academia should focus more in future studies. The first contribution from this study is a more detailed definition for each ITG enabler defined by the COBIT framework. The second contribution from this study is the list of ITG enabler for IoT implementation. This list was elicited grounded on scientific information and tuned with practitioners' experience. By combining both sources of knowledge it increases the soundness of the artefact. Such list is a baseline that researchers may fine-tune in future investigations.

6.1.2. Implications for practitioners

For practitioners this investigation is relevant in the extent that the proposed list of recommendations may guide managers in an IoT implementation. The information created in this research gives one more reason to the organizations in implementing IT governance in their IoT projects and paying more attention in the relationship between these two domains. The list of recommendations according the efficiency and the top 10 most important can be used by the organizations as a guidance tool to help them during the implementation process but also during the planning phase of the IoT in their business. Plus, this list can help to increase both the success rate and the efficiency of the implementation.

6.2. LIMITATION OF THE STUDY

This investigation also has some limitations. The first limitation encountered was the scarcity of articles regarding ITG and IoT in literature which fulfilled the inclusion and exclusion criteria, especially articles ranked as Q1 and Q2 in Scopus. In the end, some ITG enablers had more information to work with than others. The other limitation was the difficulty into obtaining a significant number of participants in the Delphi study. However, an advantage in our Delphi study was that the number of participants never varied from the beginning until the end.

6.3. FUTURE WORK

Based on this investigation's outputs the following topics are proposed to be further explore by future researchers:

- Analyze case studies to further explore the implications of each proposed ITG enablers in an IoT implementation.
- Creation of more recommendations in the ITG enablers "Information" and "Culture, Ethics, Behavior" regarding IoT implementation.
- Exploring the suitability of the proposed (and future proposed ones) ITG enablers in relation to contingency factors to understand if they differ depending on the organizational context (Pereira & Mira da Silva, 2012).

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ANNEXES

ANNEX A

Annex A - Journals and conferences selection

Journal & Conference	References	Classification
Information Systems	(Cram et al., 2016) (Kude et al., 2017)	Q1
The Journal of Corporate Accounting & Finance	(Higgins & Sinclair, 2008)	Q1
International Journal of Disaster Risk Reduction	(Othman et al., 2014)	Q1
International Journal of Project Management	(Bernroider & Ivanov, 2011)	Q1
Information and Management	(Bernroider, 2008) (Kerr & Murthy, 2013)	Q1
European Journal of Information Systems	(Huang et al., 2010)	Q1
Journal of Management Information Systems	(Tallon et al., 2013)	Q1
Society and Natural Resources	(Lockwood et al., 2010)	Q1
Computers in Human Behavior	(Bin-Abbas & Bakry, 2014)	Q1
MIS Quaterly	(Wu et al., 2017)	Q1
Information Systems Frontiers	(Ali & Green, 2012)	Q1
Journal of Management Inquiry	(Beyer & David Niñ, 1999)	Q1
MIT Sloan Management Review	(Weill & Ross, 2005)	Q1
Corporate Governance	(Spremić, 2009)	Q1
Journal of Management Studies	(Tsoukas & Vladimirou, 2001)	Q1
Strategic Information Systems	(Queiroz et al., 2018)	Q1
International Journal of Accounting Information Systems	(Bowen et al., 2007) (Prasad et al., 2012)	Q2
Information Systems Management	(Simonsson et al., 2010) (Simon et al., 2007)	Q2
Communications of the Association for Information Systems	(De Haes, 2008)	Q2
Hawaii International Conference on System Sciences	(De Haes & Van Grembergen, 2008) (Heier et al., 2007)(Heier et al., 2008) (Fink & Ploder, 2008) (Joshi et al., 2018)	A
Portland International Center for Management of Engineering and Technology Conference	(Simonsson & Ekstedt, 2006)	A

ANNEX B

Annex B - References classification and citations

References	Citations	Classification	Count
(Ali & Green, 2012) (Bernroider & Ivanov, 2011) (Bin-Abbas & Bakry, 2014) (Bowen et al., 2007) (Cram et al., 2016) (Heier et al., 2007) (Huang et al., 2010) (Kerr & Murthy, 2013) (Kude et al., 2017) (Higgins & Sinclair, 2008) (Othman et al., 2014) (Prasad et al., 2012) (Queiroz et al., 2018) (Spremić, 2009) (Simonsson et al., 2010) (Tsoukas & Vladimirou, 2001) (Weill & Ross, 2005) (Wu et al., 2015)	*3507*	Q1	*18*
(Bernroider, 2008) (Lockwood et al., 2010) (Tallon et al., 2013) (Simon et al., 2007)	*516*	Q2	*4*
(Beyer & David Niñ, 1999) (De Haes & Van Grembergen, 2008) (Fink & Ploder, 2008) (Heier et al., 2008) (Joshi et al., 2018) (Simonsson & Ekstedt, 2006)	*222*	A	*6*
None	*0*	B	*0*

ANNEX C

Annex C - Journal and conferences selection

Journal & Conference	References	Classification
IEEE Internet of Things Journal	(Keoh et al., 2014)(Shen et al., 2018)	Q1
Journal of Business & Industrial Marketing	(Jayashankar et al., 2018)	Q1
Government Information Quarterly	(Chatfield & Reddick, 2018) (Wirtz et al., 2018)	Q1
Journal of Marketing Management	(De Cremer et al., 2017)	Q1
Future Generation Computer Systems	(Gubbi et al., 2013)	Q1
Journal of Intelligent Transportation Systems	(Vlahogianni et al., 2016)	Q1
IEEE Communications Magazine	(Zhang et al., 2017)	Q1
International Journal of Production Research	(Zdravković et al., 2018)	Q1
Telematics and Informatics	(Shin, 2014)	Q1
Policy and Internet	(Van Deursen & Mossberger, 2018)	Q1
Business and Information Systems Engineering	(Wortmann & Flüchter, 2015)	Q2
Concurrency Computation Practice and Experience	(Piccialli & Chianese, 2017)	Q2
Computer Law & Security Review	(Weber, 2009)(Weber, 2013)	Q2
Computer Networks	(Roman et al., 2013)	Q2
Digital Policy, Regulation, and Governance	(Shin & Jin Park, 2017)	Q2
Enterprise Information Systems	(Verdouw et al., 2018) (Mendhurwar & Mishra, 2019)	Q2
IEEE Internet Computing	(Abobakr & Azer, 2017)(Almeida et al., 2015) (Almeida et al., 2018) (Almeida et al., 2017) (Cao et al., 2016) (Yao et al., 2015) (Wen et al., 2017)	Q2
International Journal of Communication Systems	(Ding et al., 2013)	Q2
Journal of Decision Systems	(Linger & Hevner, 2018)	Q2
Personal and Ubiquitous Computing	(Carretero & García, 2014) (Pasquier et al., 2018)	Q2
Software: Practice and Experience	(Dautov et al., 2018)	Q2
Conference on Computer Science and Electronics Engineering	(Suo et al., 2012)	A
Computer Society Conference on Human-Computer Interaction	(Bowen et al., 2017)(Cervantes-Solis & Baber, 2017)	A
International Conference on Human Factors in Computing Systems	(Soro et al., 2017)	A
IEEE 2nd World Forum on Internet of Things	(Neisse et al., 2015)	B
IEEE International Conference on Mobile Data Management	(Truong et al., 2015)	A2
Conference on Emerging Technologies and Factory Automation	(Derhamy et al., 2015)	B1

ANNEX D

Annex D - References classification and citations

References	Citations	Classification	Count
(Van Deursen & Mossberger, 2018) (Shin, 2014) (Zdravković et al., 2018) (Zhang et al., 2017) (Vlahogianni et al., 2016) (Gubbi et al., 2013) (De Cremer et al., 2017) (Chatfield & Reddick, 2018) (Wirtz et al., 2018) (Jayashankar et al., 2018) (Keoh et al., 2014)(Shen et al., 2018)	*5691*	Q1	*12*
(Abobakr & Azer, 2017)(Almeida et al., 2015) (Almeida et al., 2018) (Almeida et al., 2017) (Cao et al., 2016) (Carretero & García, 2014) (Dautov et al., 2018) (Ding et al., 2013) (Linger & Hevner, 2018) (Mendhurwar & Mishra, 2019) (Pasquier et al., 2018) (Piccialli & Chianese, 2017) (Roman et al., 2013) (Shin & Jin Park, 2017) (Verdouw et al., 2018) (Yao et al., 2015) (Weber, 2009)(Weber, 2013) (Wortmann & Flüchter, 2015) (Wen et al., 2017)	*459*	Q2	*20*
(Bowen et al., 2017) (Cervantes-Solis & Baber, 2017) (Suo et al., 2012) (Soro et al., 2017)	*364*	A (ERA)	*4*
(Neisse et al., 2015)	*10*	B (ERA)	*1*
None	*0*	A1 (Qualis)	*0*
(Truong et al., 2015)	*3*	A2 (Qualis)	*1*
(Derhamy et al., 2015)	*83*	B1 (Qualis)	*1*

ANNEX E

ANNEX E - Delphi Questionnaire Round 1

STEP 1 **Personal data**	Instruction 1: Please do provide some personal data about your function. This information will only be used by the researchers in order to better understand and interpret the results.

Name	
Function name	
Profile (business, IT, consultant, manager)	

STEP 2 **Input on IT governance enablers in IoT**	Instruction 2: The list below provides recommendations that an organisation can use to implement IT governance components during a IoT implementation, the components are categorised in seven domains: principles, policies, frameworks; processes; organisational structures; culture, ethics, behavior; information; services, applications, infrastructures; people, skills, competencies. **Review the list** of proposed recommendations IT governance enablers in IoT for completeness, **add** your feedback on each recommendation and **add** additional examples of components and objectives on the seven categories according to your professional experience.

Instruction 3:
- Please do complete this survey for your own specific environment and professional experience.
- Rate in terms of agreement ALL recommendations in a IoT implementation, using a score between 1 (strongly disagree) and 5 (strongly agree).

Components	ID	Recommendations	Rate	Feedback
Principles, Policies, Frameworks	F1	Promote interoperability via decentralization.		Detail: Opinion:
	F2	Promote collaboration between organisations.		Detail: Opinion:
	F3	Implementation of trust.		Detail: Opinion:
	F4	Implementation of transparency.		Detail: Opinion:
	F5	Implementation of data privacy and data protection.		Detail: Opinion:
	F6	Implementation of accountability.		Detail: Opinion:
	F7	Interiorization of risk management.		Detail: Opinion:
	F8	Cooperation between organizations in building policies.		Detail: Opinion:
	F9	Governance Framework Application.		Detail: Opinion:
	F10	Strategic policies to promote innovation.		Detail: Opinion:
	F11	Include users' privacy issues in IoT policies.		Detail: Opinion:
	F12	Operation Principles are aligned with IoT procedures.		Detail: Opinion:
	F13	Include Cybersecurity and digital policies in IoT policies.		Detail:

				Opinion:
	F14	Governance Framework guides management team in IoT implementation.		Detail: Opinion:
	F15	*<add new if required>*		Detail: Opinion:
	F16	*<add new if required>*		Detail: Opinion:
	F17	*<add new if required>*		Detail: Opinion:
Processes	P1	Strategy processes to coordinate IoT processes.		Detail: Opinion:
	P2	Business processes to align IoT processes with business models.		Detail: Opinion:
	P3	Governance processes to decompose and decentralize the business processes.		Detail: Opinion:
	P4	Information processing towards business decisions.		Detail: Opinion:
	P5	Implementing a sound data management process.		Detail: Opinion:
	P6	Implementation of data analytics process.		Detail: Opinion:
	P7	Implementing application management process to promote scalability.		Detail: Opinion:
	P8	Implementing application monitoring process to guarantee business continuity.		Detail: Opinion:

	P9	Implementation of application security management in development process.		Detail: Opinion:
	P10	*<add new if required>*		Detail: Opinion:
	P11	*<add new if required>*		Detail: Opinion:
	P12	*<add new if required>*		Detail: Opinion:
Organisational Structures	O1	Attribution of roles, responsibilities and tasks in IoT.		Detail: Opinion:
	O2	*<add new if required>*		Detail: Opinion:
	O3	*<add new if required>*		Detail: Opinion:
	O4	*<add new if required>*		Detail: Opinion:
Culture, Ethics, Behavior	B1	Spread social culture in IoT implementation.		Detail: Opinion:
	B2	Organisation’s culture aligns with identity, autonomy and trust protection of IoT users.		Detail: Opinion:
	B3	Organisation’s implements his culture and values in IoT acceptance.		Detail: Opinion:
	B4	Ethics integrates social behaviors, privacy and integrity in IoT implementation.		Detail: Opinion:
	B5	Implementation of awareness in people’s attitude and motivation.		Detail: Opinion:

	B6	*<add new if required>*		Detail: Opinion:
	B7	*<add new if required>*		Detail: Opinion:
	B8	*<add new if required>*		Detail: Opinion:
Information	I1	Information research techniques for IoT support.		Detail: Opinion:
	I2	*<add new if required>*		Detail: Opinion:
	I3	*<add new if required>*		Detail: Opinion:
	I4	*<add new if required>*		Detail: Opinion:
Services, Applications, Infrastructures	S1	IoT services promotes sustainability.		Detail: Opinion:
	S2	IoT services are built on top of strong standards and protocols.		Detail: Opinion:
	S3	IoT infrastructures it is aligned with continuity of investment.		Detail: Opinion:
	S4	Ensure IoT services improve organisation's efficiency by being aligned with business needs.		Detail: Opinion:
	S5	*<add new if required>*		Detail: Opinion:
	S6	*<add new if required>*		Detail: Opinion:

	S7	*<add new if required>*		Detail: Opinion:
People, Skills, and Competencies	C1	Integration of people in IoT.		Detail: Opinion:
	C2	Socio-technical skills to promote automation.		Detail: Opinion:
	C3	Implementation of strategic skills for goals guidance.		Detail: Opinion:
	C4	Implementation of information skills for requirements analysis.		Detail: Opinion:
	C5	Implementation of organization skills to improve decision making.		Detail: Opinion:
	C6	Implementing people as an important role in IoT acceptance.		Detail: Opinion:
	C7	*<add new if required>*		Detail: Opinion:
	C8	*<add new if required>*		Detail: Opinion:
	C9	*<add new if required>*		Detail: Opinion:

ANNEX F

ANNEX F - Delphi Questionnaire Round 2

STEP 1 **Personal data**	Instruction 1: Please do provide some personal data about your function. This information will only be used by the researchers in order to better understand and interpret the results.

Name	
Function name	
Profile (business, IT, consultant, manager)	

STEP 2 **Input on IT governance enablers in IoT**	Instruction 2: The list below provides recommendations that an organisation can use to implement IT governance components during a IoT implementation, the components are categorised in seven domains: principles, policies, frameworks; processes; organisational structures; culture, ethics, behavior; information; services, applications, infrastructures; people, skills, competencies.

Instruction 3:
- Please do complete this survey for your own specific environment and professional experience.
- **Rate** in terms of **Efficiency** ALL recommendations in an IoT implementation, using a score between 1 (not efficient) and 5 (very efficient).
- **Provide** the **top 10** most important components, that you consider essential to have in an IoT implementation. Give the most important component score 1, the second most important score 2, … the 10th most important score 10.

Components	ID	Recommendations	Rate	Top 10
Principles, Policies, Frameworks	F1	Promote interoperability via decentralization.		
	F2	Promote collaboration between organizations.		
	F3	Implementation of trust.		
	F4	Implementation of transparency.		
	F5	Implementation of data privacy and data protection.		
	F6	IoT agile principles.		
	F7	Interiorization of risk management.		
	F8	Governance Framework Application		
	F9	Strategic policies to promote innovation.		
	F10	End-to-End security principles.		
	F11	Data audit principle.		
	F12	Operation Principles are aligned with IoT procedures.		
	F13	Include Cybersecurity and digital policies in IoT policies.		
Processes	P1	Strategy processes to coordinate IoT processes.		
	P2	Business processes to align IoT processes with business models.		
	P3	Problem identification processes.		
	P4	Information processing towards business decisions.		
	P5	Implementing a sound data management process.		
	P6	Implementation of data analytics processes.		
	P7	Implementing application management process to promote scalability.		
	P8	Implementing application monitoring process to guarantee business continuity.		
	P9	Implementation of application security management in development process.		
	P10	Digitalization processes.		
Organisational Structures	O1	Attribution of roles, responsibilities and tasks in IoT.		
	O2	Implementation of accountability.		
	O3	Responsabilization assignment matrix.		
Culture, Ethics, Behavior	B1	Organisation's culture aligns with identity, autonomy and trust protection of IoT users.		
	B2	Organisation's implements his culture and values in IoT acceptance.		
	B3	Ethics integrates social behaviors, privacy and integrity in IoT implementation.		
	B4	Implementation of awareness in people's attitude and motivation.		
Information	I1	Data exchange between organizations.		
Services, Applications, Infrastructures	S1	IoT services promotes sustainability.		
	S2	IoT services are built on top of strong standards and protocols.		
	S3	IoT infrastructures it is aligned with continuity of investment.		
	S4	Ensure IoT services improve organisation's efficiency by being aligned with business needs.		
	S5	Predictive technologies to support decision makers.		
	S6	Service delivery management to improve scalability.		
People, Skills, and Competencies	C1	Integration of people in IoT.		
	C2	Socio-technical skills to promote automation.		
	C3	User experience to improve effectiveness.		
	C4	Implementation of information skills for requirements analysis.		
	C5	Implementing people as an important role in IoT acceptance.		

ANNEX G

ANNEX G - Delphi Questionnaire Round 3

STEP 1 **Personal data**	Instruction 1: Please do provide some personal data about your function. This information will only be used by the researchers in order to better understand and interpret the results.

Name	
Function name	
Profile (business, IT, consultant, manager)	

STEP 2 **Input on IT governance enablers in IoT**	Instruction 2: The list below provides recommendations that an organisation can use to implement IT governance components during a IoT implementation, the components are categorised in seven domains: principles, policies, frameworks; processes; organisational structures; culture, ethics, behavior; information; services, applications, infrastructures; people, skills, competencies.

			Instruction 2 **Considering the group's average, re-evaluate your rating for the degree of Efficiency of ITG enablers recommendations in an IoT implementation. (1 = not efficient, 5 = very efficient**			Instruction 3 **Considering the group's average, re-evaluate your top 10 most important ITG enablers recommendations in an IoT implementation. Give the most important recommendation score, …, the 10th most important score 10.**		
Components	**ID**	**Recommendations**	**Your rating**	**Group's average**	**New rating**	**Your rating**	**Group's average**	**New rating**
Principles, Policies, Frameworks	F1	Promote interoperability via decentralization.						
	F2	Promote collaboration between organizations.						
	F3	Implementation of trust.						
	F4	Implementation of transparency.						
	F5	Implementation of data privacy and data protection.						
	F6	IoT agile principles.						
	F7	Interiorization of risk management.						
	F8	Governance Framework Application						
	F9	Strategic policies to promote innovation.						
	F10	End-to-End security principles.						
	F11	Data audit principle.						
	F12	Operation Principles are aligned with IoT procedures.						
	F13	Include Cybersecurity and digital policies in IoT policies.						
Processes	P1	Strategy processes to coordinate IoT processes.						
	P2	Business processes to align IoT processes with business models.						
	P3	Problem identification processes.						
	P4	Information processing towards business decisions.						
	P5	Implementing a sound data management process.						
	P6	Implementation of data analytics processes.						
	P7	Implementing application management process to promote scalability.						
	P8	Implementing application monitoring process to guarantee business continuity.						
	P9	Implementation of application security management in development process.						
	P10	Digitalization processes.						
Organisational Structures	O1	Attribution of roles, responsibilities and tasks in IoT.						
	O2	Implementation of accountability.						
	O3	Responsabilization assignment matrix.						
Culture, Ethics, Behavior	B1	Organisation's culture aligns with identity, autonomy and trust protection of IoT users.						
	B2	Organisation's implements his culture and values in IoT acceptance.						

	B3	Ethics integrates social behaviors, privacy and integrity in IoT implementation.						
	B4	Implementation of awareness in people's attitude and motivation.						
Information	I1	Data exchange between organizations.						
Services, Applications, Infrastructures	S1	IoT services promote sustainability.						
	S2	IoT services are built on top of strong standards and protocols.						
	S3	IoT infrastructures it is aligned with continuity of investment.						
	S4	Ensure IoT services improve the organization's efficiency by being aligned with business needs.						
	S5	Predictive technologies to support decision makers.						
	S6	Service delivery management to improve scalability.						
People, Skills, and Competencies	C1	Integration of people in IoT.						
	C2	Socio-technical skills to promote automation.						
	C3	User experience to improve effectiveness.						
	C4	Implementation of information skills for requirements analysis						
	C5	Implementing people as an important role in IoT acceptance.						

ANNEX H

Reviewer comments to the paper
"IT governance enablers for IoT implementation: a systematic literature review"

1. Originality: Does the paper contain new and significant information adequate to justify publication?
Reviewer Comment: As this paper is a systematic literature review it does not necessarily present new information per se; however, one could argue that synthesizing a review from prior literature is sufficiently novel. Answer: We agree with the reviewer since a good SLR can provide value by itself as it strengthens the field of study (like we believe that we did in this research).
2. Relationship to Literature: Does the paper demonstrate an adequate understanding of the relevant literature in the field and cite an appropriate range of literature sources? Is any significant work ignored?
Reviewer Comment: The paper reports a literature review based on the results of a structured search of academic literature. The coverage seems to be mostly complete, although I have noticed a couple of omissions: Yang D., Liu F., Liang Y. (2010) A Survey of the Internet of Things, Proceedings of the 1st International Conference on E-Business Intelligence (ICEBI2010).European Commission (2008) Early Challenges regarding the "Internet of Things". Answer: Thanks for sharing with us these references. We have read these papers and added some new text to the Introduction Section based on them.
3. Methodology: Is the paper's argument built on an appropriate base of theory, concepts, or other ideas? Has the research or equivalent intellectual work on which the paper is based been well designed? Are the methods employed appropriate?
Reviewer Comment: The structured literature review method employed in this paper is sound and rigorous and has been implemented well. There is a small weakness in that it only considered academic journals and conferences, which led to the omission of other relevant sources such as the 2008 white paper published by the European Commission noted above. Answer: This is an important comment. Since we are talking about a mainly academic journal, we focused on more academic papers. However, and based on the previous comment, we also added this European Commission white paper to the references section.
4. Results: Are results presented clearly and analyzed appropriately? Do the conclusions adequately tie together the other elements of the paper?
Reviewer Comment: The results are presented in a logical sequence. The discussion section does not attempt to compare and contrast, or even relate, the different sources to one another. The findings from different sources for each are category are merely reported in a sequential fashion. This detracts from the paper somewhat and is a missed opportunity – it is generally interesting in literature reviews to identify areas of consensus and areas of disagreement, but this paper has not done this. (I would recommend that a revised version does so!)

Answer: Thanks for your comment. We improved the Discussion Section to address this concern.
5. Implications for research, practice and/or society: Does the paper identify clearly any implications for research, practice and/or society? Does the paper bridge the gap between theory and practice? How can the research be used in practice (economic and commercial impact), in teaching, to influence public policy, in research (contributing to the body of knowledge)? What is the impact upon society (influencing public attitudes, affecting quality of life)? Are these implications consistent with the findings and conclusions of the paper?
Reviewer Comment: The paper purports to make a series of recommendations (Table 9); it is regrettable that many of these are not recommendations at all, but merely brief statements of a domain in which a recommendation could be made. For instance, "data analytics", "data management", "application monitoring", strategic policies", information processing", strategic skills", "organization skills", etc. etc. are not recommendations. I suggest the authors re-write Table 9 to make it clear exactly what is being recommended. (A good rule-of-thumb for these recommendations might be that each of them at the very least needs to include a verb!) Answer: We agree that Table 9 deserves a better explanation. Therefore, we tried to improve the list of recommendations to address your concern.
6. Quality of Communication: Does the paper clearly express its case, measured against the technical language of the field and the expected knowledge of the journal's readership? Has attention been paid to the clarity of expression and readability, such as sentence structure, jargon use, acronyms, etc.
Reviewer Comment: I understand the challenges writing in a language which is not your native tongue and congratulate the authors for their effort. However, that said the document would benefit a great deal from proof-reading by an English language native speaker, or at least somebody with established fluency in English. Answer: We tried to improve the text quality by using an English proofreading service.

ANNEX I

Reviewer comments to the paper
"IT governance enablers: A systematic literature review"

Abstract: it is worth giving objectivity to the research (specify the research question), and clearly define the relevance (for example, focus the work more accurately — the current version presents a wide range of technologies which further is not specified). It is needed to describe the methodology (for example, specify what constitutes "high quality scientific researches"; which sources are used to determine "among literature"), clarify the authors' input and the practical value of the research (since the current formulations are quite general: for example, "define the scope of their problems, proposals").

Answer: We agree with the comments from the reviewer and we performed the changes as suggested.

Introduction: when first mentioning specific terms, it is worth determining them (ITG, COBIT, SLR, etc.). To justify the relevance, the authors often refer to (Higgins & Sinclair, 2008), however, more than 10 years have passed. The authors describe in general terms the added value of the work ("bring clarification on each ITG enable"), however the work would have clearer framework if the authors could visualize their IT enablers classification results by demonstrating how these elements relate to each other. The structure of the article does not correspond to the one presented in the introduction (for example, the "background" section is missing; the "results" section is duplicated twice).

Answer: We made the corrections in this section as suggested by the reviewer.

Methodology: the section should contain a description of the methodological basis that will justify the selection of sources and criteria for the selection of journals, since WoS or Scopus databases are used most actively for such literature reviews. If to anticipate the results and see Tables 5-6, then there is a need to provide a histogram with the distribution of sources by year. The choice of criteria for final filtering of journals is not obvious, as a result of which only 8% of the initially selected sources remain. At the same time, if you pay attention to the distribution of sources by keywords, it turns out that most of the keywords are represented only in two sources. In addition, there is a conflict with the name of the work: since the term "IT governance enablers" is found in only one source. Moreover, the consistency of the set of sources after filtering is doubtful. For example, after the third filtering (based on the abstract which should reflect the research question) there are no sources that mention "IT governance enablers", and only one such source is observed in the final filtering. Thus, after a detailed study of the table 3, it seems that a very narrow topic has been chosen that is not properly reflected in the literature, and the criteria for creating samples after applying the filter are not consistent with each other. In table 4 it is necessary to substantiate the choice of these three criteria for analyzing the quality of the article. In addition, it is worth clarifying the third question — what is meant by the value of each work (how is it evaluated and what concepts are we talking about). In Table 7, it is worth using a breakdown at the level of each work. In addition, it is worthwhile to build semantic maps (networks) to show the continuity of research and what works are cited by whom.

Answer: We agree with the comments from the reviewer and we performed the changes as suggested.

Results: analytics is very scarce; analysis of the results is needed. The order of the elements in the table 8 is inconsistent with the test that describes this table. There is no connection between the selection of keywords and the justification for the selection of ITG enablers (Table 8 and Table 3). When describing the elements of ITG enablers, the structure is not clear: in the text there is a sharp transition from sources dating back to 2005 to modern works and back. Apparently, the authors tried to define the terms with reliance to the problem-oriented approach, but this approach was not properly implemented. There is no author viewpoint on the presented definitions of the elements of ITG enablers.

Answer: We agree with the comments from the reviewer and we performed the changes as suggested.

Conclusions: it is worth making this section more applied and focused on a scientific article, and not on a report on analytical work, in the framework of which all goals are achieved. The second point is that there is no description of the research limitations in the work, and the directions for further research are formulated quite ambiguously (although the abstract contains a clear reference to the authors' contribution to the definition of the research agenda).

Answer: We took in regarding the comments of the reviewer and we added more information regarding the research limitations.