A technological framework for building a learning organization

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Abstract

Recent decades have seen a dramatically accelerating pace in the development and adoption of new technologies, reshaping the workplace by integrating multiple aspects of an organization. These aspects can vary from business processes to workforce processes, such as learning and collaborating.

All organizations learn, and almost every day, new technologies promise to help companies to achieve every kind of competitive advantage. However, the real challenge is the commitment to learning, guaranteeing continuous improvement, and addressing gaps, like the time to produce, interpret and manage knowledge, and enhance learning using information technology, pursuing what is known as a learning organization.

A successful learning organization must have successfully integrated technology to create, share, and provide a learning environment and allow clear communication among its workforce or event with its competitors.

The absence of clear identification and definition of information technologies that can facilitate an organization to become a learning organisation, lead to a proposal of specific dimensions that constitute a framework that can, in a coherent, consistent, and suitable manner, ultimately help the organization adapt, change, and obtain a competitive advantage.

To derive this conceptual framework, data from the literature review was used for the first proposal of this framework. It was then validated by performing a survey research methodology using a questionnaire, including only closed-ended questions to gather information, from the employees of a financial organization.

Through the analysis of the questionnaires, it was possible to verify that the proposed framework is viable.

Keywords: *Learning Organization, Technology, Framework, Learning Management, Digital Learning*.

Resumo

Nas últimas décadas assistiu-se a uma aceleração dramática no desenvolvimento e adopção de novas tecnologias, reformulando o local de trabalho através da integração de múltiplos aspectos de uma organização. Estes aspectos podem variar desde processos empresariais a processos laborais, tais como a aprendizagem e a colaboração.

Todas as organizações aprendem, e quase todos os dias, as novas tecnologias prometem ajudar as empresas a alcançar todo o tipo de vantagem competitiva. Contudo, o verdadeiro desafio é o verdadeiro compromisso na aprendizagem, garantindo a melhoria contínua, e a resolução de lacunas, como o tempo para produzir, interpretar e gerir o conhecimento, e melhorar a aprendizagem utilizando a tecnologia da informação, perseguindo o que é conhecido como uma *learning organization*.

Uma *learning organization* bem sucedida deve ter integrado com êxito tecnologia para criar, partilhar e proporcionar um ambiente de aprendizagem e permitir uma comunicação clara entre a sua força de trabalho ou evento com os seus concorrentes.

A ausência de uma identificação e definição clara das tecnologias de informação que podem facilitar uma organização a tornar-se uma *learning organization*, foi identificada a necessidade de uma proposta de dimensões específicas que constituem uma *framework* que pode, de uma forma coerente, consistente e adequada, ajudar a organização a adaptar-se, a mudar e a obter uma vantagem competitiva.

Para desenvolver esta *framework* conceptual, foram utilizados dados da revisão bibliográfica para a primeira proposta desta *framework*. Foi então validada através da realização de uma metodologia de pesquisa de inquérito utilizando um questionário, incluindo apenas perguntas fechadas para recolher informações, dos funcionários de uma organização financeira.

Através da análise dos questionários, foi possível verificar que a *framework* proposta é viável.

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Palavras-chave: *Learning Organization, Tecnologia, Framework, Gestão de Formação, Aprendizagem Digital*

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List of Abbreviations

Abbreviation	
BI	Business Intelligence
DM	Data Mining
ICT	Information and Communication Technologies
IT	Information Technology(ies)
KM	Knowledge Management
KMS	Knowledge Management System
LCMS	Learning Content Management System
LMS	Learning Management System
LO	Learning Organization
LR	Literature Review
OL	Organizational Learning

1 Introduction

No one can dispute the impact that technological innovations have had on our lives, especially the rapid development of information technology.

Technology is present in every aspect of an organization, whatever area of activity this organization operates in. Either at an academic level or even at a corporate level through the most varied tools, is considered to be the most important ingredient for managing organisational knowledge [1].

Also, the effective implementation of technology in an organisation leads to a decisive competitive advantage [2].

In a 2018 Deloitte [3] report on learning, leadership and legacy, one of the key challenges remained buying/implementing the "right" technology

1.1 Overview

Organizations are constantly confronted with change [4], so learning better and faster is important to remain relevant and thrive or even survive [5].

An organization might decide to become fully committed to defining processes for creating, acquiring, and transferring knowledge, and modifying its behaviour to reflect new knowledge and insights. As such, allowing to function successfully in a rapidly evolving business environment that includes continual mergers, rapid technological advances, massive social change, and a world of increasing global competition [6], This summarizes the definition of a learning organization (LO), that will be explored in depth in chapter 2.

Many studies have shown that organizations that have this kind of commitment will be more prepared to change, survive or even be ahead of their competitors [7][8].

A great number of employees, during their professional experience, realize that most organizations, if not all, have an enormous emphasis on learning, training, and retaining knowledge [8].

The knowledge can be *tacit* (extremely hard to capture and share) or *explicit* (data that is already processed, organized, structured, and interpreted, and that can be easily articulated, recorded, communicated, and stored).

In a certain way, there was a shift from knowledge management to learning management [9]. However, most of the time, the tools to enable this kind of action were lacking, have not lived up to their expectations, or had a very steep learning curve that eventually led to poor user adherence and usage [10].

Suppose a learning organization is considered something that requires a great effort to be accomplished [8]. In that case, it turns out that certain types of technologies can be seen as an important set of drivers or facilitators to accomplish this commitment.

1.2 Research Problem

As the 21st century unfolds, organizations will not be able to expand into new markets and be competitive unless they have the technologies to learn systematically and effectively using their past knowledge and changing their behaviour according to that same knowledge and learned lessons.

Many organizations claim to have initiated measures to convert their organizations from a traditional model to a learning model.

As previously mentioned, it was defined as a research problem, the absence of clear identification and definition of information technologies to create an adequate framework to facilitate an organisation to become a learning organisation.

Hence mapping the motivations indicated above with the absence, of information technologies that can efficiently accelerate the learning process, the knowledge sharing.

1.3 Purpose

This paper addresses the apparent void regarding the required or suitable information technologies for an organization by establishing a technological framework. It also sets up guidelines for building a set of technologies to help achieve and maintain a learning organization status.

The following research question was identified: ***Which technological dimensions can the current main information technologies (IT) support or facilitate in becoming a Learning Organization?***

With this main question and to fully understand the relevant technological dimensions, we have also identified the following sub-question: ***What are the main IT tools relevant for a LO?***

1.4 Scope and Delimitations

The evolving definition of a learning-organization paradigm can be examined along three dimensions: social, structural, and technological.

This study focused on the latter, providing a technological perspective on a LO. Having the right technological tools in place is important but creating a sustained learning impact requires more than technology.

A holistic framework, technologies, people, processes, and methodologies must function as a whole.

The usage of information technology (IT) is not considered vital to becoming a LO but facilitates in many aspects and frees up people to do important tasks rather than waste time assessing how to access information and how and where to store it.

1.5 Dissertation outline

This dissertation is organized, structured, and divided into 6 chapters:

- Chapter 1 presents an overview of the subject discussed in this study, the purpose, and some delimitations that were taken into consideration. This chapter also includes this section that presents an overview of the structure of this dissertation.

- Chapter 2 presents the theoretical framework, with the most important concepts and themes related to this study. It begins by presenting what many authors consider to be the definition of a LO and the concepts and topics about the differentiation between organizational learning and LO. In the next chapter, we also analyze some important technologies and technological innovations (subchapters 2.4 and 2.5) that will serve as guidelines for the technological aspects.

- Chapter 3 presents the literature review performed for this study, the protocol followed, the existing research frameworks (subchapter 3.4.1), and other important findings in the literature. These findings relate specifically to IT tools (subchapters 3.4.2 and 3.4.3).

- Chapter 4 presents an initial framework proposal (subchapter 4.2) organized including the four dimensions (subchapters 4.2 to 4.6), developed for a LO after a literature review.

- Chapter 5 presents the research methodology for this study based on the survey strategy to obtain the final framework proposal. We also explain our approach to the methodology used in this study (subchapter 5.3) and more details about how we selected the population for the methodology (subchapter 5.4). The development of the questionnaire is also presented (subchapter 5.5) as the instruments (subchapter 5.6) used to perform the questionnaire and how the data was collected (subchapter 5.7).

- Chapter 6 presents the extraction of the data from the previous chapter. We begin by analyzing the characteristics of the population (subchapter 6.1). We also present the questionnaire results for each of the four dimensions (subchapter 6.2) initially proposed and discuss the results (subchapter 6.3), which suggests that some improvements are needed in the initial framework.

- Finally, in Chapter 7, the study concludes with a discussion of future research possibilities and considerations.

2 Theoretical Background

This literature review highlights the following important terms and concepts that were required to have a greater depth for this study during the definition of this framework: *Learning organization (LO); Organizational Learning; Knowledge management (KM); knowledge management system (KMS); Learning Management Systems (LMS) and Business Intelligence (BI).*

In the next sections, we will present an overview of each of the concepts and terms reviewed in the existing literature.

2.1 Learning Organization

This section describes concisely how the construct differs from organizational learning. It then presents various definitions of this concept and how to build a LO. Many authors have different definitions for a LO, but we will try to cover all the important aspects of this definition in the next section.

2.1.1 Defining Learning Organization

The concept of a LO has been around since the ’90s [11] and has maintained its relevancy throughout the years (see Figure 1).

Although the recognition of the concept of organization-wide learning, or simply organizational learning, can be traced to the 1940s [12], it was not till the 1980’s that organizations began to realize their true potential for increasing organizational success [13]. The term “**learning organization**” evolved out of the term “organizational learning” but is very similar and sometimes used interchangeably [14].

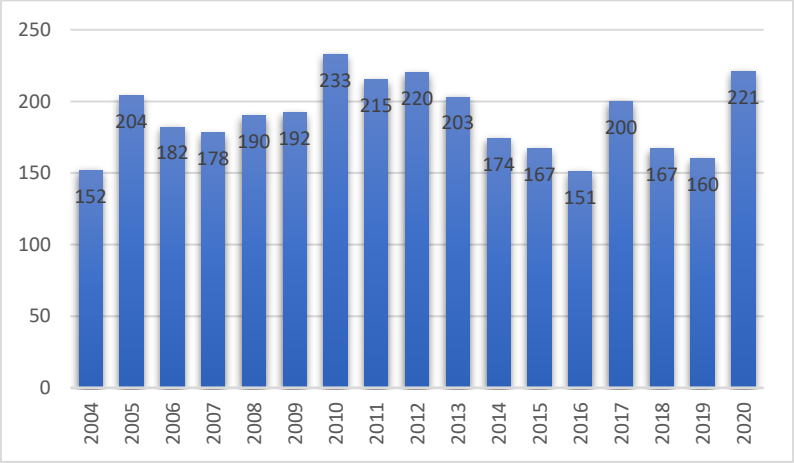

Figure 1 - Number of articles referring to "Learning Organization" from SCOPUS

To describe this relationship, the LO is good at organizational learning [14] and implemented in the

organization's processes [15]. There are various definitions of this concept (**Table 1**), but learning processes in an organization do not instantly provide an organization with a LO status. It is an evolving concept, an idea, and a never-ending quest [12].

Table 1. Definitions of the Learning Organization.

Author(s)	Definitions
Pedler et al. (1989) [16]	An organization that facilitates the learning of all its members and consciously transforms itself and its context
Senge (1990) [11]	An organization where people continually expand their capacity to create the results they truly desire, where new and expansive patterns of thinking are nurtured, where collective aspiration is set free, and where people are continually learning how to learn together.
Garvin (1993) [7]	An organization skilled at creating, acquiring, and transferring knowledge and at modifying its behaviour to reflect new knowledge and insights
Marquardt (2002) [17]	An organization of this type possesses the ability to continuously adapt, renew, and revitalize itself in response to the changing environment
Brower (2008) [18]	[An] organization [that] constantly adapts to changing environments and uses the knowledge of employees to create competitive advantages.
Gagnon (2015) [18]	is an organization that exhibits adaptability, learns from mistakes, explores situations for development, and optimizes the contribution of its personnel.

2.1.2 Becoming a Learning Organization

As explained in the previous section, an organization is never considered a LO in crystalized condition, but in reality, an organization is always becoming a LO [19].

Table 2 – Sixteen Steps in Building a Learning Organization - Marquardt [19]

1. Commit to becoming a learning organization.
2. Form a powerful coalition for change.
3. Connect learning with business operations.

4. Assess the organization’s capabilities on each Systems Learning Organization model subsystem.
5. Communicate the vision of a learning organization.
6. Recognize the importance of systems thinking and action.
7. Leaders demonstrate and model commitment to learning.
8. Transform the organizational culture to one of continuous learning.
9. Establish corporate-wide strategies for learning.
10. Reduce bureaucracy and streamline the structure.
11. Extend learning to the entire business chain.
12. Capture learning and release knowledge.
13. Acquire and apply the best technology to the best learning.
14. Create short-term wins.
15. Measure learning and demonstrate learning successes.
16. Adapt, improve, and learn continuously.

Initiatives such as continuous process improvement (see **Table 2**) are just part of a LO's goal to have everyone in the organization learn as much as possible to increase performance and productivity [20]. Maintaining this learning momentum is perhaps the biggest challenge.

Becoming a LO requires three fundamental **building blocks** [21]:

1. A supportive learning environment. This environment must allow employees to make mistakes, present alternative ideas, and take risks to bring innovative approaches without being cast aside.
2. Concrete learning processes and practices. The generation, collection, interpretation, and sharing of information are vital for a LO. By experimenting and using it to solve problems, create new services/products, or keep track of competitors, clients, and technological trends, this knowledge is a key factor for an organization to thrive.
3. Leadership behaviour. If a leader actively questions, listens and is open to dialogue, employees feel prone to learn or share their tacit knowledge, thus reinforcing learning.

We can identify three subsystems, knowledge, people, and organization, with these building blocks. A LO values this role through an inspiring vision of learning and national effectiveness.

It proves that this kind of learning can play a role in the organisation's development, and this kind of learning strategy will support the organization in realizing its vision.

A LO needs people to be curious about their work and constantly use experience-based change theories to test these in practice with their colleagues [22]. These change theories will actively reflect on their own experience and development. In short, it requires those who are willing to contribute with their knowledge.

To expand and protect employee investment, LOs need to pay special attention to the development and

retention of employees. Closely related to staff development and retention is the importance of recognition and motivation for learning. The LO ensures that the time and energy spent on effective knowledge management and learning is regarded as the core activity of the organization's time and performance management system [23].

Rewarding people who contribute to learning and knowledge development can be more conventional (such as career development, increased income, and higher formal status) [22] or less conventional (such as informal peer status, time available for learning, or contribution to innovation is publicly recognized).

In every LO, knowledge is a vital asset. Since learning is both a product of knowledge and a source of knowledge, LO's recognize the inextricable links between the two and manage them accordingly And the importance of strong and resilient organizational memory.

The LO ensures that individuals and teams are encouraged to use multiple methods to show their tacit knowledge and provide it to others through carefully targeted documentation and collaborative work practices.

Also, Marquardt [17] highlighted that technology is another key subsystem (**Figure 2**) that will be described in greater depth in the next sections.

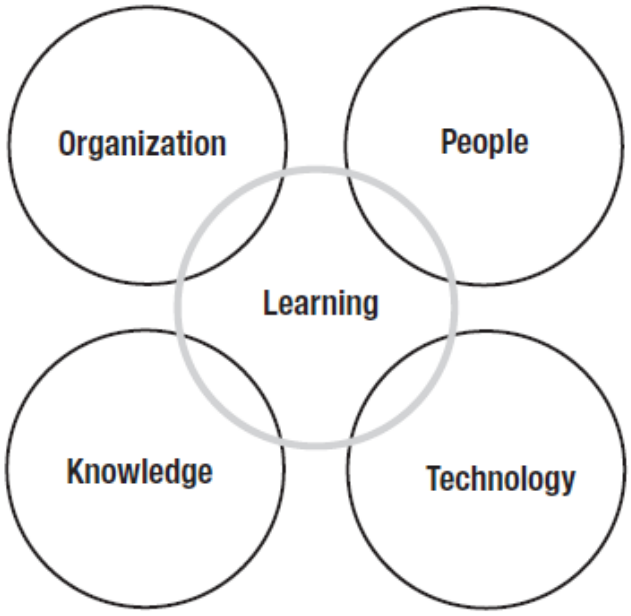

Figure 2 - Systems Learning Organization Model [24].

Technology plays an important role in all the subsystems. For example, communication systems promote the horizontal transfer of information and knowledge in the formal structure, encourage horizontal

communication, and overcome the growing dangers created by silos for decentralized and geographically spread organizations.

LO need to know how to adapt learning methods to develop this embedded knowledge by deploying the necessary systems and infrastructure for knowledge management and allowing documentation to be accessible to others in the organization with user-friendly information and communication technologies.

Finally, sufficient opportunities are provided for employees to learn how to use available information and communication technologies for knowledge management and learning in a learning organisation.

2.2 Organizational Learning vs Learning organization

Much discussion around these two concepts has occurred in the past few decades, and sometimes both concepts are used interchangeably (see Table 3). However, there is some consensus about a basic distinction.

Table 3 - Differences between organizational learning and learning organization. [25]

	Organizational Learning	**Learning Organization**
Focus	Processes	Organization form
Approach	Descriptive	Normative
Aim	Theory building	Increasing the organizational performance
Existence	Exists naturally, neutral	Needs activity, preferable
Key question	How does an organization learn?	How should an organization learn?
Target group	Academics	Practitioners / Consultants
The result of learning	Potential behaviour change	Existing behaviour change
Learning-performance relation	Positive or negative	Expected to be positive

Organizational learning is a multilevel process, as it occurs across the individual, group, and organizational levels through intuiting (tacit knowledge acquired by recognizing a pattern or possibilities and developing insights based on a personal experience), interpreting (explaining, through words and/or actions, of an insight or idea from an individual to others), integrating (develop shared understanding among individuals and of taking coordinated action through mutual adjustment), and institutionalizing(embed learning that has occurred by individuals and groups into the organization) [26].

These four subprocesses are closely related to the SECI Model [27] (Figure 3). It is a purposeful process

designed and sustained by inspired leadership. It may be an adaptive process based on single-loop learning, or a generative process based on double-loop learning, in concordance with their effect on inputs (single-loop learning) and governing variables (double-loop learning) [28].

Organizational learning and learning organization represent conceptual metaphors that help us understand the interactions between different knowledge fields within an organization and the relationships between these phenomena and the company's economic performance.

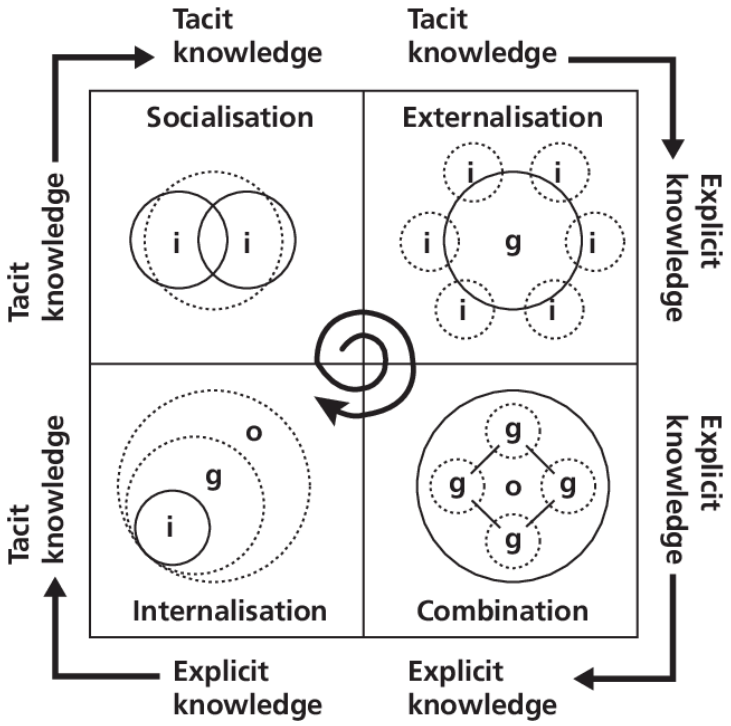

Figure 3 - Nonaka SECI Model [29].

Organizational learning represents a learning process using social interactions across individuals, groups, and organizational levels, leading to a change in the organization's mental models, rules, processes, or knowledge [30], based on detection and correction.

As a result of organizational learning, an organization can adapt faster and better to the external environment requirements. Organizational learning can be conceived as a sequence of four interactive processes: intuiting, interpreting, integrating, and institutionalizing.

These processes are responsible for knowledge creation and transformation from individual knowledge into organizational knowledge. Although research so far concentrated on cognitive knowledge, organizational learning embraces all three fundamental forms of knowledge: cognitive, emotional, and spiritual. Organizational learning is based on reinforcing feedback and balancing feedback and feed-forward reaction.

These interactions between inputs and outcomes have been structured into single-loop and double-loop

learning, in concordance with their effect on inputs (single-loop learning) and governing variables (double-loop learning). Organizational learning involves symmetry in organizational unlearning [28]. Learning new skills, new methods, new processes, new technologies or developing new strategies for realizing a competitive advantage implies at the same time discarding some of the old knowledge and unlearning those things that might become resistant in the learning process. Both processes are intertwined dynamically and use organizational memory, another conceptual metaphor used in organizational knowledge dynamics.

While the OL is about building theory and understanding how an organization should learn, LO is about action geared to achieve creativity and an ideal [15], maximizing learning and using the knowledge to change organizational behaviours.

A LO refers to a type of organization in and of itself as opposed to OL. It is described as a certain type of activity where employees act based on experience and knowledge they gather through day-to-day activities to handle various business situations[14].

An organization able to integrate all processes of organizational learning into a whole structural process aiming at creating a sustainable competitive advantage becomes a learning organization, to continuously expand its capacity [31] and create and facilitate its future as a competitive organization [28][32]

2.3 Knowledge Management

A simple way of describing KM is that it is a process of creating, storing/retrieving, sharing/transferring, and applying knowledge [33] and an organisation's information. These subprocesses can be further subdivided into creating internal knowledge, acquiring external knowledge, storing knowledge in physical and digital documents versus storing in routines, updating the knowledge, and sharing knowledge internally and externally [33].

Organizational knowledge creation involves developing new content or replacing existing content within the organization's tacit and explicit knowledge. Through social and collaborative processes and an individual's experiences and cognitive processes (e.g., perception), knowledge is created, reviewed, updated, and justified in organizational settings [27].

After this creation, storing and retrieving this knowledge is extremely important, constituting organizational memory and preserving it using information technologies, such as databases, digital documents, and others [34].

A few decades ago, the different modes of knowledge conversion were brought to light using a model, or spiral, known as the SECI model. This model of knowledge creation explains how tacit and explicit knowledge is converted into organizational knowledge

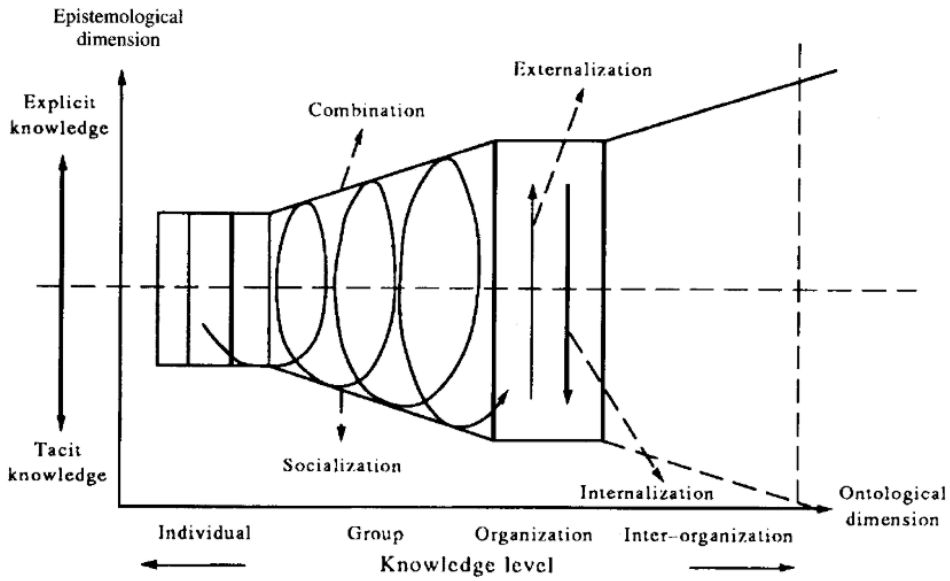

Figure 4 - Spiral of Organizational Knowledge Creation [27]

This model was a spiral (Figure 4), that views organizational knowledge creation as a continual interchange between the tacit and explicit dimensions of knowledge and a growing flow as knowledge moves through an individual, group, organizational, and sometimes even inter-organizational levels.

Four modes of knowledge creation have been identified: *socialization, externalization, internalization, and combination* (hence the name SECI model, regarding the first letter of each mode of knowledge creation) [27].

The ***socialization*** mode refers to converting tacit knowledge to new tacit knowledge through social interactions and shared experiences among individuals, especially if they are part of a team or in a particular field of interaction.

The ***combination*** mode is creating new explicit knowledge by merging, categorizing, reclassifying, and synthesizing existing explicit knowledge collected inside or outside the organization (e.g., building prototypes).

The other two modes, externalization and internalization, involve interactions and conversion between tacit and explicit knowledge.

Externalization refers to converting tacit knowledge to new explicit knowledge, using, among other ways, a dialogue or collective reflection. This process facilitates the dissemination throughout the organization [35], as tacit knowledge has been converted into documents, books, articles, and web pages.

Internalization refers to creating new tacit knowledge from explicit knowledge and personal experience. Knowledge is acquired from real-world experiences and through simulation and experimentation in which knowledge is acquired from the virtual world.

A similarly broad definition state that KM "is managing the corporation's knowledge through a systematically and organizationally specified process for acquiring, organizing, sustaining, applying, sharing and renewing both the tacit and explicit knowledge of employees to enhance organizational performance and create value."[36]

2.4 Information Technology and Learning Organization

As a result of the great emergence of the internet, increasingly faster and globally available digital devices such as smartphones and tablets, and the evolution of information technologies, it is becoming obvious that using these tools in the different sectors represents a great opportunity to develop them.

In our everyday life, almost all questions related to communication and management include some computer technology commonly known as Information and Communication Technologies (ICT).

Many authors consider technology one of, if not the most, important pillar for managing organizational knowledge and subsequently lay the ground for a LO [20] [37] [38].

Organizations that harness technology to enhance their learning capacity have a real competitive advantage over those still using relatively “Stone Age” tools.

These technologies consist of supporting, integrated technological networks and information tools that enable access to and exchange of information and learning.

They also include technical processes, systems, and structures for collaboration, coaching, coordination, and other knowledge skills. It also comprises various electronic tools and advanced methods such as computer conferences, simulation, and computer-supported collaboration. All these elements combined create knowledge freeways.

ICT can be constructed and deployed in an organization to strengthen the organizational memory (either by only storing it or even process-specific outcomes) and enhances continuous learning.

Such technology can provide tools (see Table 4), that will enhance individual, team, organizational and inter-organizational knowledge sharing for maximum improvement. Consequently, these technologies/systems extensively use organizational knowledge to affect shared understanding and learning.

Table 4 - Common IT tools used for different knowledge conversion methods. [31]

Knowledge Conversion Mode	IT Categories	IT Tools
Socialization	Videoconferencing Electronic discussion, E-mail	Social networks Forums Communities of practice Groupware • Group decision support systems Conference systems Chat groups IPTV
Externalization	Expert system Chat groups Best practices and lessons learned from databases	Expert Systems Blogs Wikis Decision support system Business modelling Knowledge warehouses Cognitive mapping tools IPTV
Combination	Databases Web-based access to data data mining repositories of information Web portals	Wikis Content management systems Databases Data warehouses OLAP analytical solutions Business intelligence Data mining Statistical analysis Machine learning Neural networks Artificial intelligence systems Case-based reasoning systems Intranets Genetic algorithms
Internalization	Computer-based communication AI-based Knowledge acquisition Computer-based simulation	E-learning Using the above tools

2.4.1 Knowledge Management Systems

As discussed in the previous sections, becoming a LO is a captivating endeavour to transform an organization into employees skilled at creating, acquiring, and transferring knowledge and knowledge sharing, one of the building blocks of a LO [21].

Knowledge management (KM) was already known as the mantra of modern organizations seeking to survive in a constantly evolving and increasingly competitive world.

KM refers to identifying and leveraging the collective knowledge in an organization to help the organization compete[33].

Knowledge management systems (KMS) allow firms to manage their knowledge resources. It is relatively easy to understand the importance of KM. By motivating the creation, dissemination, and application of knowledge.

KM processes help the “organization embed knowledge into organizational processes so that it can continuously improve its practices and behaviours and pursue the achievement of its goals” [44].

This last definition is fundamentally a definition for a LO. We can say that if a LO is a system, then KM is a subsystem. KM and LO cannot survive without the other [45].

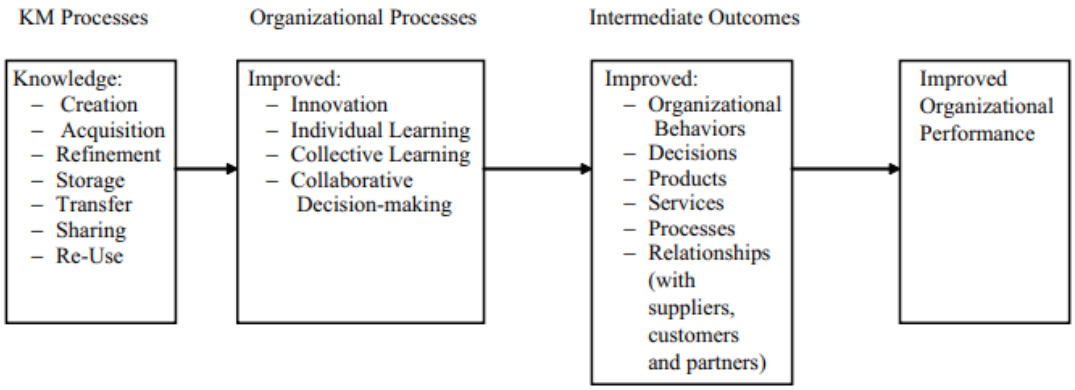

Figure 5 - KM in an Organization. [44]

Initially, KM approaches focused on knowledge as objects that could be organized to support decision making, and KMS were seen as tools to manage codified knowledge.

Most of the KM projects were initiated and driven by top management [46]. However, this approach has changed over the years, and now KM occurs in the different layers of an organization.

As KM focused on knowledge as objects, KMS typically focused on explicit knowledge. However, increasing attention is given to how KMSs might support tacit knowledge capture and transfer [47].

The precise extent to which a KMS can help capture, transfer, and enhance tacit knowledge is a lengthy topic. However, a successful KMS implementation must strongly emphasise this type of knowledge by focusing on management, employees, and processes.

Regarding tacit knowledge, one of the terms that were identified in the LR is “Conversational KM” [46]. This term relates to an approach that emphasizes sharing tacit knowledge through ongoing exchanges within workgroups, either in discussion forums, instant messaging, Weblogs, podcasts, or wikis.

All these tools are collaborative and can assist in creating and sharing knowledge through conversations. Even some of them (e.g. Cisco Webex) have some functionalities that allow real-time closed captions as the conversations occur.

Everyone stays updated on the ongoing activities of business operations. These activities have reduced the mess of unnecessary meetings, calls, and tedious e-mails, eventually saving time that can be utilized more productively at the workplace.

A wiki, when used within organizational settings, is a conversational KMS [87] designed for open KM [46]. It is a Web-based application that allows users to collectively author documents, such that the most recent version reflects the cumulative contributions of all the authors [51].

Although wikis have the potential to alleviate the knowledge acquisition bottlenecks associated with

traditional KMS [70], for wikis to succeed, users must share their knowledge and participate in the collaborative authoring process.

It follows, then, that we need to understand the motivational dynamics that drive user participation within conversational KM, particularly within the context of wikis.

Table 5 - Different types of support for knowledge management [88]

AI-based	**Conventional**
Case-based reasoning	Bulletin boards
Data mining	Computer-supported co-operative work
Expert systems	Databases
Genetic algorithms	Data warehousing
Intelligent agents	Decision support systems
Knowledge-based systems	Discussion forums
Multi-agent systems	Document management
‘‘Push’’ technology	Electronic publishing
	E-mail
	Executive information systems
	Groupware
	Information retrieval
	Intranets
	Multimedia/hypermedia
	Natural language processing
	People finder/‘‘Yellow Pages’’
	Search engines
	Workflow management

Reviewing the literature discussing applications of KMS initiatives reveals three common applications[33]:

1. Codify, store, and share best practices, enhancing better decision-making,
2. Create corporate knowledge directories, also referred to as the mapping of internal expertise or learning from past mistakes,
3. Create knowledge networks, enabling organization-wide access to information.

The extent of tools available in the market is extensive and sometimes overlaps with LMS which will be explained in the following section.

2.4.2 Learning Management Systems

A Learning Management System (LMS) is a web-based software application designed for administration, documentation, and delivery of educational content, student interaction, assessment tools, tracking, and reporting learning progress and student activities.

An LMS replaces isolated and dispersed fragments of learning programs [48]with a systematic assessment of the organization's workforce.

As the KMS, LMS can help increase the performance throughout the organization [49] by offering a strategic IS a planning solution, delivering, and managing all learning events, mainly focused on online content [50].

While KMS are specifically designed to facilitate the sharing and integration of 'knowledge', LMS is designed to maximize learning within the organization [48].

Both these systems share many similarities, but it is important to outline that LMS and KMS are used for two different goals[51].

The goal of an LMS is to enhance the learning process, not only delivering content but also enabling a skill gap analysis and enabling tracking and reporting of the learning path.

An LMS uses technologies, including discussion boards, chat environments, self-diagnostic quizzes, multimedia, audio, or video facilities [52], so the users can interact with the learning resources.

There are two main categories of LMS, open-source and commercial. Each organization must assess and compare its advantages and disadvantages to choosing either an open-source or a commercial platform.

Each platform has its benefits and advantages, so LMS platforms should be chosen based on the needs of the users but also focused on the organizational goals for that platform.

Commercial LMS may be easy to develop and use but have a high initial cost[53]. Meanwhile, open-source LMS is free, but support, new releases, and improvements are highly dependent on a community and can be considered inferior to a commercial solution.

The crucial factor that affects user satisfaction is that the features available in an LMS meet their needs and facilitate its use. For example, integrating an e-learning system with other complementary systems is a strength of an e-learning system [54].

An information management system provides systematic and interactive elements that can easily be

managed in the LMS and are supported by its flexibility and student-centeredness. It is thus able to provide a more meaningful learning experience for students.

The features described can impact the selection of an LMS by an organization. These characteristics are extremely important for the human resources or training staff to know to make the right choice of the platform that will meet the needs of the employees.

Each LMS has different characteristics, so to choose which system to use, every criterion needs to be analyzed according to the needs of the users and the course. A few basic but important steps must be performed when choosing an LMS [55].

From the management or organization point of view, the **first step** is to evaluate if either deploys this platform on-premises or is hosted in a cloud provider. It is related to the ability of an organization to have a physical structure (datacentre, servers, computers, networking) to deploy this platform and the know-how to have some elements or a team to administer the platform.

The **second step** is to think about the goals and objectives of the organization but also the needs of users and courses to achieve a holistic alignment between them. This step is very important to engage the employees in an early stage, both from a learner and from an administrative perspective, so that the needs are correctly met and contribute to having a successful result.

The **third step** is to consider the features for which the LMS was developed.

The **fourth step** is to ensure that the LMS has all the essential features identified previously like flexibility, to combine, and integration with other systems, and is user-friendly in a way that helps employees easily manage their learning and personal needs but at the same time meet the organizational goals.

An evaluation of the LMS platforms then needs to be done. For example, if only a one-course leader is responsible for sending and editing the content, perhaps only a cheap system is needed.

2.4.2.1 LCMS

Learning content management systems (LCMS) and Learning management systems (LMS) generally have common futures but are considered two different systems. The key difference between them is that the primary objective of an LMS is to manage learners, keeping track of their progress and performance across all types of training activities. By contrast, an LCMS manages content or learning objects, and the user is the content creator [56] instead of the learner in the LMS.

LCMS is an education perspective of a Content Management System (CMS), a tool based on web technology that provides an environment for creating, accessing, editing, and managing learning content in a friendly, reliable, and secure way.

Table 6 - Comparison of LMS and LCMS. [57]

Features	LMS	LCMS
Content creation and management	-	R
Course Catalogue	R	L
Portfolio management)	L	R
Instructor-led sessions management	R	-
A searchable library of reusable content	-	R
Registration system	L	R
HRM application integration	R	-
Competence management	R	L
Assessments management	L	R
Location-based aware delivery of content	-	R
Collaboration and communication	L	R
Planning tools	R	L

R = Robust functionality L = Limited functionality

An LMS provides an instructor with a way to monitor and assess student participation and performance. The LMS thus mainly manages the students and learning events and collects data about the learner's progress. Moodle (Williams [1]) is an example of such an LMS.

On the other hand, the main components of a Learning Content Management System are an authoring application (editor), a learning objects repository (LOR), a dynamic delivery interface, and a set of administration tools.

An LCMS is a multi-user environment where the e-learning developers can create, store, reuse, manage, and deliver digital learning content from a central object repository.

Some existing LCMS are iTutor, and ePath Learning ASAP. The main difference between LMS and LCMS is that LMS focuses more on the student while an LCMS focuses more on the learning content.

2.4.2.2 Distance learning technologies

The term "*distance learning*" has evolved to describe other forms of learning, e.g. online learning, e-learning, technology, mediated learning, online collaborative learning, virtual learning, and web-based learning.

The introduction of ICTs to training has led to the concept called e-learning, which is nowadays more familiar to almost everyone.

A clear definition for this term is that e-learning is technology-based learning in which learning materials are delivered electronically to the remote learner via a computer network. Defined as a fusion between multimedia (sound, image, text) and the Internet (online distribution, interactivity), e-learning has become a new breath for distance learning to make up for its shortcomings in terms of easy access, educational or competitive needs [79][80].

This form of learning has also become part of a pillar in almost every organization, in a manner to quickly address either organizational matters, such as training to use an enterprise tool that has become available to some or all employees, or just to keep their workforce up to date in specific skills.

In addition, the dematerialization of the workplace has been an important driver for the expansion of e-learning platforms in corporate environments. Many concepts have derived from this “umbrella” concept, specifically the blended-learning (b-learning), mobile learning (m-learning), and massive open online courses (MOOCs).

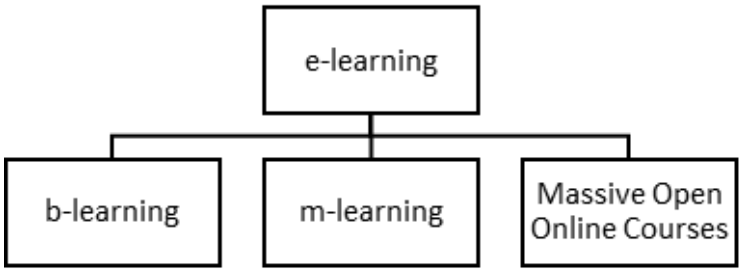

Figure 6 - Derivatives of the e-learning concept

Massive Open Online Course (MOOC) is an open-access platform where anyone with an internet connection can enrol in an online course[81]. The delivery of learning material is mainly video lectures designed to keep students’ views in mind [20].

Most of the courses offered are free and can prove a critical medium for providing education in remote areas where enough expertise is unavailable.

It is considered one of the biggest advances in distant learning by providing quality e-learning from eminent experts without reduced cost.

Most MOOC platforms are designed so that they mimic the traditional features of pedagogy in electronic form [82].

Professionals, who are not in the situation to attend classes at a specific location daily, could find e-learning a great opportunity to enhance their knowledge and skills.

2.4.3 Business Intelligence

There are many definitions for BI. Although it dates to the 1950s, BI is essentially a framework of processes, tools, and techniques that gather, change, and present organized information from various sources to enable greater efficiency in the management decision-making process [58].

This concept is intrinsically related to the technology required to reduce the required time to acquire important business data in enormous volumes of data. A lot of scattered data is available, is gathered, analyzed, and builds the knowledge used to make plans [2].

In a decision-support context, business intelligence systems emerged as a promising technological solution with a wide range of analytical capabilities to provide stakeholders at various organizational levels with valuable information for their decision-making.

When properly used, business intelligence systems assist management in developing a data-based decision-making environment that provides more consistent results compared to non-business intelligence methods

The leading purposes of implementing business intelligence systems are to increase the level of information quality provided to knowledge workers at various levels of an organization [59] and to improve inter-organizational business processes, especially those operating in real-time [60].

A business intelligence (BI) system needs to analyze large amounts of data, information, or knowledge ad-hoc fashion (Figure 7). It is closely linked to knowledge management, which integrates the subprocesses of knowledge creation, enabling access to knowledge and the use of knowledge [61].

Access to knowledge is made possible by the appropriate technology, contributing substantially to knowledge management in a company.

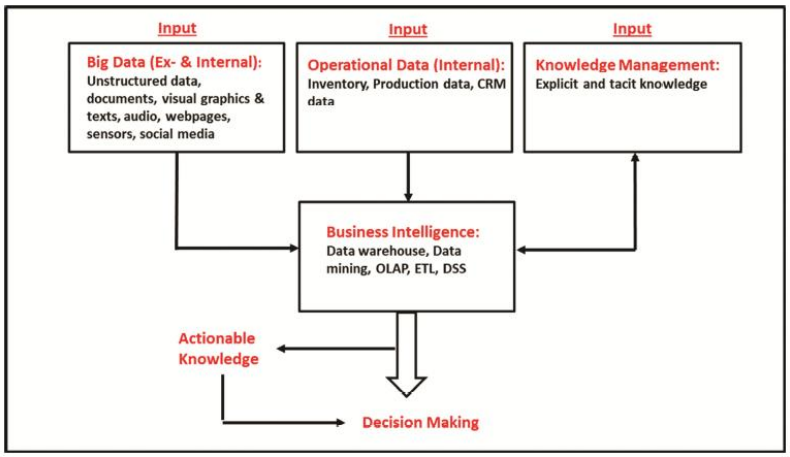

Figure 7 - Proposed inputs/model for improving decision-making [62]

In general terms, the definition of (BI) is intrinsically related to IT, where a lot of scattered data is available, gathered, analyzed, and builds the knowledge used to make plans [2].

Knowledge comprises the information generated from the data about customers, competitors, business partners, and the organization's workforce.

2.5 Technological innovations

The technological advances needed to build **learning platforms** with a personalized recommendation of **learning content and relevant knowledge** are becoming a reality.

As we enter the so-called web 4.0, where artificial intelligence gains a continuously increasing momentum, these platforms are designed to make content recommendations based on the users' past courses, behaviours, roles, and interests.

With artificial intelligence, we are also starting to move past mere content recommendations but also enable to connect learners to relevant people and discussions.

With the right combination of hand-picked data and real-time analysis through artificial intelligence, companies can quickly react to new information and keep personalized content and connection recommendations as relevant and timely as possible to enhance learning and competitive advantages.

This section will provide an **overview** of some of the current topics and the possibilities these innovations allow, especially in the context of Learning Technologies and Learning Systems.

2.5.1 Big Data

The term Big Data (BD) is an abstract concept that refers to data (structured, unstructured, and semi-structured) – generation, acquisition, storage, and analysis - that is so large, fast, and complex that is considered impossible to process without the use advanced techniques and technologies [63]. These characteristics are considered the initial three "v's" (volume, velocity, and variety) when this concept first emerged, but there are many other "V's" that have been added to this concept.

The emergence of the BD concept in the recent years has significantly changed Business Intelligence (BI) and Business Analytics (BA), as it represents new and unusual sources of data (e.g. social media, IoT sensors), advanced technologies (e.g., Apache Hadoop architectures, visualization, predictive analytics), and new requirements of user skills (e.g., data scientists).

Over the past decades, IT and digital data have contributed a lot to improving the profitability of business departments [64]. Harvesting and analyzing even more volume of relevant data for business activities is a competitive advantage and can potentially enhance profitability even further.

With so much information available, having appropriate tools and technologies to deal with BD can help businesses speed up their decision-making processes while still being confident in their choice.

In addition, BD can be applied to learning because an LMS generates tons of data and can help organizations improve their “learners” needs. It could help monitor learning progress, detect potential problems or areas for improvement, and discover learning patterns or others.

They could also assess the usefulness of learning materials, help struggling learners, and allow the creation of personalized experiences. The users can tailor their learning experience to their preferences and adapt their needs based on their performance.

Organizations can extract valuable information and patterns that may affect business through big data analytics [65]. Thus, advanced data analysis is needed to identify the relations between features and forecast future observations.

Big data analytics refers to techniques applied to achieve insights from huge datasets [65]. The big data analytics results can improve decision-making and increase organizational efficiency. Various analytical approaches are developed to extract knowledge from the data, such as:

- Descriptive analytics is concerned with analyzing historical data of a business to describe what occurred in the past [66].
- Predictive analytics is focused on a variety of statistical modelling and machine learning techniques to predict future possibilities [66].
- Prescriptive analytics include descriptive and predictive analytics to recommend the most appropriate actions to enhance business practices [66].

Learning optimization – Big data means that companies can monitor several data points on an individual level of learning and can better optimize documentation, courses, and other learning material based on the data source, improve productivity, extend the learning material's lifespan, and reduce the obsolescence of the learning assets.

As explained in the previous section, Big data can also contribute to organizations helping organizations cut down their expenses on new knowledge or other learning documents, platforms, or applications.

From analyzing their usage to evaluating the effectiveness of staff learning patterns, data collected by organizations can help them identify where they can make cost savings without harming important factors such as tolerance, fostering an open discussion environment, and continuously enabling staff to think holistically.

2.5.2 Artificial Intelligence and Machine Learning

The rise of Artificial Intelligence (AI) in recent years and its development in many knowledge fields is due to three key factors: significant volume of data (Big Data), improved algorithms, and substantially

better access to computational hardware or resources.

The term Big Data (BD), as explained in the previous sections, is an abstract concept that refers to data (structured, unstructured, and semi-structured) – generation, acquisition, storage, and analysis - that is so large, fast, complex that is considered impossible to process without the use advanced techniques and technologies.

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This concept has a major impact on the fundamental of the traditional BI and KM processes. Using AI algorithms for various advanced analytical approaches are developed to extract knowledge from the data, such as:

- Descriptive analytics is concerned with analyzing historical data of a business to describe what occurred in the past, seeking to answer questions such as “What happened” and “Why did it happen”[67].
- Predictive analytics is focused on a variety of statistical modelling and machine learning techniques to predict future possibilities [68][18].
- Prescriptive analytics include descriptive and predictive analytics to recommend the most appropriate actions to enhance business practices [67]. “What should be done” and “why should it be done.”

Currently, in organizational contexts, AI can be considered a technology that has been introduced as a means of emulating human performance with the potential to draw its conclusions through learning which can aid human cognition or even replace humans in tasks that require cognition [69].

AI technologies generally enable performance improvements in speed, flexibility, customization, scale, innovation, and decision-making.

Machine Learning (ML) is a subfield of AI. It focuses on using data, particularly BD, as discussed in the previous section, to make predictions and uncover key insights within data mining projects. These insights subsequently drive decision-making processes within organizations, influencing business value and key growth metrics. Machine Learning applications are enormous but especially relevant by increasing workplace efficiency, as the resulting automation of repetitive tasks, thus saving time that can be used for learning purposes.

Another relevant application is the ability to extract information from unstructured data, for example, in

multimedia content [70],

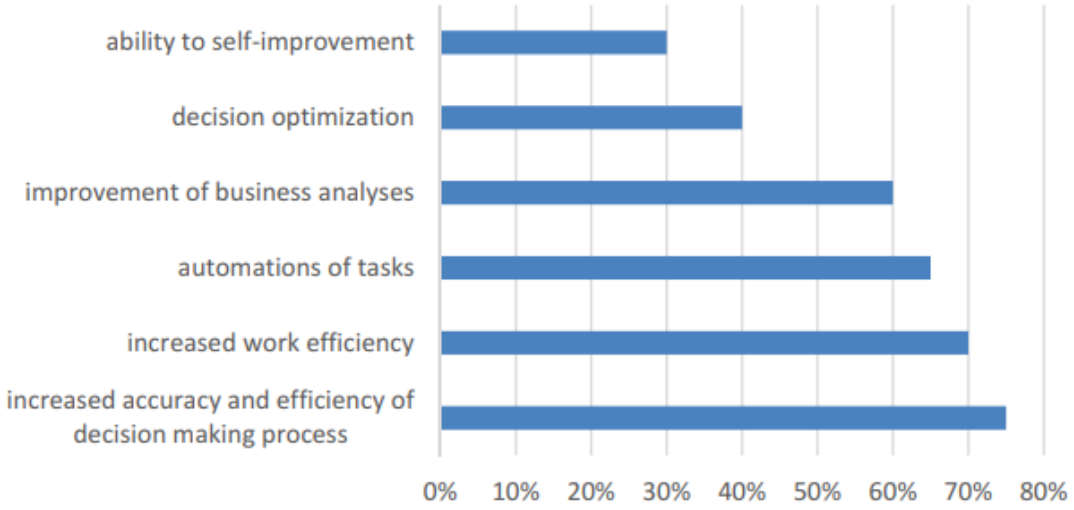

Figure 8 - Advantages resulting from the application of ML in a business organization[71]

Machine Learning is expected to handle explicit knowledge well and a certain level of tacit knowledge, as the algorithms involve learning by experience. The machine learning algorithm can integrate or capture tacit knowledge by having a human provide supervised learning (**Error! Reference source not found.**).

2.5.3 Cloud Computing

In the previous sections, some concepts seemed only possible to be built by large organizations, but that paradigm has also changed significantly in recent years.

Cloud computing is an Internet-based computing paradigm, with its built-in elasticity, scalability, and availability of computing resources, for delivering on-demand IT services on a pay-per-use basis (for example, processors by the hour and storage by the day), in a similar fashion as already done for other utilities[72] (see examples of Cloud Service providers on Figure 9).

It enabled organizations to focus on more strategic tasks without worrying about access and management of computing resources by having access to an “endless” infrastructure for IT available on-demand and required for the concepts described in the two previous sections.

Figure 9 - Gartner's Magic Quadrant (July 2021) for Cloud Infrastructure and Platform Services.

This technology reduces CAPEX costs and Total Cost of Ownership (TCO). Organizations do not need to invest in hardware, facilities, utilities, or build a large data centre to grow their business.

Table 7 - Comparing cloud computing and private data centres [73].

Advantage	**Cloud Computing**	**Conventional Data Center**

The appearance of infinite computing resources on demand	Yes	No
Elimination of an up-front commitment by cloud users	Yes	No
Ability to pay for the use of computing resources on a short-term basis as needed	Yes	No
Economies of scale due to very large data centres	Yes	Usually not
Higher utilization by multiplexing workloads from different organizations	Yes	Depends on company size
Simplify operation and increase utilization via resource virtualization	Yes	No

Organizations do not even need large IT teams to handle their cloud data centre operations, as cloud provider teams are available to operate the organization's cloud assets (see Table 7).

Besides these advantages, cloud computing offers the following key advantages [65]:

- It dramatically lowers the cost of entry for smaller organizations requiring compute-intensive business analytics that were only available to the largest corporations.
- Cloud computing also represents a huge opportunity for many third-world countries that have been so far left behind in the IT revolution. As we discuss later, some cloud computing providers are using the advantages of a cloud platform to enable IT services in countries that would have traditionally lacked the resources for the widespread deployment of IT services.
- It can provide almost immediate access to hardware resources with no upfront capital investments for users, leading to a faster time to market in many businesses. Treating IT as an operational expense (OPEX) also helps dramatically reduce the upfront costs in corporate computing. For example, many of the promising
- Adaptative computing capacity for different needs, as inside an organization, different departments have different computing needs or even during the workday, the workloads vary. Using a cloud provider allows adding computing capacity as simple as a click of a mouse, making it extremely easy to deploy computing resources very fast as new requirements arise
- Cloud computing can help lower IT barriers to innovation because it offers a stable platform on top of which organizations can build their products.

2.5.4 Data mining

DM and ML are terms often confused because they employ the same methods. So the overlap is significant, but while machine learning focuses on prediction based on known properties (“known knowledge”) learned from the training data, data mining focuses on the discovery of (previously) unknown properties in the data (“unknown knowledge”).

In the current stage of IT, the amount of generated and collected data has had exponential growth, assuming the term “big data”. This term refers to the essential characteristics of this data like volume, variety, and velocity.

So, IT has had a significant development regarding the DM, allowing it to automate and assist with the extraction, especially in large sets of data, transformation, and presenting information in a clear and easily understandable manner. Otherwise, this whole process would be overwhelming, if not impossible.

DM techniques have existed for several years and can be traced back along three family lines: classical statistics, artificial intelligence, and machine learning [62], with the latter two families gaining more traction each year.

The term itself was only introduced relatively recently, in the 1990s, due to increased computer power and improved data collection and management techniques.

DM techniques concept/class description, association analysis, classification and prediction, cluster analysis, outlier analysis, and evolution analysis.

Examples of this task group are regression analysis, classification, and prediction.

DM methods can be categorized into two groups: descriptive and predictive tasks. Descriptive tasks find human-interpretable patterns that describe the data.

They mainly outline the characteristic features of the database records[62], such as data summarization, association rule mining, and clustering analysis.

Predictive tasks use some variables to predict unknown or future values of other variables. They make inferences from the present data to perform predictions. Decision-makers have relatively limited cognitive processing capacity, as all humans do, so too much information can difficult a clear decision and multiply their doubts.

This dimension of the proposed framework, particularly using IT tools (see Table 8), such as classification or predictive tools [63], is a mitigation/solution to this natural limitation and helps lower the risk associated with decision-making.

Table 8 - Data Mining Tools

Commercial	Strengths	Open Source	Strengths
Alteryx		ELKI	
Dataiku		Keel	
DB2 Intelligent Miner (IBM)		KNIME	Extraction, transformation and loading
Oracle Data Mining	Advanced analytics and real-time application support	Orange	Data analysis and visualization
SAS Enterprise Miner		Rapid-Miner	Predictive Modeling
SPSS Clementine (IBM)		Weka	

Organ decision-making is a broad issue that impacts an organization's strategic, tactical, and operational decisions. These decisions include external decisions (related to customers and suppliers) and internal decisions (employee competencies development to achieve organizational goals, tasks, and aspirations) that ultimately lead to far better business results or even market expansion.

Information-based decision-making is used in almost every business area, including human resources (HR). Advanced, pervasive, and invisible analytics is one of the top technology trends currently and will be for years to come. Every modern application needs to be an analytic application. Therefore, LMS also evolved into an analytic system of applications.

3 Literature Review

Most of the concepts described in this study have been explored intensively in the current literature. However, we set an objective to retrieve any guide, framework, or other information about IT in a LO.

This section presents several aspects of his methodology, including the objectives of conducting this review, the research question, and the protocol review.

3.1 Planning the review

Planning refers to the first approach of Literature Review (LR) using the motivation and the objectives mentioned above in sections 1.2 and 1.3; respectively, it is proposed that the initial investigation supports the research questions to be answered and determines the research protocol to follow

3.1.1 Review Protocol

To start the literature review is necessary to define a range of rules or a set of follow-up lines to have a referral scheme used during the review. However, some issues will probably be resolved only after analyzing the selected data/documents[74].

The search process was performed through a manual search that consisted of search strings in two data sets. The individual search strings and data sets are mentioned below:

Search strings:

1. “Learning Organization” AND Technology
2. “Learning Organization” AND Technology AND (Framework, Model, or Theory)

Data Base sets:

Scopus and Web of Science

After querying the specified data sets with the search strings and having initial results, it was necessary to apply the **inclusion and exclusion criteria** (Table 9) to reduce the sample of documents found in the libraries only to keep the most relevant ones and start narrowing the results to evaluate

In this first interaction of this study, it has been interpreted the following criteria:

Table 9 - Inclusion and exclusion criteria

Inclusion Criteria	**Exclusion Criteria**
IT - Related technology	Not IT related technology

Corporate environment	Educational environments such as schools, colleges, and universities
Framework	Documents will be excluded where only the abstract but not the full text is available

The search intended to select relevant articles up to December 2020, which was the date that the extensive literature review began. Our search string only considers the title of the articles, considering we wanted to focus especially on relevant literature, avoiding waste as much as possible.

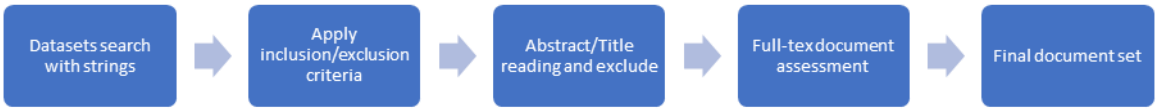

Figure 10 - Review protocol of Literature Review (LR)

3.2 Conducting the review

This section covers the second phase of the LR. We will address the articles selected according to the protocol review defined in the previous section and provide the data extracted from the selected literature.

- Exclude if the focus of the paper is not about the corporate environment.
- Exclude if the focus of the paper is not about technology in a learning organization
- Exclude if the focus of the paper is educational institutions.

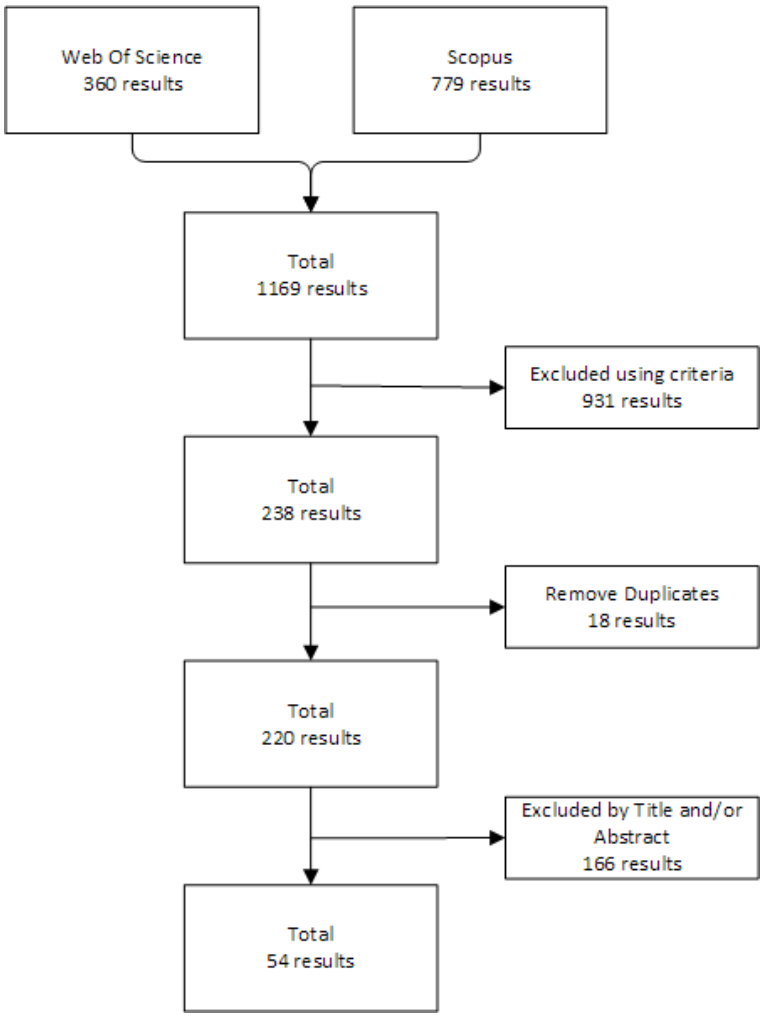

Figure 11 - Documents selection process.

3.2.1 Selection of documents

Once we applied our search string, the number of articles (Figure 12),Figure 12 - Number of papers by document type. collected corresponded to 1169 throughout the whole data sets in use. Then, applying the inclusion and exclusion criteria, the number of articles decreased considerably to 238. Removing the duplicates and excluding them by reading the title and abstract resulted in **54 results**.

3.3 Reporting the review

Throughout the literature review, it has been evident that organizations use IT to manage knowledge, particularly with two knowledge management strategies; personalization and codification.

The personalization knowledge management strategy concerns social interactions and dialogues to share tacit knowledge. The codification knowledge management strategy, on the other hand, captures and extracts knowledge from individuals to document and store it in an electronic database which allows easy reuse of explicit knowledge.

This section addresses the last phase of the Literature Review (LR).

The results of this phase are divided into three different topics: Existing frameworks, IT role on a LO, and relevant IT technologies.

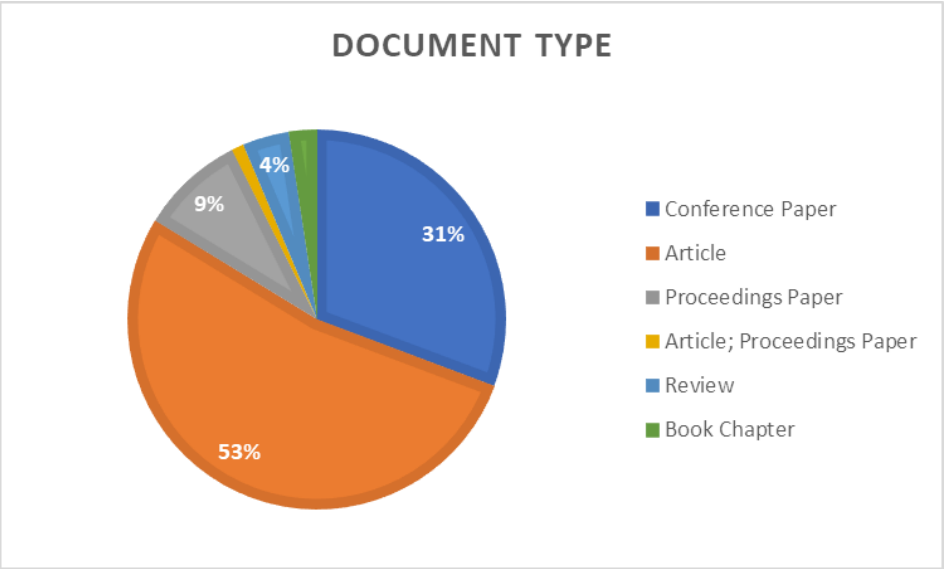

Figure 12 - Number of papers by document type.

3.3.1 Existing frameworks

Some authors identified IT as a pillar for a LO during the extensive literature review. One of these authors, Michael Marquardt, identifies Technology[20] as a subsystem in the so-called Systems Learning Organization Model (SLOM).

Although Marquardt's model includes Technology as essential for a LO, the depth of this subsystem is relatively shallow. The definitions of this technology subsystem only refer to:

- *Technology to manage knowledge:* Computer-based technology for gathering, coding, processing, storing, transferring, and applying data among machines, people, and organization

- *Technology to increase the speed and quality of learning*: Video, audio, and computer-based multimedia training for delivering and sharing knowledge and skills anywhere, any time.

Exploring even further in detail these references, we can see that the author only gives a somehow abstract definition of the learning technology.

The author divides learning technology essentially into two categories:

- *Presentation*: Electronic text or publishing, Computer-based training, Multimedia. Television, Teleconferences, Virtual reality, and Electronic performance support system (EPSS)

- *Distribution*: Cable TV, CD-ROM, Extranet, Internet: Intranet and other computer networks (LAN and WAN) and simulators.

Marquardt's Technology subsystem can be vague, except for EPSS and a few proprietary systems (Ford's Learning Technology Network – FORDSTAR).

The concept of ESPSS did not gain much traction over the years (Figure 13)

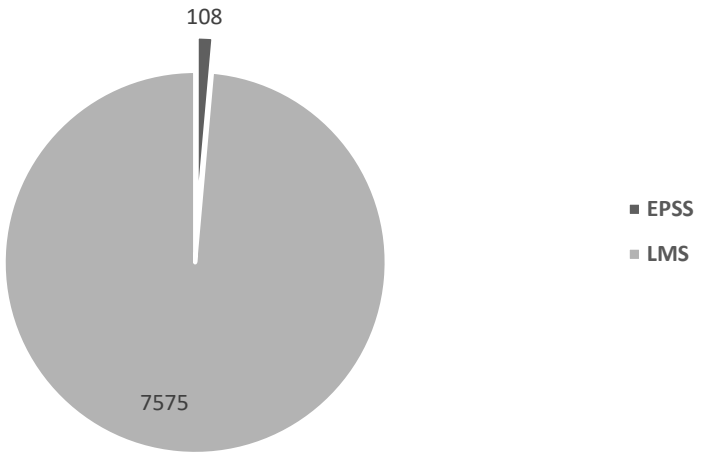

Figure 13 - Articles reflecting the terms EPSS and LMS (SCOPUS)

Another extremely relevant article was "*A framework for building a learning organization in the 21st century*"[75]. The core of this framework is about technology. However, one of the six dimensions of this framework, "Human asset infrastructure", regards the identification and utilization of the employee's special skills in a way that creates a higher business value to the organization.

It does not explain if this process is attained using technology or other tools, and this is also the case for the other six dimensions.

There is no information or examples of the technologies that the author considered for each of these dimensions. Despite this lack of detailed information, this study is particularly relevant for the framework presented in the next section.

3.3.2 IT role on a LO

IT tools have been identified as key assets that facilitate the KM processes in organizations, such as collecting, sharing, transferring, and retrieving information and knowledge.

As the world becomes digital, IT is undeniable in every aspect of an organization's day-to-day operations, in particular creating an environment for employees to access knowledge and improve their skills or competencies.

Implementing information systems in an organization helps flatten the organisation's structure and promotes greater dissemination of information and knowledge to all individuals (Figure 14).

This structure makes the organization more informed, adaptative, flexible, and organic. Increased availability of information helps members share information, thereby increasing learning and more responsibility and autonomy to make decisions typically made by middle management. Information systems automate and "*informate*" the organization (Zuboff, 1988).

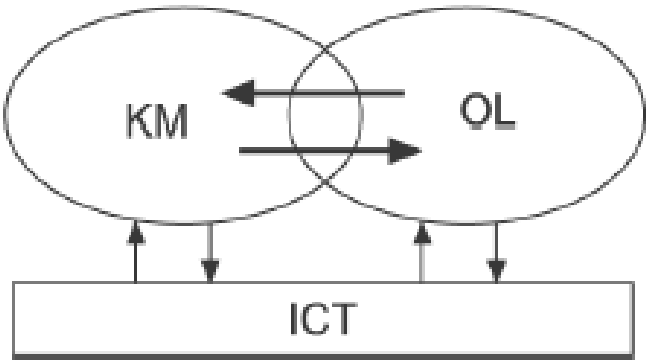

Figure 14 - Relationship between KM, OL, and ICT [76].

These systems can generate new streams of information, thereby expanding knowledge.

In an informed organization, the locus of control shifts from managers to workers, who are now empowered with all the information required for their effective performance. Knowledge thus becomes the core of an organization's asset.

3.3.3 Relevant IT technologies

Most of the documents have many references to technologies used for knowledge conversion. Technology tools such as email, video-conferencing, and social media are also influential in the knowledge transferring processes of the SECI model, which ultimately enhances knowledge creation. This section presents a list of technologies found while analyzing the documents.

Table 10 - List of summarized technologies for each dimension of knowledge conversion.[77]

Socialization	Externalization	Combination	Internalization
Social networks	Expert Systems	Wikis	e-Learning
Forums	Blogs	Content management systems	Using wikis
Communities of practice	Wikis	Databases	Using expert systems
Groupware	Examples of god and bad practice	Data warehouses	Web browsers
Group decision support systems	Questions and answers	OLAP analytical solutions	Using decision support systems

Conference systems	Decision support systems	Business intelligence	Using blogs
Chat groups	Business modelling	Data mining	Using analytical solutions
IPTV	Knowledge warehouses	Statistical analysis	Using statistical analysis
Video-conferencing	Cognitive mapping tools	Machine learning	Using data mining results
electronic discussion	IPTV	Neural networks	Using neural networks
e-mail	Expert system	Intelligent agents	Using social networks
	chat groups	Artificial intelligence systems	Using forums
	best practices and lessons learned from databases	Case-based reasoning systems	Using communities of practice
		Document systems	Using case-based reasoning systems
		Workflow systems	IPTV
		Yellow pages	Using other KMS Combination
		Knowledge maps	Computer-based communication
		Electronic bulletin boards	AI-based Knowledge acquisition
		Intranets	computer-based simulation
		Web portals	
		Genetic algorithms solutions	
		Databases	
		Web-based access to data	
		data mining	
		repositories of information	
		Web portals	

Communities of practice are groups of people who share a concern or an interest in something they do and learn how to do it better as they interact regularly. Inevitably, people in communities of practice share their experiences and knowledge in free-flowing, creative ways that foster new approaches to problems. [78]

Table 11 - IT tools for the SECI model dimensions [35]

SECI phase	Possible IT Tools
Socialization	Video Conferencing
	Community of Practice Platforms
	Mobile Technology
	Social Media
	Email
Externalization	Community of Practice Platforms
	Email
	Mobile Technology
	Social Media
	Blogs
Combination	Portal
	Blogs
	Electronic Document Management Systems

	Community of Practice Platforms
	Email
	Social Media
Internalization	Blog
	Social Media
	Community of Practice Platforms
	Email

4 Technological Framework for a Learning Organization

As demonstrated in the previous section, the technological perspective of a LO is considered essential in the current digital world. However, IT definitions or guidelines in a LO are very limited. This approach to developing a framework started to be developed sometime before the thesis itself.

After performing the literature review, explained in Chapter 2, about LO, it made sense that the technological perspective was not being explored in depth. This framework was also a challenge that this thesis supervisor presented after reviewing the initial project that led to this thesis.

Many articles, papers, books, and other documents discuss LO (about 4,658 if we use the same time reach, the same data sets, and the search string “Learning Organization”). However, only about 7% of those documents include IT components to define a LO.

This chapter presents the proposed artefact in the form of a framework that aims to achieve the objectives defined in previous chapters. This chapter also provides details about the dimensions of the proposed framework divided into four sections, which correspond to the four dimensions that compose our proposal.

4.1 Objectives

The main objective **is to provide a framework to guide achieving a LO status regarding relevant and important IT systems and applications that an organization should have available**.

Therefore, our framework should be able to become a useful artefact for organizations to use as a guide for implementing IT in such a manner that will constitute the pillars of learning and knowledge throughout their workforce. These pillars would enable them to deliver extensive internal benefits, such as employee and management engagement, competitive advantage, and digital capabilities.

This approach to developing a framework started to have a special relevance sometime before the thesis itself, especially after reviewing extensive literature about LO and realizing that the technological perspective was not being explored in depth. This framework was also a challenge presented by this thesis supervisor after reviewing the initial project that led to this thesis.

4.2 Proposed Framework

After concluding the literature review, the data extracted allowed us to present a proposal for an initial framework, explained in this chapter.

The dimensions that we identified in the literature also helped to have a clear vision of the most important areas that the IT tools that should be used or implemented to enhance the capability of an organization to become a LO.

This tool had great importance in developing the dimensions presented in this framework (Figure 15)

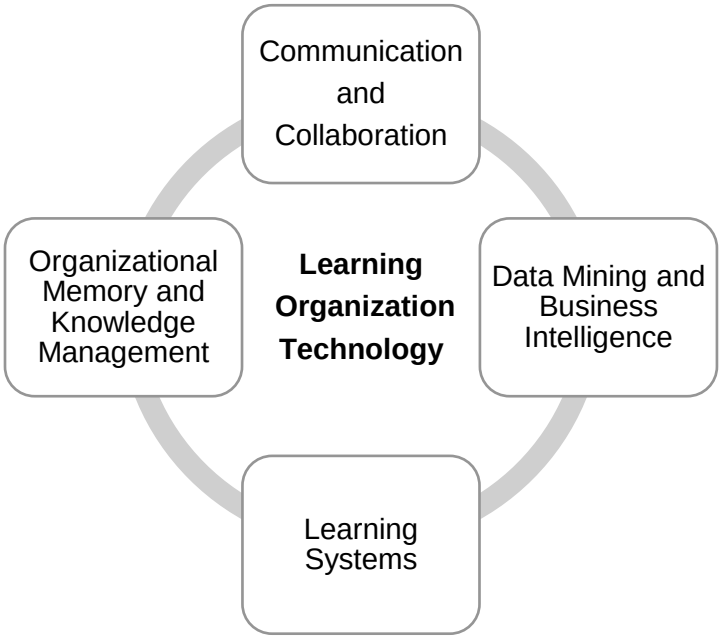

Figure 15 - Framework of technological dimensions for building learning organizations.

We believe that this framework makes the task of planning and developing the necessary IT tools, systems, and applications for a learning organization more manageable, by graphically and visually presenting the dimensions.

The dimensions presented in this framework result from the literature review, in which the most relevant terms to knowledge conversion were identified (see Table 12)

Table 12 - Percentage of articles referencing terms relevant to the dimensions of the proposed framework

Dimension	Percentage of Articles
Organizational Memory and Knowledge Management	43%
Communication and Collaboration	34%
Data Mining and Business Intelligence	4%
Learning Systems	21%

Learning organizations require technology to support capturing and sharing people's knowledge, promote collaboration, and provide unhindered access to an extensive range of information. Therefore, technology must support all activities (capture, organization, retrieval, distribution, and maintenance) involved in the knowledge life cycle.

Figure 15 represents the integrated structure we have presented as a framework. The Framework includes the following key components: *Organization Memory and Knowledge Management, Communication and Collaboration infrastructures, Learning Systems and Data Mining and Business Intelligence*.

Each of these components will be explained in detail in the next sections.

4.2.1 Learning Systems

A supportive workplace learning environment is one of the most important blocks when an organization is focused on the quest of becoming a LO [21].

Workplace learning, which originated from educational research, focuses on improving conditions and practices of learning and instruction in work settings and has gained some important tools and evolutions over the years.

Part of that evolution has moved from the conventional classroom and formal learning to provide distance learning with digital materials, specifically electronic learning (e-learning).

For a long time, e-learning has become a ubiquitous learning modality for numerous organizations. This form of learning has two primary benefits from a learner's perspective:

1. Provides tailored learning to the individual needs of each learner by offering just-in-time and just-for-me learning
2. It can be accessed virtually anywhere using an electronic device and the Internet

In addition, using an electronic learning platform also has many benefits for an organization:

- It is time and cost-saving. Learning time is reduced by 50%, and lost productivity due to travel is eliminated. Training-related travel costs, facilities reservations, instructors, and are eliminated. The employer gets unlimited training for less than most instructor-led 1-day courses, reducing course-management overhead.
- The quality of learning is improved and is also consistent. The content is kept more up-to-date, and the way it is delivered is always the same as in the face-to-face sessions where an instructor has his or her teaching method. Also, the contents can be reviewed at any time as a refresher.
- It is scalable. The learning content can be made available to any employees as needed and is a one-time investment. The more learners take the course, the more justification for this expense is justified.

Choosing the right learning platforms is the biggest challenge when providing a supportive learning environment. Every organization has its skills, and even inside the organization, those skills and needs vary.

Most of the platforms that we have identified in this study need some technical knowledge, especially LMS, which are constituted by a technology infrastructure that manages, monitors, and maintains electronic data and communication. Having an IT department or staff is an important factor in discarding some platforms as opposed to others

The spectrum of these LMS is wide, ranging from either free or commercial (Figure 16), on-premises or hosted in a provider, and typically includes methods to manage users, role, and course information, online communication, grading, and web-based or blended delivery of content.

There are popular commercial products such as Blackboard (www.blackboard.com), SAP SuccessFactors (https://www.sap.com/products/corporate-lms.html), and open-source products such as Moodle (http://moodle.org) and Sakai (www.sakaiproject.org)

Figure 16 - Best Learning Management Systems - 2021 Reviews & Pricing (softwareadvice.com)

4.2.2 Organizational Memory and Knowledge Management

In the almost available literature, knowledge management is the most referenced term. An organization needs to have suitable tools for acquiring and retaining information and searching and retrieving information.

A knowledge management infrastructure is a backbone to capture and disseminate knowledge that constitutes the organization's memory within that specific organization.

Organizational memory is a generic concept representing the organizational ability to encode, store, retrieve, and decode organizational knowledge.

It is an intangible asset of any organization that contains many knowledge forms, from multiple cognitive, emotional, and spiritual knowledge forms [28]. It is also memory is a side effect of learning; and learning, in turn, derives from working in a community.

Organizational memory (OM) and knowledge management (KM) are closely related topics that have grown in importance for organizations over the past few decades.

KM includes various practices of managing organizational knowledge, such as knowledge generation, capture, sharing, and application of that knowledge in the organization's processes.

Within these processes or practices, effective sharing and use of organizational knowledge strongly depend on the organization's ability to create and manage its collective memory [83].

The OM can be described as how organisations store past knowledge to support present activities and processes. Using IT to recall prior knowledge helps users comprehend the context of operations and activities and learn how the organization has worked in the past.

Therefore, providing faster decision-making [84], behaving accordingly in the context of the provided knowledge, and reducing the need to "recreate the wheel".

Also, unpleasant historical lessons are repeated less often by learning from past mistakes. As a result, better performance is achieved in the present by having relevant information and knowledge from the past.

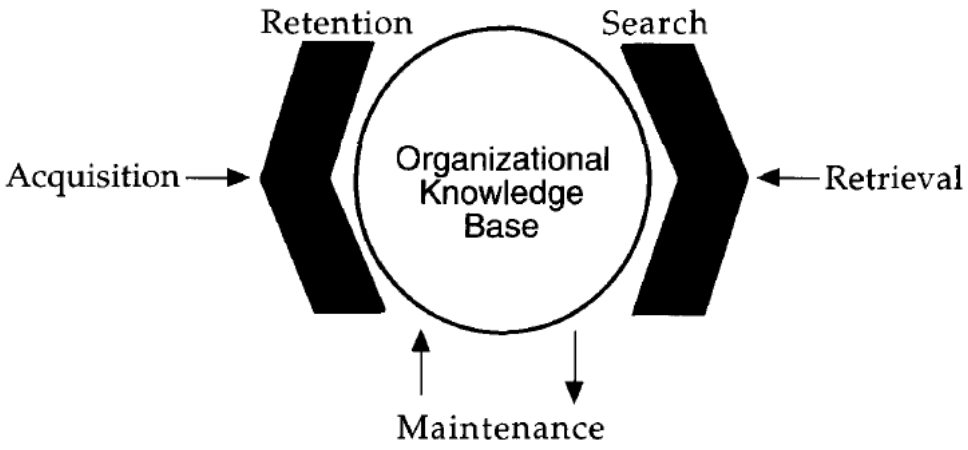

Figure 17 - Processes of organizational memory [85]

However, there are some problems involved in using organizational memory OM. First, much of the knowledge in the OM is used within a specific context.

When knowledge is transferred, the receiving end of the communication system often does not know the original context of the knowledge and therefore cannot interpret it correctly.

This point represents a challenge to the effective application of technology to support organizational memory.

This effectiveness tends to be greater in low-context cultures (the definition of culture relates to the dynamics of a team or an organization workforce) and more challenging in high-context cultures [83].

Communication technology and document processing tools do not easily retain the context of documents, which is the difference between meaningless piles of documents versus useful information.

Another problem is related to the sources of the OM, residing in individuals, cultures, and other forms of knowledge that consist mainly of tacit knowledge. This type of knowledge is very hard to formalize and track and maintain.

Other issues concern the volatility and validity of organizational knowledge, so more challenges are presented to assess if information or knowledge needed at a specific time should be retained forever. Last, validity concerns assessing whether memory is valid or even if it is no longer needed and thus should be deleted.

In summary, IT contributes to the possibility of automated OM by storing and making recorded knowledge retrievable or shareable across the organization but providing extremely effective organizational memories [86] is not a problem that IT has solved and, perhaps, is one of the problems that IT alone is incapable of solving.

The concept of OM is intertwined with the KM concept as the latter can be defined as: "*the identification and analysis of available and required knowledge assets and knowledge-asset related processes, and the subsequent planning and control of actions to develop both the assets and the processes to fulfil organizational objectives*."

Furthermore, those knowledge assets can also be considered a definition for OM.

4.2.3 Communication and collaboration

Most of the IT systems discussed in this study provide communication and collaboration but providing alternative means for collaboration and communication is most important.

These ways of interaction are key factors to the knowledge conversion regarding the tacit knowledge –

socialization and externalization.

In addition, these modes are considered a prime component of a LO to facilitate communication throughout the organization and diffuse knowledge effectively.

The workforce may be located in many different geographic locations. Unless there is a strong communication infrastructure (see Table 13) in place, people would not be able to communicate and thus will not be able to transfer knowledge.

Table 13 - Conversational technology overview. [87]

Technology	**Communication**	**Tools available**
E-mail	1-to-1, 1-to-many, person-to-person	Local e-mail archives possible
Static and DB backed web pages	1-to-many, approaching many-to-many, "dialogue" between web pages through hyperlinks	Local archives
Discussion forum	Many-to-many in web-based forums	Central repository if web-based, local if list server
Internet chat	1-to-1, many-to-many	Frequently none, transient communication
Video / audio streaming	1-to-many	Central host or decentralized streamers
Video / audio conference	1-to-1, 1-to-many	Local repository if the content is recorded
Web Log	1-to-many can approach many-to-many (similar to web pages)	Local repository within each weblog. "Metablogs" are now emerging
Wiki	Many-to-many	Yes, current knowledge and history ("temporal database")

Apart from e-mail and intranets, the introduction of wikis within a workplace to perform project tasks has provided a method by which project managers can build a more sophisticated approach involving everyone involved

New management practices address the challenges faced in a rapid and unpredictable business environment where reactivity and adaptability become fundamental. These "agile" practices stress close collaboration and frequent feedback between colleagues, suppliers, clients, and competitors.

As discussed in previous sections, organizational knowledge is created through the continuous interaction of tacit and explicit knowledge. While explicit knowledge can be codified and transferred through formal communication or documentation, tacit knowledge is more difficult to transfer.

It relies on cognitive (mental models of the world) and technical elements (concrete know-how and skills). Dialogue is an important means for converting and translating tacit knowledge into a readily understandable form, enhanced through collaboration.

There are many tools for companies to communicate and collaborate, especially using the capabilities of the internet. Intranets are also valuable for creating a knowledge transfer network, such as discussion rooms, bulletin boards for meetings, and information displays.

Many experts (knowledge workers) are usually quiet by nature and confine their ideas. Many may have inhibitions to sharing in-group. Therefore, bulletin boards may allow those individuals to post their messages and information that could be vital for knowledge creation.

Organizations should create the ability to use the knowledge intelligently already inherent within it, and the new intellectual capital created daily and use technology to ensure efficient knowledge transfer.

4.2.4 Data Mining and Business Intelligence

A warehouse with data about the organization's internal operations, customers, competitors, business partners, and suppliers cannot be considered an advantage if it is not used, i.e., converted into relevant knowledge. This knowledge is crucial to outlining a successful strategic plan for the organization and making effective and good-quality business decisions.

Extraction and searching for valuable and actionable information to detect trends and identify patterns[61], particularly in large volumes of data, is the process of data mining (DM).

5 Research Methodology

This chapter describes the methodology used to validate the proposed framework in the previous section, the **survey research methodology,** a quantitative method survey design, using only closed-ended questions to gather information from employees throughout the financial organization regarding their perception of the technologies available.

This methodology is used to answer questions, solve problems, assess needs and set goals or adjustments to a specific goal, determine whether or not specific objectives have been met, establish baselines against which future comparisons can be made, analyze trends, and generally, to describe what exists, in what amount, and in what context. [89] (Isaac & Michael, 1997, as cited in Glasow, 2005)

The research method chosen is essential to the success of the study developed. Thus, we were also chosen to develop a literature review of the research method to be implemented.

Also, in this chapter, we opted for a literature review are included the description of the design method, participants' sample, instrumentation, and data analysis.

5.1 Introduction

A **survey** is typically performed to evaluate perceived viability. It can be defined as a process of gathering data that could involve a wide variety of data collection methods [90], including a questionnaire, as was the preferred method in this study.

The use of audience-distributed surveys is one of the oldest and most widely used methods of collecting all kinds of data. Numerous authors have analyzed the advantages and disadvantages of this methodology over the years. the advantages and disadvantages of this methodology (Table 14)

This research methodology might contain the question: "*Do you think the presented framework provides a viable solution to the problem*?" To assess all of the dimensions of the proposed framework, we have defined specific questions to cover all the dimensions in the most unbiased manner possible.

Additionally, the survey might include a question on the problem's relevance, even though relevance has already been tested during problem identification.

A survey can be described simply as a data collection tool for executing survey research, as a means to gather information about the characteristics, needs, actions, and opinions of a large group of people [89].

The most common survey methods are interviews and questionnaires; in this study, we used the latter, an online survey using Google Forms.

As with all methods, the survey methodology has advantages and disadvantages, as described in the following table [89].

Table 14 - Survey advantages and disadvantages [89].

Advantages	Disadvantages
The research produces empirical data.	The produced data are likely to lack details or depth on the investigated topic.
Can produce a large amount of data in a short time for a fairly low cost	Securing a high response rate to a survey can be hard

Besides some disadvantages, there are also weaknesses common to all types of surveys. These weaknesses include bias, either from the participant/respondent or the researchers.

This bias can also occur, either in the lack of response from intended participants or in the nature and accuracy of the received responses [89].

Other weaknesses include intentional misreporting of behaviours by respondents to confound the survey results or change their answers or behaviours.

Finally, respondents may have difficulty assessing their behaviour or poorly recall their behaviour's circumstances [89].

5.2 Context

For this study, one questionnaire was conducted in a financial organization. This financial organization has several departments, with approximately 1800 employees from various degrees and academic areas, ranging from economics, mathematics, law, human resources, sociology, psychology and others.

Some of the strategic values or guidelines of this organization are aligned with the principles of a LO. This information was obtained through company documents publicly available. For confidentiality reasons, only excerpts are available in Appendix 1. By analyzing those organizational goals and documents, we could observe that:

- The organization has highly qualified employees in its mission areas. Its governance model, internal organization and processes are benchmarked against best practices;
- The organization's employees work in a spirit of mutual help and knowledge sharing.
- Proximity to the institutions, with independence and responsibility. A dynamic and transparent organization in the institutional framework, in the relationship with other national and international financial institutions and other authorities, preserving its independence and ensuring efficiency and sustainability in the use of the resources at its disposal
- The proximity between teams. An organization is exemplary in collaboration, sharing, and

knowledge construction, with skilled and motivated employees, in a framework of inclusion and diversity.

- The organization has a broad and complex mandate that interacts with a demanding and constantly changing environment. To support the achievement of its mission, it is a priority to strengthen internal management at the level of systems and processes and invest in strengthening the skills of employees.
- The transformations to be carried out in the internal management areas aim, above all, to improve the organization's performance in its mission activities. They also reflect the organization's willingness and efforts to constantly adapt its internal structure in line with best practices and demanding efficiency criteria in managing the resources entrusted to it.
- Accompany the evolution and sustainability of the institutions, focusing on the dimensions of digital transformation
- Acknowledgement that it must adapt its business models to the new paradigm of the economy and the challenges posed by climate change in the medium term.
- It will favour closer contact with all its partners, national and international, through forms of communication that favour wider audiences' understanding of its functions.
- Enhancing the enhancement and development of employees, providing the organization and the people with the skills and profiles necessary, diversifying the opportunities for development and encouraging mobility
- Define the innovation management model associated with the digital transformation process;

This organization is attempting to develop a set of competencies consistent with the attributes of a learning organization. Using as a reference the eight characteristics of a learning organization described by Hitt (1995), and shown in table 1 above, this organization presents many of the features. Much of this has occurred during the past five years.

During this period, Exco experienced significant transformational organisational change to ensure that the organisation is flexible and able to respond to the competitive marketplace rapidly.

The organisation structure has been flattened with an emphasis on cross-functional teams (see Appendix 2). Much effort has gone into setting up programs that allow people to make a greater contribution to the organisation's success.

Table 15 - Eight Characteristics of the Learning Organisation [12], with evidence of the financial organization.

Element	**Learning Organization**	**Evidence of the financial organization based on public documents**
Shared Values	Excellence	Yes
	Organisational renewal	Yes

Management Style	Facilitator	Yes
	Coach	Yes – problematic
Strategy/Action Plan	Everyone is consulted	Consultation growing
	Learning map	Evolving
Structure	Flat structure	Yes
	Dynamic networks	Evolving
Staff Characteristics	People who learn	Yes
	Mistakes tolerated as part of learning	Yes
Distinctive Staff Skills	Generative learning	Limited
Measurement System	Both financial and non-financial measures	Yes
Teams	Cross-functional teams	Yes

5.3 Research Methodology Strategy

This research study used primary data and secondary data.

The primary data was collected through the survey research using a specific questionnaire.

Secondary data was obtained through a state of the art and literature review.

State of the art and the literature review regarded the first two research questions and helped formulate the structure of the questionnaires.

There is one difference between keywords used in state of the art and those used in the literature review.

To help us prepare for the process of designing the components of this methodology, we used a questions checklist (Table 16) as a general guide.

Table 16 - A Checklist of Questions for Designing a Survey Method. [91]

Is the purpose of a survey design stated?
Are the reasons for choosing the design mentioned?
Is the nature of the survey (cross-sectional vs longitudinal) identified?
Are the population and its size mentioned?
Will the population be stratified? If so, how?
How many people will be in the sample? On what basis was this size chosen?
What will be the procedure for sampling these individuals (e.g., random, nonrandom)?

What instrument will be used in the survey? Who developed the instrument?
What are the content areas addressed in the survey? The scales?
What procedure will be used to pilot or field-test the survey?
What is the timeline for administering the survey?
What are the variables in the study?
How do these variables cross-reference with the research questions and items on the survey?
What specific steps will be taken in data analysis to do the following: (a) Analyze returns? (b) Check for response bias? (c) Conduct a descriptive analysis? (d) Collapse items into scales? (e) Check for the reliability of scales? (f) Run inferential statistics to answer the research questions or assess the practical implications of the results
How will the results be interpreted?

5.4 Sample Selection

Determination of sample size depends on five factors [89]:

- Desired level of precision (significance level or confidence interval);
- Sensitivity or statistical power required (determined, in part, by effect size and sample size);
- Ability to gain access to the study subjects (or use a theoretical sample);
- The degree to which the population can be partitioned into non-overlapping groups (according to the sector, technology level);
- Selection of the relevant units of analysis (whether the respondents to a survey will be 2-3 individuals, offices, departments, or entire organizations)

The survey was sent to **112 employees** of a financial organization related to the building blocks of a LO.

The selection was performed to cover every department, using a random selection of at least 1 or 2 employees from each department, ranging from mathematical, economics, finance, IT, and HR background.

With randomization, a representative sample from a population provides the ability to generalize to a population[91] and extrapolate conclusions.

Generally, random sampling is employed when methods are used to collect data [92], particularly as we used a questionnaire.

Out of the 112 employees, only 50 employees finished the survey. The next section will go into more

detail about the population sample and responses.

5.5 Questionnaire

The goal of the questionnaire was to validate the existence of the four dimensions of the proposed framework.

The questionnaire survey used in this study was very influenced by Michael Marquardt's "Learning Organization Profile" [17] survey, in particular section V. "Technology Application: Knowledge Information Systems, Technology-Based Learning, and Electronic Performance Support Systems" (see Appendix B).

These questions were all reviewed, and some were discarded because they were outdated or had terms that we do not use anymore.

The remaining questions of Marquardt's section V helped construct the questions for this questionnaire.

The following methodological steps were taken to create the questionnaires:

1. Reading the research problem, questions and objectives;
2. Reading the Theoretical Background and the Literature Review;
3. Coding of information into topics to facilitate analysis;
4. Creation of questions based on the topics;
5. Initial evaluation, review and discussion of questions with Supervisor;
6. Determine how the questionnaire will be administered and the question format;
7. Addition of questions;
8. Review;
9. Placement of questions in their appropriate section and order;
10. Description of sections to inform the participants about them;
11. Final evaluation, review and discussion of the overall questionnaire with supervisor;
12. Delivery of questionnaire to the participants.

A link to the questionnaire was sent to the respondents, by e-mail, to a Google Forms landing page. The population consisted of 112 employees in a financial organization, of which 50 of them answered the questionnaire, meaning 45% of the employees participated in this questionnaire.

An effort was made to keep this questionnaire as short as possible but in such a way that it covers the various topics or dimensions that we intend to analyze, as longer questionnaires result in decreased data quality due to the increased respondent and enumerator burden and declining response rates and premature termination[93].

A fatigued respondent introduces nonsampling error in the collected data reducing the precision of the survey estimates [93].

5.6 Instrumentation

The instrument for this study, a survey questionnaire titled “Information Technology for organizational learning” (Appendix D), was formatted in Google Forms (https://docs.google.com/forms) (see Figure 45), an online form creator.

Assuming every participant has access to this online tool, this type of web-based survey has many advantages, such as easy access to the survey and removing almost all the unnecessary tasks from the traditional paper and mail survey method.

The survey included a cover letter describing the goals and objectives, instructions on how to complete the survey, an explanation of anonymity and how the information collected will be used, and a description of the survey layout, such as enveloping mailing.

The survey questionnaire comprises 22 questions and two sections with only closed-ended questions. There are 4 questions regarding demographics to seek descriptive data about the participants: gender, age, highest education degree attained, and level of IT knowledge.

Additionally, there are 17 questions concerning participants' viewpoints on IT tools available in their organization.

All of these 17 questions used a Likert scale consisting of five-point scales:

1. Totally Disagree
2. Disagree
3. Undecided
4. Agree
5. Totally Agree

5.7 Data collection

The data used were collected as part of the questionnaires developed in Google Forms programs sent by e-mail to the participants at the end of each edition.

Each participant received an email (Appendix C) identifying myself as the researcher and the study, goals and objectives, approximate time required to answer all questions, key dates when the survey window closed, and a link to the questionnaire.

All surveys completed generated data into the survey program database. (surveymonkey.com). The database provided the author with respondent summary information regarding:

a) the total number of persons that answered the survey,
b) number and percentages of each person responding to each option in the multiple-choice questions

6 Results

The focus of this study is to examine the technological dimensions and tools capable of supporting or facilitating an organization in becoming a Learning Organization, find the perceptions and beliefs of employees regarding IT tools, and determine if there is consensus among all the participants.

The questions were divided into the four dimensions or topics:

1. Communication and Collaboration
2. Data Mining and Business Intelligence
3. Learning Systems
4. Organizational Memory and Knowledge Management

6.1 Participants Demographic Data

Wide sample varieties were used in this survey, ranging from age, education, and IT knowledge.

The sample size of 50 respondents, 70% are male, 44% of the participants on the survey are between 36 and 44 years old, 88% have a university degree – 40% have a bachelor's degree, and 48% of the participants have a masters degree – and 74% consider that they have advanced IT knowledge.

Also, 96% of the participants consider information technology very relevant in their daily professional duties.

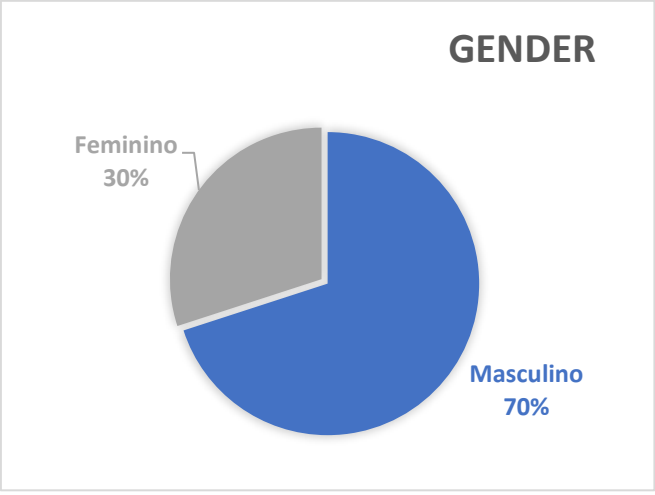

Figure 18 - Gender of the respondents

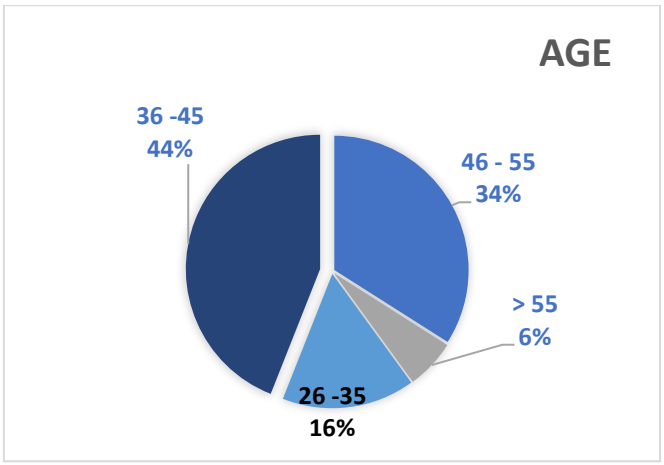

Figure 19 - Age of the respondents

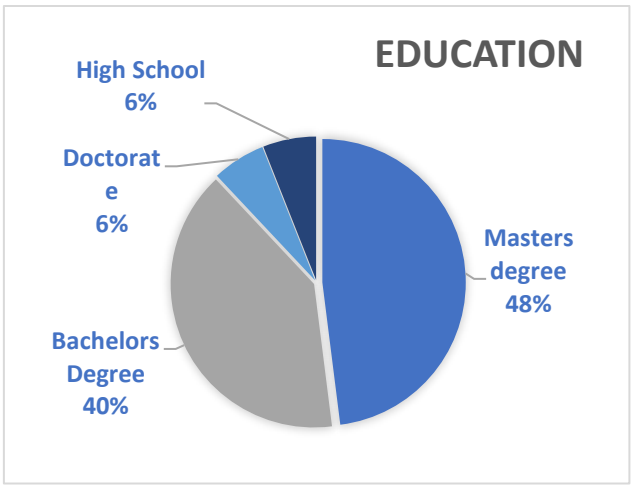

Figure 20 - Education level of the respondents.

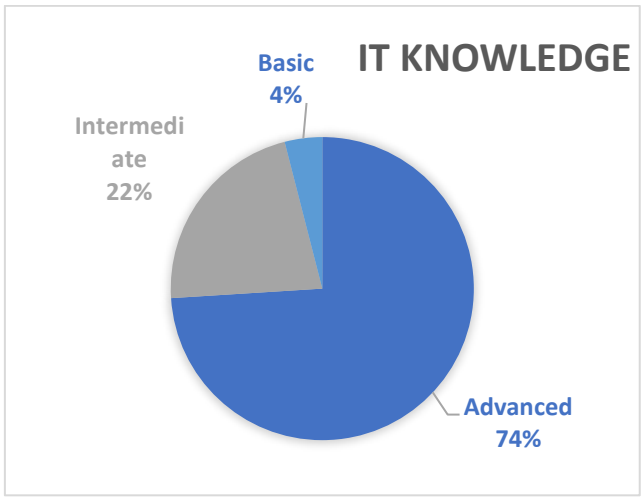

Figure 21 - IT knowledge self-assessment of the respondents

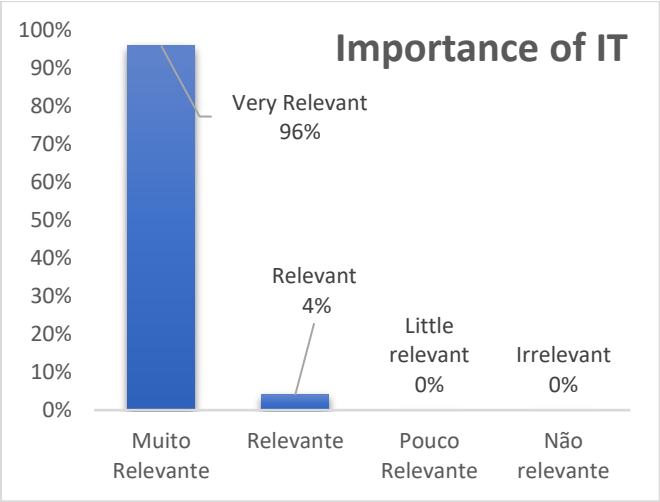

Figure 22 - Importance of IT tools in the training and learning processes of the respondents.

6.2 Research Dimensions and Questions

The scale used in the survey is a Likert scale ranging from 1 – "totally disagree" to 5 – "totally agree".

Table 17 - Responses to the survey

		scale				
Main Topic	Question	1	2	3	4	5
Organizational Memory and Knowledge Management	Q1	0%	0%	10%	54%	36%
Organizational Memory and Knowledge Management	Q2	0%	2%	12%	48%	38%
Organizational Memory and Knowledge Management	Q3	0%	16%	39%	37%	8%
Organizational Memory and Knowledge Management	Q12	10%	50%	34%	6%	0%
Communication and Collaboration	Q4	0%	6%	22%	48%	24%
Communication and Collaboration	Q5	0%	12%	20%	38%	30%
Communication and Collaboration	Q6	0%	0%	12%	34%	54%
Communication and Collaboration	Q7	0%	6%	20%	34%	40%
Communication and Collaboration	Q8	0%	6%	10%	38%	46%
Learning Systems	Q9	0%	12%	42%	36%	10%
Learning Systems	Q10	0%	6%	38%	44%	12%
Learning Systems	Q15	4%	40%	40%	14%	2%
Data Mining and Business Intelligence	Q11	4%	38%	46%	10%	2%
Data Mining and Business Intelligence	Q13	8%	26%	34%	28%	4%
Data Mining and Business Intelligence	Q14	8%	24%	34%	32%	2%
Data Mining and Business Intelligence	Q16	10%	22%	38%	22%	8%
Data Mining and Business Intelligence	Q17	14%	44%	32%	10%	0%

The scale is a Likert scale ranging from 1 – totally disagree to 5 – totally agree

6.2.1 Organizational Memory and Knowledge Management

Both organizational memory and knowledge management are concepts that dominate much of the literature analyzed in this study.

Efficient implementation and use of robust organizational memory systems ensure that access to information or knowledge throughout the organization is possible for everyone.

In terms of tools and technologies, the KM systems, including hardware and software, should be established so that knowledge can be created from any new events, accessed, and reviewed continually. The entire know-how or new knowledge can only be created, and shared KM infrastructure is established effectively.

This section presents the questions included in the survey to assess this technological dimension. Note that in every question, the scale used is a Likert scale ranging from 1 – "totally disagree" to 5 – "totally agree".

Q1. - In my organization, work documents, information, and other data are stored centrally and digitally.

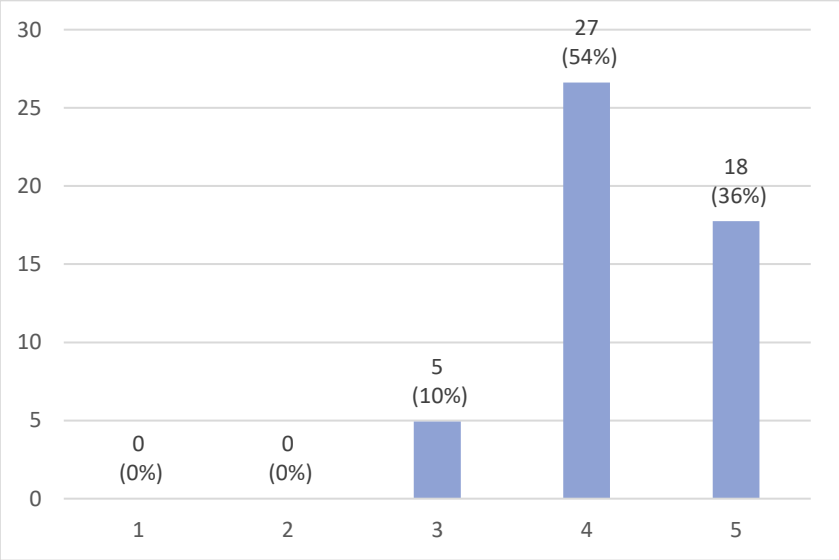

Figure 23 - Answers to question 1- "*In my organization, work documents, information, and other data are stored centrally and digitally*"

Q2. - I have access to the data/documents/information I need to perform my tasks in my organisation.

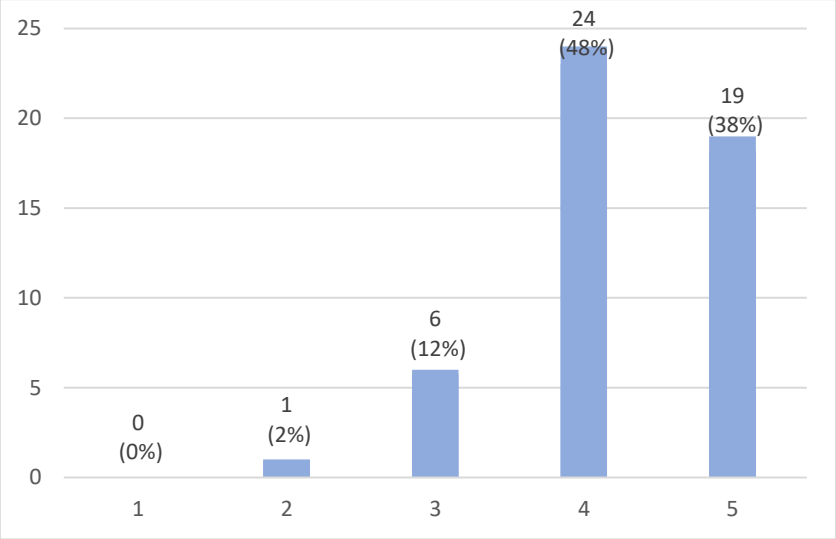

Figure 24 - Answers to question 2 - "*In my organization, I have access to the data/documents/information I need to perform my tasks"*

Q3 - In my organization, people have the information they need for their tasks at any time and centrally.

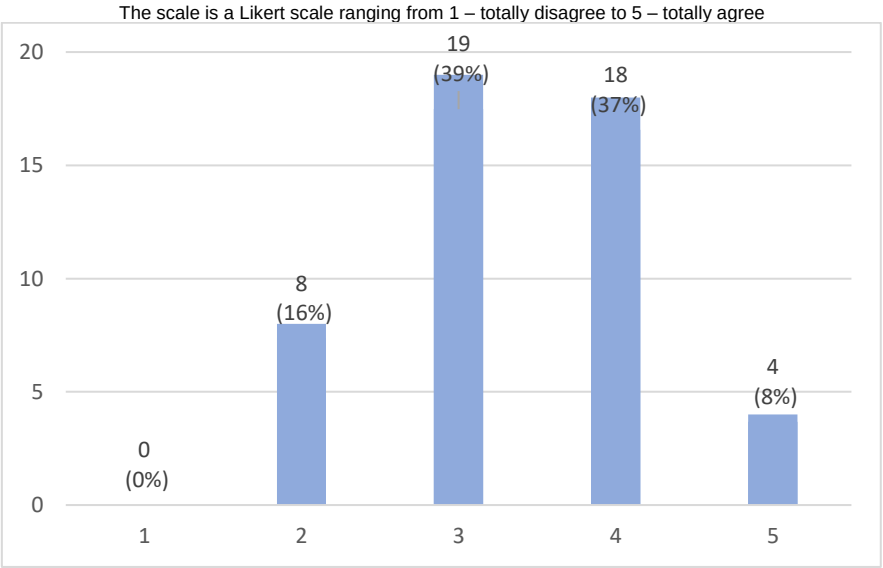

Figure 25 - Answers to question 3 – "*In my organization, people have the information they need for their tasks at any time and centrally"*

Q12 - In my organization, lessons learned and best practices from my area of expertise are made digitally available to all colleagues.

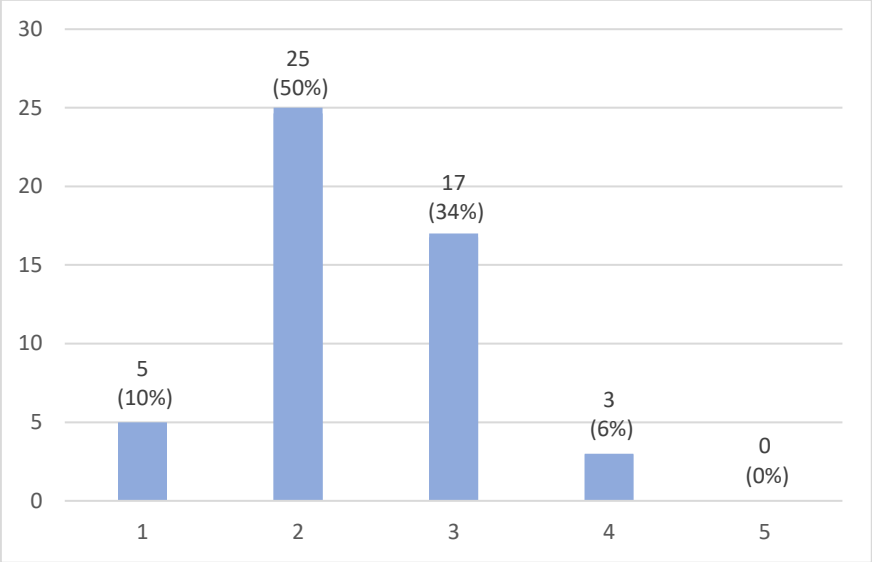

Figure 26 - Answers to question 12 – *"In my organization, lessons learned and best practices from my area of expertise are made digitally available to all colleagues*."

6.2.1.1 Summary of findings

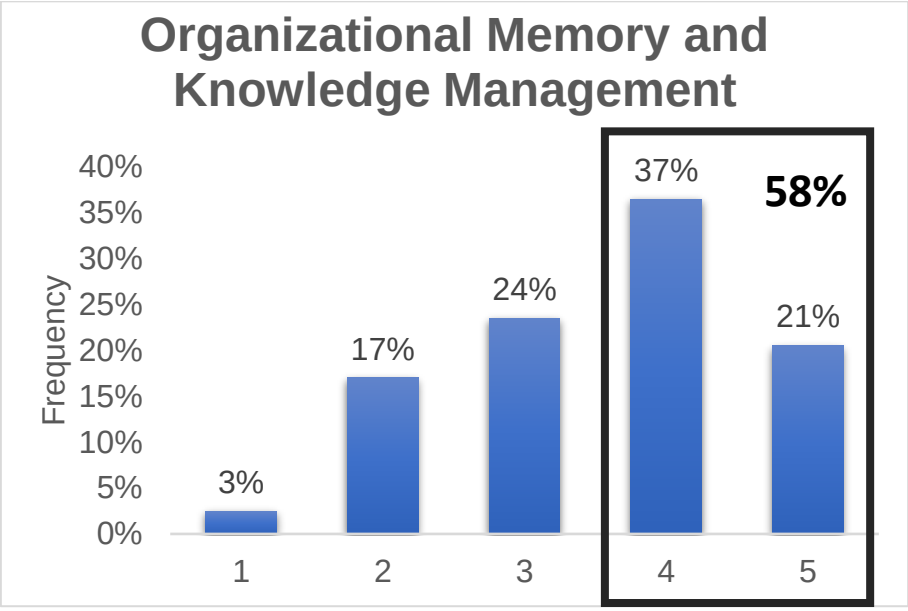

Figure 27 - Frequency of the responses regarding the "Organizational Memory and Knowledge Management" dimension

Question 12 overlaps in several topics. We could consider that the outputs from certain actions could

be processed by data mining the data produced. However, these actions are typically done by experimentation and are tacit knowledge that can be converted to explicit knowledge or passed to others via socialization [8].

The answers provided for question 12 may concern several viewpoints; there is no action from the employees to create, share and store the knowledge, so to convert the tacit to explicit knowledge can be somehow immature in this organization.

Another viewpoint regards the IT enhanced conversion of knowledge, through a combination process [8], as needs improvement.

However, these conclusions can be biased because there are many types of knowledge, and this question only focuses on lessons learned and best practices of the employee's professional background. Although this is identified as one of the most important activities, a LO learns from their own experience and history [7].

The answers to questions 1,2 and 3 indicate that much of the knowledge in the organization is IT enhanced, so to clearly understand which is

6.2.2 Communication and Collaboration

LO should not only depend on internal forces to foster learning and new insights. They should share ideas with internal groups and with customers, suppliers, outside experts or strategic partners to maximize the creation of new knowledge.

Increasing communication and the flow of knowledge and information throughout the organization, but also externally, helps an organization in many aspects [94][95]:

- Better strategic alignment and decision making;
- Aligning brand image from the inside out;
- Building trust among employees and customers;
- Keeping up-to-date with the organization’s news and industry trends;
- Creating more engaging content;
- Creating a sense of teamwork;
- Handling rapid corporate changes more efficiently.

IT enhanced communication and collaboration, can increase autonomy and participation but also facilitate creativity, and support opportunistic business development [94].

In this section, we present the questions to understand if this organization has communication and collaboration enhanced capabilities.

Q4 - In my organization, there are technology tools/applications to manage projects, teams, and meetings.

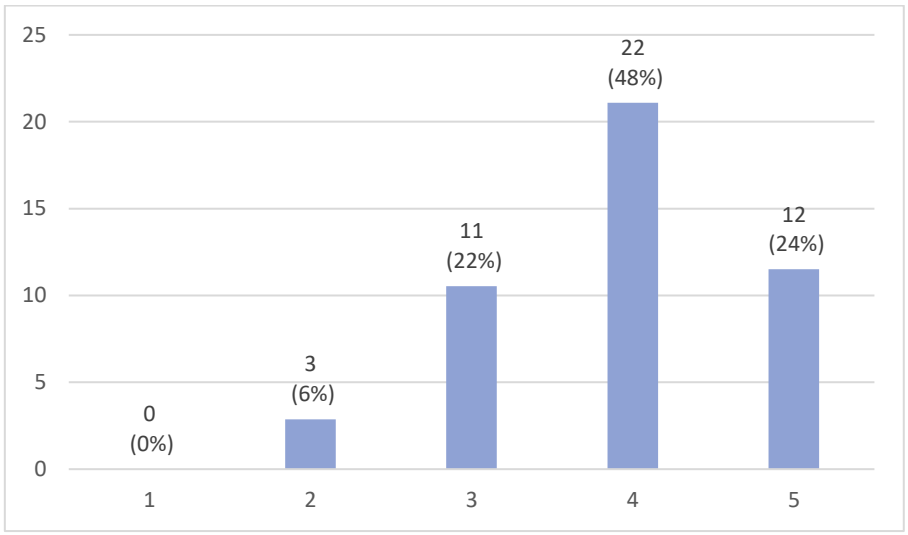

Figure 28 - Answers to question 4 – "*In my organization, there are technology tools/applications to manage projects, teams, and meetings*"

Q5 - In my organization, I have the tools to work with the external community (people from other companies, suppliers, and competitors).

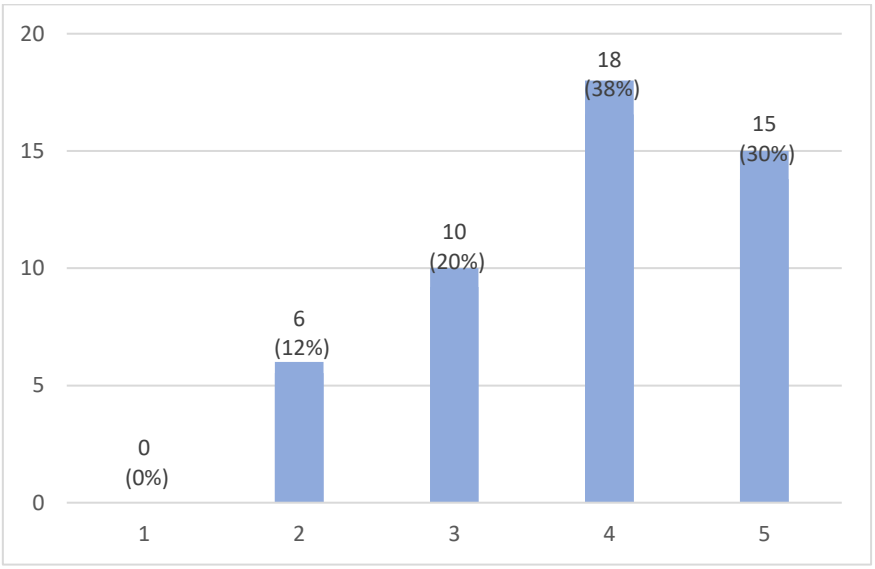

Figure 29 - Answers to question 5 – "*In my organization, I have the tools to work together with the external community (people from other companies, suppliers, competitors, etc.)"*

Q6 - In my organization, people and teams have the tools to work in a virtual collaborative environment in real-time.

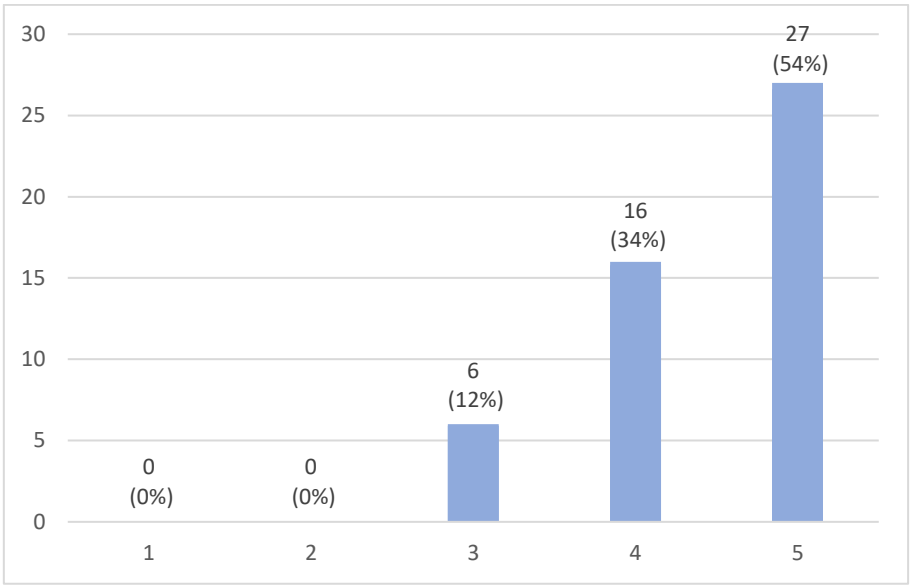

Figure 30 - Answers to question 6 – "*In my organization, people and teams have the tools to work in a virtual collaborative environment in real-time"*

Q7 - In my organization, there are tools where I can easily create and share content with others.

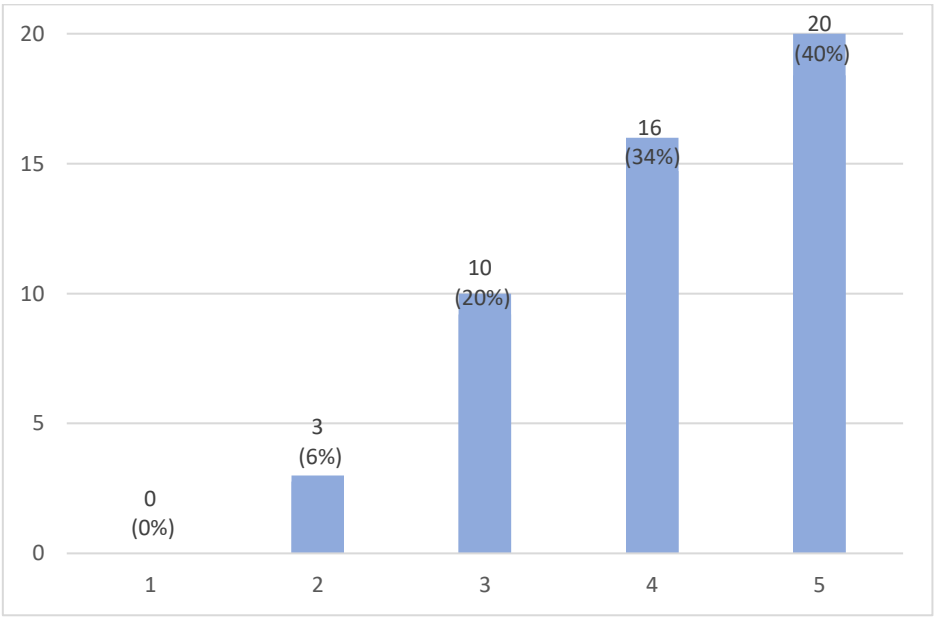

Figure 31 - Answers to question 7 – "*In my organization, there are tools where I can easily create and share content with others"*

Q8 - In my organization, there are digital channels for people to exchange information with the entire organization in a targeted way.

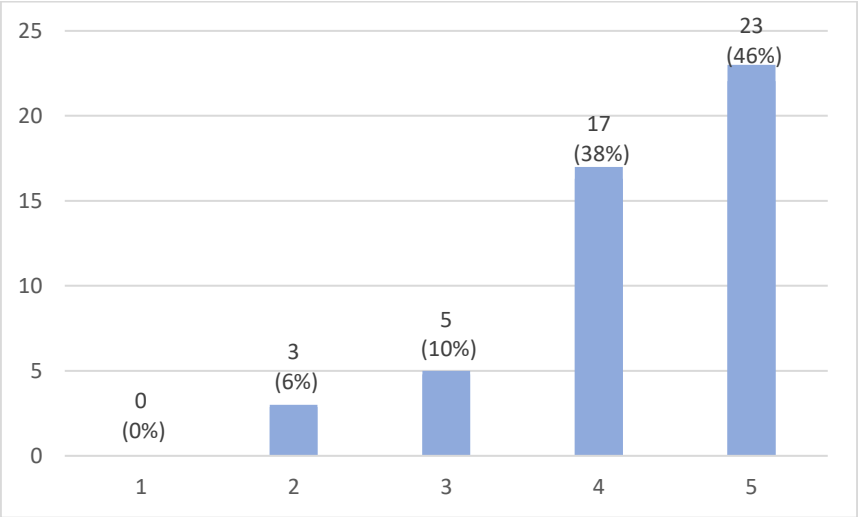

Figure 32 - Answers to question 8 – *"In my organization, there are digital channels for people to exchange information with the entire organization in a targeted way"*

6.2.2.1 Summary of findings

After reviewing the answers, we could identify that this dimension is the most relevant in this organization Figure 33). IT tools for communicating and collaborating are available to all employees and are used internally and externally.

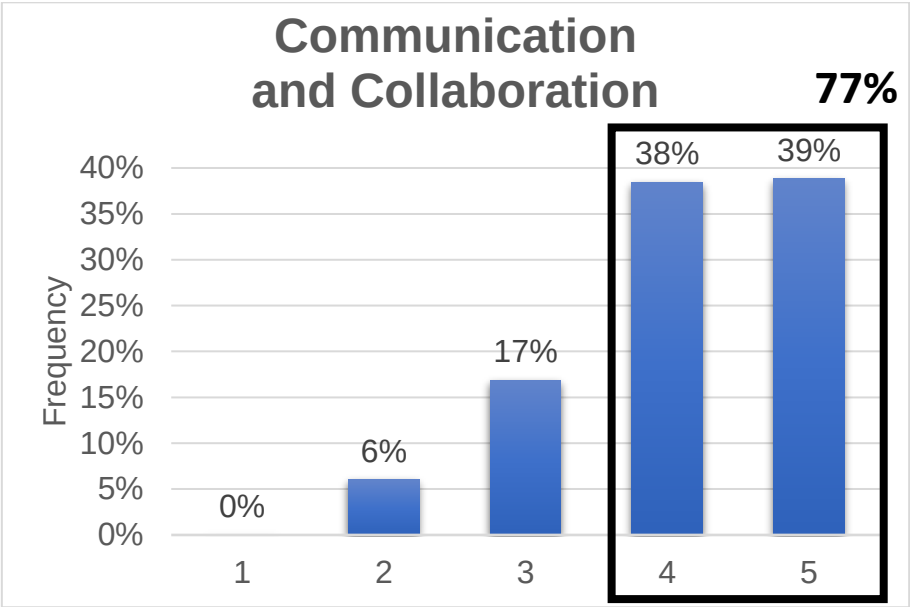

Figure 33 - Frequency of the responses regarding the "Communication and Collaboration" dimension

This point is a pillar of the technological aspect of a LO. These findings support that a LO requires a strong and efficient IT communication infrastructure, allowing employees to communicate, share ideas and knowledge, and ensure efficient knowledge transfer.

6.2.3 Learning Systems

A Learning System (LS) aims to provide a simple and easy way for employees – or any other person - to learn and discuss using the IT enhanced tools.

They may overlap with the previous dimension because an efficient learning environment should provide communications tools [96].

Also, they can provide important inputs for the topic in the Data Mining and Business Intelligence dimension that we will present in the next section.

Q9 - In my organization, learning is facilitated by effective and efficient information systems.

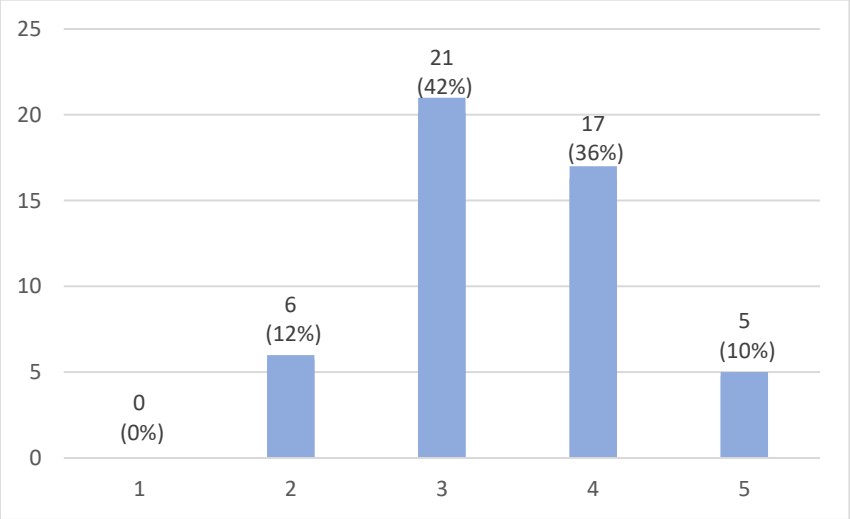

Figure 34 - Answers to question 9 – *"In my organization, learning is facilitated by effective and efficient information systems."*

Q10 - In my organization, information and Learning Systems and technologies allow me to access content relevant to my needs.

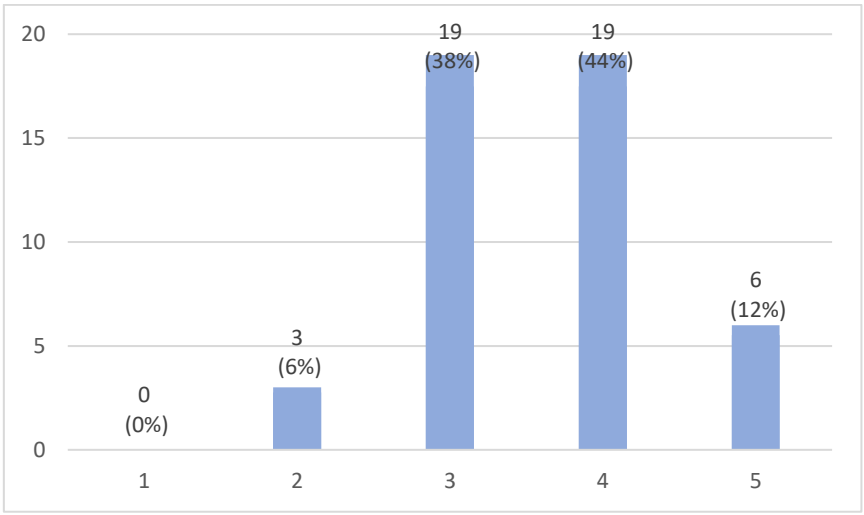

Figure 35 - Answers to question 10 – *"In my organization, information and Learning Systems and technologies allow me to access content relevant to my needs."*

Q15 - In my organization, people can adapt the system, software and/or applications to their learning needs.

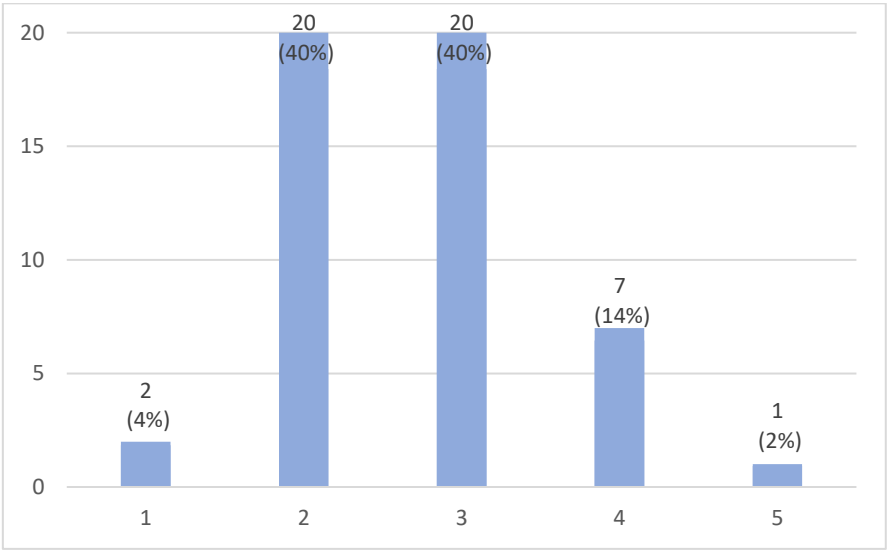

Figure 36 - Answers to question 15 – *"In my organization, people can adapt the system, software and/or applications to their learning needs."*

6.2.3.1 Summary of findings

These findings support that this dimension is important for a LO. In this organization where the survey was performed, we could identify that there is an IT-supported learning system (Figure 37).

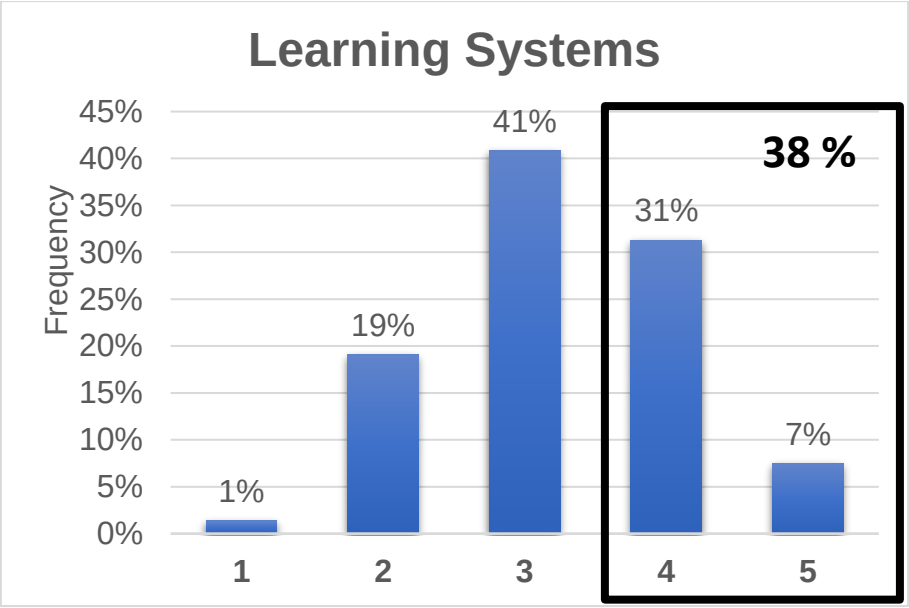

Figure 37 - Frequency of the responses regarding the "Learning Systems" dimension.

The answers to question 15, reveal that the tools provided may not cover all the areas that an employee requires or can have content that is not relevant to a particular department or field of expertise.

6.2.4 Data Mining and Business Intelligence

Knowledge can come from many sources, internal and external sources. The amount of data that is unstructured or in diverse formats produced by the daily operations of an organization is greater each year. [97].

With incorrect, inaccurate, or incomplete information, managers and employees will make worse decisions.

As such, DM and BI attempt to solve this problem by analyzing data and presenting it in easily readable reports or dashboards that facilitate management decisions and allow for better decision-making.

Q11 - In my organization, some platforms help resolve important problems based on the history of previous problems.

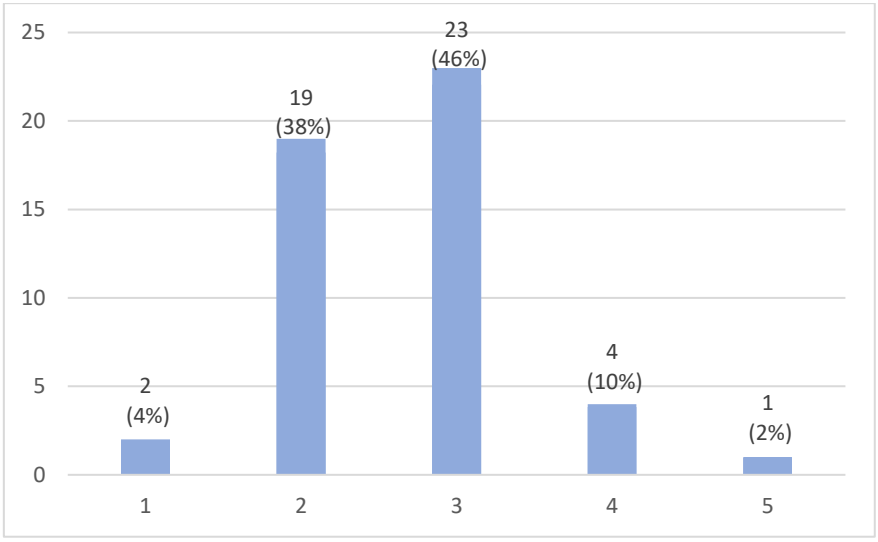

Figure 38 - Answers to question 11 – *"In my organization, there are platforms that help in resolving important problems, based on the history of previous problems."*

Q13 - In my organization, there are information systems that process data quickly and allow new patterns/results to be discovered.

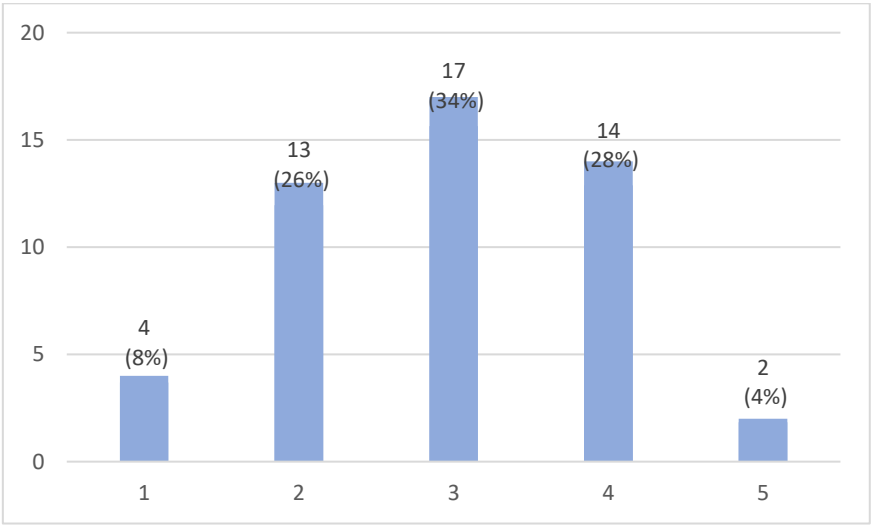

Figure 39 - Answers to question 13 – *"In my organization, there are information systems that process data quickly and allow new patterns/results to be discovered."*

Q14 - In my organization, there are computer-based tools to measure the results and potential risks of the actions I intend to take.

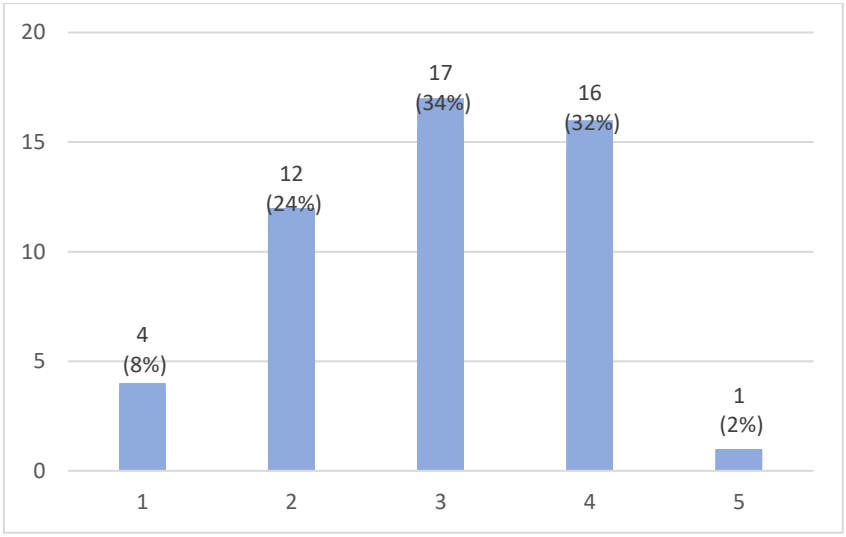

Figure 40 - Answers to question 11 – *"In my organization, there are computer-based tools to measure the results and potential risks of the actions I intend to take."*

Q16 - In my organization, there are visualization tools to monitor our performance indicators (KPIs) and other important information related to the performance of our work.

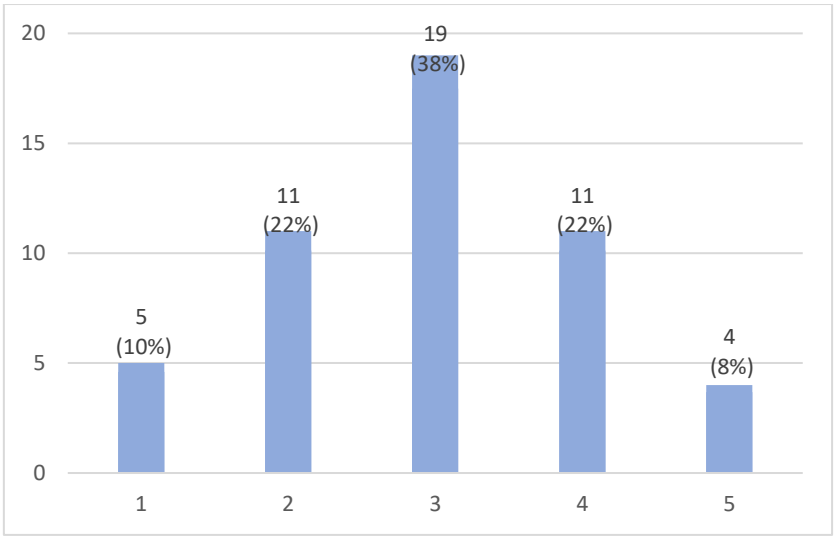

Figure 41 - Answers to question 16 – *"In my organization, there are visualization tools to monitor our performance indicators (KPIs) and other important information related to the performance of our work."*

Q17 - In my organization, IT systems measure the gaps between current and expected performance.

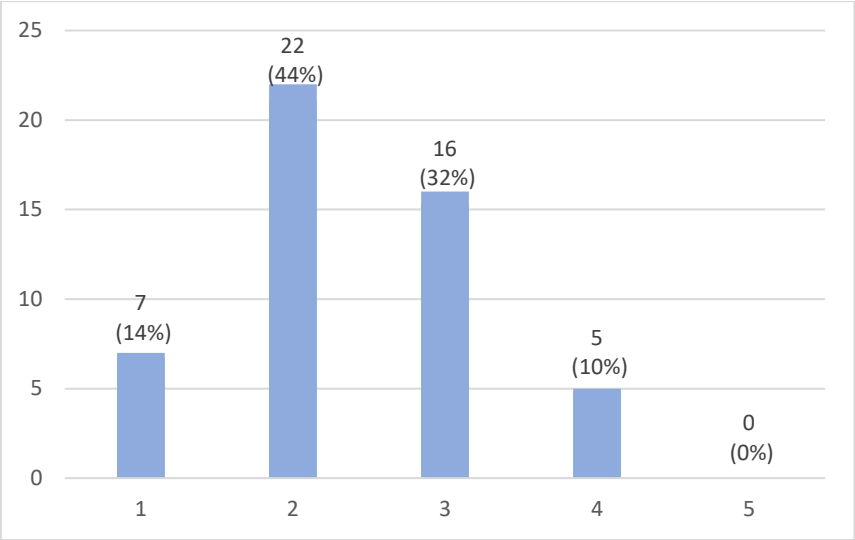

Figure 42 - Answers to question 17 – *"In my organization, IT systems are used to measure the gaps between current and expected performance."*

6.2.4.1 Summary of findings

This dimension can be identified in this organization, although the answers support that process of implementing this type of tools/platform is in an initial state to leverage the most outcomes possible.

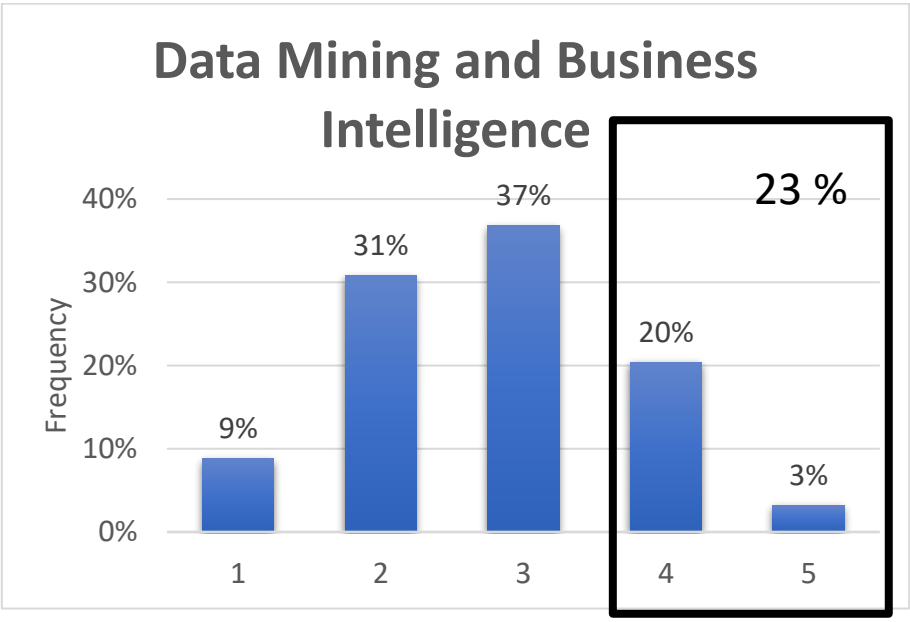

Figure 43 - Frequency of the responses regarding the "Data Mining and Business Intelligence" dimension

Again, in this topic, questions 11 and 13 may overlap two topics: organizational memory and knowledge management and data mining and business intelligence. In question 11, separating the two topics is a

more difficult task, but we wanted to understand if this organization and any IT tool to analyze data and produce reports.

After reviewing this question and its answers, it became clear that this question may lead to an incorrect conclusion. However, in question 13 the word “process” is extremely important to make the correct differentiation.

6.3 Results Analysis

The questionnaire developed was useful in confirming the dimensions proposed in this study, through the interpretation of the answers provided by the fifty employees in the organization and the joint construction of interpretations that allow a better response to the initial question of this study.

Considering the findings in each of the dimensions, it was possible to conclude that all of the dimensions in the proposed framework were validated.

However, we identified by interpreting the answers to all of the questions that the four dimensions did not have the same weight or relevance within this organization.

As such, we present a visual review of the proposed framework in the next section, taking into consideration these outputs gathered from the survey.

6.4 Framework Adjustments

After analyzing the survey results, some adjustments need to take place. Some dimensions were not as significant as others from the participant's perception or viewpoint.

We present the reviewed framework, considering a ponderation of the dimensions assessed using the survey.

The bottom dimension is considered more relevant in a LO than the dimension at the top of the pyramid.

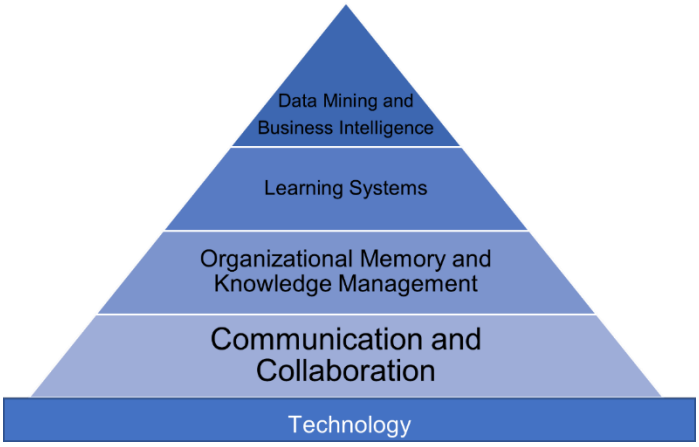

Figure 44 - Reviewed framework and ponderation of technological dimensions

7 Conclusions and Recommendations

This chapter contains the summary of the study, interpretation of the findings, limitations of the study, discussion, and suggestions for future work.

7.1 Summary of the study

Continuous learning has become necessary for professional development in response to a changing environment and new developments.

Ranging from employee retention or staying ahead in an evolving competitive world, having the right tools to enable a creative, easily accessible learning environment, create, store and share knowledge, and apply that same knowledge to the organization's behaviour and processes, is essential.

The world has become digital and global; therefore, every aspect of an organization, both business and customer aspects and internal processes, needs to follow this trend. This trend will help company growth, so organizations must look outward and form strategic alliances with their suppliers and customers. Learning organizations must always improve their ability to be inventive and creative

Success in the next decade will be determined by a mix of these two variables and new business processes and business models. Learning from customers, employees, and suppliers will provide a huge competitive edge to learning organizations.

Learning organizations combine the potential of the human intellect, leveraging it with various technologies. A proper framework is required to facilitate the transformation of data and leverage the most valuable resource – the organization’s workforce.

With this goal defined, to enhance the digital transition regarding the learning process or building the right technological path to become a LO, we set ourselves to develop a framework as a referral for organizations pursuing this challenge.

Before starting the development of the framework, we carried out a Literature Review (LR) to identify the IT-related technologies and processes in which the LO can forward their learning needs.

After that extensive LR, we acknowledge that people and technology are the only two important factors in creating learning organizations.

The latter is the focus of this study, to seek an answer to the following research question:

1. ***Which technological dimensions can the current main information technologies (IT) support or facilitate in becoming a Learning Organization****?*

The LR allowed us to have a clearer vision of the IT needs of a LO and enabled us to make a consistent choice of the approaches used for the development of the framework.

To evaluate the framework, we used a survey to validate a specific organization that defines itself as having or pursuing the characteristics of a LO.

7.2 Limitations

There are multiple limitations to this study. The framework presented in this study is intended to function as a baseline or as solid ground for technologies that function as facilitators for organizations that want to pursue the learning organization's goals.

Nevertheless, there is no “silver bullet” to every organization, and even in the same organization, different departments may have different needs.

Another limitation is about the tools/technologies themselves since some of those tools need expertise either in the implementation or require some advanced knowledge by the end-user.

Other limitations can be identified as:

- Sample size;
- Unfamiliar with the IT tools of the organization that the survey was performed;
- “One size fits all” framework;
- A clear assessment of the organization's LO profile.

Greater sample size should be used, using other organizations from different sectors to understand the framework's viability better. The employee responses were limited to 50, and because it was confidential, there is no information about the respondent's area of expertise. So these facts limit the possibilities of generalizing the findings in this study.

Therefore is important to promote studies with larger samples whose findings could be generalizable and add a comprehensive insight on relevant adjustments to the proposed framework that may still prevent the correct leverage of ICT tools in the path of becoming an LO as well as assess their impact on facilitating the building block and dimensions of a LO.

The IT tools that the organization deployed and are available to employees, particularly for learning purposes, should be addressed.

Defining a framework for all organizations can add some risk regarding organization-specific needs. Different organizations have different needs, and of course, a technological framework is recommended but by no means is undeniably required.

Lastly, defining a LO is somehow challenging; therefore, a clear assessment performed by the investigators should have been performed.

7.3 Future Work

Many tasks can be performed to complement future work. In this section, we will present most of the tasks.

Defining critical success factors to implement, deploy and ensure the correct use of IT tools in the framework four dimensions. Just buying and installing the tools is just not enough. Clear steps must be defined to guarantee that the workforce takes advantage of the technological ecosystem.

The validation of the contents of organizational memory is an important area for further research. Time to maintain the knowledge base, expiration date, relevant knowledge, and remove unused or expired knowledge.

Complementing this framework with every dimensions landscape of tools and applications should also provide great input to an organization pursuing the LO status.

Although the framework presented in this study identifies the technological dimensions and tools/technologies available, choosing the right tools for the organization for each of the dimensions would be extremely helpful. It would need enough literature review and outputs for another study.

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9 Appendixes

*

Appendix A – Financial organization vision, mission and values

Competência, eficácia e eficiência

[redacted] tem colaboradores altamente qualificados nas suas áreas de missão. O seu modelo de governo, organização interna e processos têm como referência as melhores práticas.

Espírito de equipa

Os colaboradores [redacted] trabalham com espírito de entreajuda e de partilha do conhecimento.

- **Proximidade das instituições, com independência e responsabilidade.** [redacted] dinâmico e transparente no quadro institucional, de relacionamento com os outros supervisores e demais autoridades, preservando a sua independência e assegurando eficiência e sustentabilidade na utilização dos recursos à sua disposição;
- **Proximidade entre equipas.** Uma organização exemplar na colaboração, partilha e construção de conhecimento, com colaboradores capacitados e motivados, num quadro de inclusão e diversidade.

Appendix B – Michael Marquardt's Learning Organization Profile

This survey had five sections, each with 10 questions, and had the following scale:

4 = applies totally

3 = applies to a great extent

2 = applies to a moderate extent

1 = applies to little or no extent

*

Table 18 - Marquardt's Section V. Technology Application: Knowledge Information Systems, Technology-Based Learning, and Electronic Performance Support Systems.

In this organization
____ 1. Learning is facilitated by effective and efficient computer-based information systems.
____ 2. People have ready access to the information highway via, for example, local area networks, the Internet, and an intranet.
____ 3. Learning facilities incorporate electronic multimedia support and an environment based on the powerful integration of art, colour, music, and visuals.
____ 4. Computer-assisted learning programs and electronic job aids (just-in-time and flowcharting software) are readily available.
____ 5. We use groupware technology to manage group processes such as project, team, and meeting management.
____ 6. We support just-in-time learning, which integrates high-tech learning systems, coaching, and actual work on the job into a single process.
____ 7. Our electronic performance support systems enable us to learn and perform our jobs better.
____ 8. We design and tailor our electronic performance support systems to meet our learning requirements.
____ 9. People have full access to the data they need to do their jobs effectively.
____ 10. We can adapt software systems to collect, code, store, create and transfer information in ways best suited to meet our needs.

Appendix C - Email to participants

From: Joaquim Santos

Sent: sexta-feira, 3 de dezembro de 2021 10:11

Subject: Questionário para dissertação de Mestrado

Bom dia,

Estou, atualmente, a desenvolver a minha dissertação de Mestrado em Informação e Sistemas Empresariais (do IST e da Universidade Aberta), que aborda a temática da utilização de tecnologias de informação para a aprendizagem e gestão do conhecimento nas organizações.

O objetivo deste questionário é avaliar a existência e perceber o grau de utilização destas tecnologias na sua organização.

O tempo para responder a este questionário deverá ser inferior a 10 minutos e estará disponível até ao próximo dia 10 (6ª feira).

Todas as respostas serão totalmente anónimas e utilizadas apenas para fins académicos.
Agradeço desde já a sua disponibilidade para responder a este questionário.
Para aceder ao questionário por favor clique aqui.

Com os melhores cumprimentos, Joaquim Santos

Appendix D - Survey form

*

Tecnologias de Informação para a aprendizagem organizacional

Este questionário realiza-se no âmbito de uma dissertação para a obtenção do grau de Mestre em Informação e Sistemas Empresariais.

Pretende-se, através do presente questionário, conhecer a perceção que tem sobre as tecnologias de informação na sua organização que promovam a criação, o armazenamento e partilha da informação. Pretende-se igualmente, avaliar se existem tecnologias que permitem uma maior produtividade e redução das atividades redundantes ou repetitivas.

As respostas a este questionário são totalmente anónimas assim como o nome da organização.

Este questionário está dividido em duas partes:

Parte I - Caracterização sobre si próprio(a) e dos seus conhecimentos de tecnologias de informação.

Parte II – Perguntas sobre a sua organização. Por favor, responda a todas estas questões optando por um valor entre:
1 - "Discordo Totalmente" ou 5 - "Concordo totalmente".

Agradeço desde já a sua disponibilidade e participação.

*

1. Género *

Mark only one oval.

- ◯ Masculino
- ◯ Feminino

2. Idade *

Mark only one oval.

- ◯ Menos de 26 anos
- ◯ Entre 26 e 35 anos
- ◯ Entre 36 e 45 anos
- ◯ Entre 46 e 55 anos
- ◯ Mais de 55 anos

3. Formação académica *

Mark only one oval.

- ◯ Ensino Secundário
- ◯ Licenciatura
- ◯ Mestrado
- ◯ Doutoramento
- ◯ Other: _____

4. Como avalia os seus conhecimentos de Tecnologias de Informação? *

Mark only one oval.

- ◯ Inexistentes
- ◯ Básicos
- ◯ Intermédios
- ◯ Avançados

5. Como considera a utilização das tecnologias de informação nas suas funções profissionais? *

Nas minhas tarefas diárias necessito de determinadas aplicações, sistemas ou outras plataformas informáticas.

Mark only one oval.

- ◯ Não relevante
- ◯ Pouco relevante
- ◯ Relevante
- ◯ Muito Relevante

6. Na minha organização, os documentos de trabalho, informações e outros dados são armazenados de forma centralizada e digital. *

Desta forma a rapidez de acesso e a capacidade de processar uma maior quantidade de dados aumentam significativamente.

Mark only one oval.

	1	2	3	4	5	
Discordo Totalmente	◯	◯	◯	◯	◯	Concordo Totalmente

7. Na minha organização, tenho acesso aos dados/documentos/informação de que preciso para realizar as minhas tarefas . *

Sei quais são os sistemas e tenho acesso aos mesmos para poder realizar as minhas tarefas

Mark only one oval.

	1	2	3	4	5	
Discordo Totalmente	◯	◯	◯	◯	◯	Concordo Totalmente

*

8. Na minha organização, as pessoas têm as informações necessárias p ra as suas tarefas a qualquer momento e de forma centralizada.

Desde informação organizacional, a boas práticas referentes à minha função.

Mark only one oval.

	1	2	3	4	5	
Discordo Totalmente	◯	◯	◯	◯	◯	Concordo Totalmente

9. Na minha organização, existem ferramentas tecnológicas/aplicações para gerir projetos, equipas e reuniões. *

Ferramentas que permitam acompanhar o estado dos projetos/tarefas em que estou envolvido(a), gerir a minha ocupação e da minha equipa, entre outros.

Mark only one oval.

	1	2	3	4	5	
Discordo Totalmente	◯	◯	◯	◯	◯	Concordo Totalmente

10. Na minha organização, tenho ferramentas para trabalhar em conjunto com a comunidade externa (pessoas de outras empresas, fornecedores, competidores, etc).

Consigo estabelecer uma conferência, trocar e obter informações, obter ajuda com outras pessoas que não exclusivamente os colegas internos. *

Mark only one oval.

	1	2	3	4	5	
Discordo Totalmente	◯	◯	◯	◯	◯	Concordo Totalmente

11. Na minha organização, as pessoas e equipas têm ferramentas para trabalhar em ambiente colaborativo virtual em tempo real. *

Consigo estabelecer uma sessão virtual para troca de ideias, resolução de problemas, etc *

Mark only one oval.

	1	2	3	4	5	
Discordo Totalmente	◯	◯	◯	◯	◯	Concordo Totalmente

12. Na minha organização, existem ferramentas onde posso facilmente criar e partilhar conteúdo com outras pessoas.

Existem blogs, áreas de trabalho digitais, wikis ou outros que permitam que eu consiga criar conteúdos informativos e partilhar com outros colegas

Mark only one oval.

	1	2	3	4	5	
Discordo Totalmente	◯	◯	◯	◯	◯	Concordo Totalmente

13. Na minha organização, existem canais digitais para as pessoas troc rem informação com toda a organização de forma direcionada.

Tenho a possibilidade trocar informações via correio eletrónico, messenger ou outros

Mark only one oval.

	1	2	3	4	5	
Discordo Totalmente	◯	◯	◯	◯	◯	Concordo Totalmente

14. Na minha organização, a aprendizagem é facilitada por sistemas de informação eficazes e eficientes. *

Existência de plataformas que reúnam informação pertinente para o desempenho das minhas tarefas diárias

Mark only one oval.

	1	2	3	4	5	
Discordo Totalmente	◯	◯	◯	◯	◯	Concordo Totalmente

*

15. Na minha organização, existem Sistemas e Tecnologias de Informação e de Aprendizagem que permitem aceder a conteúdos relevantes para as minhas necessidades.

Plataformas que disponibilizem conteúdo que ajudem a aprofundar os conhecimentos atuais ou outros que promovam o meu desempenho, conteúdos acessíveis via plataforma tipo Moodle, Coursera, Udemy ou outra.

Mark only one oval.

	1	2	3	4	5	
Discordo Totalmente	◯	◯	◯	◯	◯	Concordo Totalmente

16. Na minha organização, existem plataformas que ajudam na resolução de problemas importantes, com base em histórico de problemas anteriores.

Consigo utilizar conhecimento obtido anteriormente para evitar a repetição dos mesmos passos ou a criação de eventuais novos problemas, ou seja, evita "reinventar a roda". *

Mark only one oval.

	1	2	3	4	5	
Discordo Totalmente	◯	◯	◯	◯	◯	Concordo Totalmente

17. Na minha organização, as lições aprendidas e boas práticas da minha área de conhecimento são disponibilizadas digitalmente para todos os colegas. *

A aprendizagem não fica retida na minha unidade mas é partilhada por todos que tenham interesse .

Mark only one oval.

	1	2	3	4	5	
Discordo Totalmente	◯	◯	◯	◯	◯	Concordo Totalmente

18. Na minha organização, existem sistemas de informação que process m os dados rapidamente e permitem descobrir novos padrões/resultados.

Aplicações que permitam a análise de dados, seja em bases de dados, em documentos ou outros

Mark only one oval.

	1	2	3	4	5	
Discordo Totalmente						Concordo Totalmente

*

19. Na minha organização, existem ferramentas baseadas em computação para medir os resultados e riscos potenciais das ações que pretendo executar. *

Tenho acesso, por exemplo, a ferramentas de Business Intelligence (BI) que ofereçam algum grau de confiança nos resultados esperados.

Mark only one oval.

	1	2	3	4	5	
Discordo Totalmente						Concordo Totalmente

20. Na minha organização, as pessoas podem adaptar o sistema, software e / ou aplicações às suas necessidades de aprendizagem. *

Flexibilidade para acesso e controlo de aplicações que permitam melhorar a minha aprendizagem

Mark only one oval.

	1	2	3	4	5	
Discordo Totalmente						Concordo Totalmente

*

21. Na minha organização, existem ferramentas de visualização para monitorar os nossos indicadores de performance (KPI's) e outras informações importantes relacionadas com a performance do nosso trabalho. *

Dashboards que permitam avaliar a performance ao longo do tempo e praticamente em tempo real

Mark only one oval.

	1	2	3	4	5	
Discordo Totalmente	◯	◯	◯	◯	◯	Concordo Totalmente

22. Na minha organização, os sistemas de TI são usados para medir as lacunas entre o desempenho atual e o desempenho esperado. *

Consigo perceber quais são as minhas oportunidades de melhoria de forma sistematizada

Mark only one oval.

	1	2	3	4	5	
Discordo Totalmente	◯	◯	◯	◯	◯	Concordo Totalmente

Figure 45 - Google Form used for the questionnaire.

Appendix E – Survey questions

*

Table 19 - Survey questions

#	Question
1	My organisation stores work documents, information, and other data centrally and digitally.
2	I have access to the data/documents/information I need to perform my tasks in my organisation.
3	In my organization, people have the information they need for their tasks at any time and centrally.
4	My organisation has technology tools/applications to manage projects, teams, and meetings.
5	In my organization, I have the tools to work together with the external community (people from other companies, suppliers, and competitors).
6	In my organization, people and teams have the tools to work in a virtual collaborative environment in real-time.
7	There are tools where I can easily create and share content with others in my organisation.
8	In my organization, there are digital channels for people to exchange information with the entire organization in a targeted way.
9	In my organization, learning is facilitated by effective and efficient information systems.
10	In my organization, information and Learning Systems and technologies allow me to access content relevant to my needs.
11	In my organization, some platforms help resolve important problems based on the history of previous problems.
12	In my organization, lessons learned and best practices from my expertise are made digitally available to all colleagues.
13	In my organization, information systems process data quickly and allow new patterns/results to be discovered.
14	There are computer-based tools to measure the results and potential risks of the actions I intend to take in my organisation.
15	In my organization, people can adapt the system, software and/or applications to their learning needs.
16	In my organization, there are visualization tools to monitor our performance indicators (KPIs) and other important information related to the performance of our work.
17	IT systems measure the gaps between current and expected performance in my organisation.

Table 20 - Raw data of responses to the survey.

Idade	Formação académica	Como avalia os seus conhecimentos de Tecnologias de Informação?	Como considera a utilização das tecnologias de informação nas suas funções profissionais?	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17
Entre 46 e 55 anos	Mestrado	Avançados	Muito Relevante	5	5	5	5	5	5	5	5	5	4	4	3	5	4	2	3	3
Mais de 55 anos	Licenciatura	Avançados	Muito Relevante	5	5	4	4	3	5	5	4	4	4	3	3	4	3	3	3	3
Entre 46 e 55 anos	Mestrado	Avançados	Muito Relevante	5	5	5	4	4	4	4	4	3	4	3	3	3	2	2	3	3
Entre 46 e 55 anos	Licenciatura	Avançados	Relevante	4	2	2	2	2	3	2	2	2	2	2	2	2	2	2	2	2
Entre 26 e 35 anos	Mestrado	Intermédios	Muito Relevante	5	4	4	4	5	5	5	4	4	4	4	3	4	4	4	4	2
Entre 36 e 45 anos	Doutoramento	Intermédios	Muito Relevante	4	3	3	5	5	5	5	5	4	5	4	3	4	3	3	3	2
Entre 46 e 55 anos	Ensino Secundário	Básicos	Relevante	5	5	4	4	3	5	3	5	3	3	3	3	4	4	2	3	3
Mais de 55 anos	Mestrado	Avançados	Muito Relevante	5	4	3	4	3	4	3	4	5	4	2	2	3	3	3	3	4
Entre 36 e 45 anos	Mestrado	Avançados	Muito Relevante	5	5	4	5	5	5	5	5	4	3	2	1	2	3	2	1	1
Entre 46 e 55 anos	Mestrado	Intermédios	Muito Relevante	4	4	2	3	4	4	2	5	3	3	3	2	4	3	3	4	2
Entre 46 e 55 anos	Mestrado	Avançados	Muito Relevante	3	4	3	5	3	4	4	5	3	4	3	2	3	4	2	2	2
Entre 46 e 55 anos	Ensino Secundário	Avançados	Muito Relevante	5	5	4	4	3	4	4	4	3	3	3	2	3	3	3	4	2
Entre 26 e 35 anos	Mestrado	Avançados	Muito Relevante	4	4	3	4	4	5	5	4	3	3	2	2	2	2	3	2	3
Entre 26 e 35 anos	Mestrado	Avançados	Muito Relevante	4	4	4	5	5	4	5	5	3	3	3	2	3	3	2	4	2
Entre 46 e 55 anos	Licenciatura	Avançados	Muito Relevante	5	5	4	5	4	5	4	5	4	4	4	3	4	2	2	3	2
Entre 46 e 55 anos	Licenciatura	Avançados	Muito Relevante	4	4	3	4	4	4	4	4	2	3	3	2	2	3	2	2	3
Entre 46 e 55 anos	Mestrado	Avançados	Muito Relevante	3	4	2	3	2	4	2	2	3	3	3	2	2	1	2	1	1
Entre 46 e 55 anos	Licenciatura	Avançados	Muito Relevante	5	5	4	4	4	5	4	3	3	3	2	2	3	2	2	2	2
Entre 36 e 45 anos	Licenciatura	Avançados	Muito Relevante	4	5	4	4	3	3	3	3	3	3	2	2	2	2	1	2	1
Entre 36 e 45 anos	Mestrado	Avançados	Muito Relevante	4	4	3	4	3	4	4	4	4	4	3	4	4	4	4	4	4
Entre 36 e 45 anos	Mestrado	Avançados	Muito Relevante	5	4	2	2	4	5	5	5	3	4	3	2	4	4	4	4	3
Entre 26 e 35 anos	Doutoramento	Intermédios	Muito Relevante	4	3	3	4	4	4	5	5	4	4	2	2	1	1	3	3	3
Entre 36 e 45 anos	Licenciatura	Avançados	Muito Relevante	4	3	3	4	2	4	4	4	4	4	3	3	2	2	2	3	2
Entre 36 e 45 anos	Licenciatura	Avançados	Muito Relevante	4	4	4	4	4	5	5	4	3	4	3	3	3	3	3	3	3
Entre 36 e 45 anos	Mestrado	Avançados	Muito Relevante	3	4	2	4	2	3	3	4	2	4	3	2	3	4	3	4	3
Entre 36 e 45 anos	Mestrado	Avançados	Muito Relevante	5	4	3	4	4	5	5	5	4	3	3	2	3	4	3	2	2
Mais de 55 anos	Mestrado	Avançados	Muito Relevante	4	5	3	3	5	5	5	5	4	4	2	2	4	2	4	3	2
Entre 36 e 45 anos	Doutoramento	Básicos	Muito Relevante	3	5	2	3	5	5	5	4	3	5	2	1	2	2	2	3	2
Entre 46 e 55 anos	Mestrado	Avançados	Muito Relevante	4	5	4	4	4	5	4	5	3	3	2	2	2	2	2	3	2
Entre 46 e 55 anos	Licenciatura	Avançados	Muito Relevante	4	3	2	2	3	3	3	2	2	2	2	1	2	1	2	1	1
Entre 46 e 55 anos	Licenciatura	Avançados	Muito Relevante	4	5	4	5	5	5	3	5	3	3	3	2	4	4	3	3	1
Entre 36 e 45 anos	Mestrado	Avançados	Muito Relevante	4	5	4	4	5	5	5	5	4	3	3	3	4	3	3	3	3
Entre 36 e 45 anos	Licenciatura	Avançados	Muito Relevante	5	5	4	4	5	5	5	5	4	3	2	2	2	3	2	3	2
Entre 36 e 45 anos	Licenciatura	Intermédios	Muito Relevante	5	4	3	3	3	4	3	4	4	4	3	3	3	4	3	3	2
Entre 46 e 55 anos	Ensino Secundário	Intermédios	Muito Relevante	4	3	3	3	4	4	4	3	2	2	1	3	3	3	4	1	2
Entre 26 e 35 anos	Mestrado	Avançados	Muito Relevante	4	3	2	4	4	5	4	3	3	3	2	2	2	3	2	3	3
Entre 36 e 45 anos	Licenciatura	Intermédios	Muito Relevante	4	4	3	3	4	4	3	4	4	4	2	1	1	2	2	2	2
Entre 36 e 45 anos	Mestrado	Avançados	Muito Relevante	4	4	4	4	4	5	5	5	3	3	2	2	1	2	3	4	2
Entre 36 e 45 anos	Licenciatura	Intermédios	Muito Relevante	4	4	4	3	5	3	4	5	2	3	1	2	3	4	2	2	1
Entre 36 e 45 anos	Licenciatura	Avançados	Muito Relevante	3	4	3	5	5	5	5	5	4	5	3	2	3	4	3	5	3
Entre 36 e 45 anos	Mestrado	Avançados	Muito Relevante	5	5	5	5	5	5	5	5	5	5	5	4	5	5	4	5	4
Entre 46 e 55 anos	Mestrado	Avançados	Muito Relevante	4	4	3	4	4	5	4	4	3	4	2	1	1	1	1	1	1
Entre 26 e 35 anos	Licenciatura	Intermédios	Muito Relevante	4	5	3	3	4	5	3	4	4	4	3	3	4	4	5	5	4
Entre 46 e 55 anos	Licenciatura	Avançados	Muito Relevante	4	4	4	5	5	5	5	5	4	3	3	3	4	4	3	4	2
Entre 26 e 35 anos	Mestrado	Avançados	Muito Relevante	5	4	4	3	4	5	4	4	3	4	2	2	2	3	3	2	2
Entre 26 e 35 anos	Mestrado	Intermédios	Muito Relevante	5	4	3	3	3	3	4	4	4	4	2	4	3	3	3	4	4
Entre 36 e 45 anos	Mestrado	Intermédios	Muito Relevante	5	5	5	4	5	5	5	5	5	5	3	3	3	4	4	4	3
Entre 36 e 45 anos	Licenciatura	Avançados	Muito Relevante	4	4	4	5	4	4	4	4	5	4	4	3	3	3	3	3	3
Entre 36 e 45 anos	Licenciatura	Avançados	Muito Relevante	4	4	3	4	2	4	4	5	3	4	2	2	3	4	2	2	2
Entre 36 e 45 anos	Licenciatura	Avançados	Muito Relevante	4	5	3	5	2	4	3	3	3	5	3	3	4	3	3	5	3