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ECONOMICS OF BUSINESS AND STRATEGY

IMPROVING ORGANIZATIONAL DOCUMENTATION PRACTICES: A CASE STUDY OF EFACEC

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Abstract

In today's data-rich society, the success of an organization depends on its ability to use the data available and achieve results. To support that, recently organizations have invested more in Business Intelligence (BI) and data experts. As a result, the importance of BI has increased, leading to the necessity of documentation practices, which allows the BI team members to organize properly their daily activities.

This report is a case study of the company Efacec, within the BI team, which faces the issue of not having the habit of documenting its daily work, and when there is documentation, it is too simple. Therefore, the first goal of this study is to investigate the actual state of its documentation practices. The second goal is to identify possible areas for improvement, and the third is to develop a template or a set of guidelines for the BI team to follow when applying documentation practices.

The research methodology involves gathering evidence through participant observation, conducting semi-structured interviews, and analyzing relevant documentation from the organization. Through this, it is possible to know the current state of documentation at the Efacec. Consequently, the research identifies the challenges in the documentation process by employing the Documentation Maturity Model (DMM) framework, which assesses the documentation's efficiency, granularity/precision, and format.

Overall, the results of this study highlight some critical areas for improvement. For instance, the lack of a standardized template and guidelines leads to inefficiencies, impacting the documentation quality. Nonetheless, what is most noticeable is the poor data culture around documentation at Efacec, and a lack of motivation to invest time in this practice. Therefore, the improvements suggested are expected to enhance those areas and make the documentation practice more efficient and enjoyable for the collaborators.

Keywords: Documentation, Business Intelligence, Efficiency, Guidelines.

Resumo

Na sociedade atual rica em dados, o sucesso de uma organização depende da sua capacidade de utilizar os dados disponíveis e de alcançar resultados. Para atingir isso, recentemente as organizações investiram mais em Business Intelligence (BI) e em especialistas em dados. Como resultado, a importância do BI tem aumentado, levando à necessidade de práticas de documentação, que permite aos membros da equipa de BI organizar melhor as suas atividades diárias.

Este relatório é um caso de estudo da empresa Efacec e da sua equipa de BI, que se depara com o desafio de não documentar regularmente o seu trabalho diário, e quando existe documentação, ela é demasiado simples. Assim sendo, o primeiro objetivo deste estudo é investigar o estado atual das suas práticas de documentação. O segundo é identificar possíveis áreas de melhoria e o terceiro é desenvolver um modelo ou conjunto de diretrizes para a equipa de BI seguir quando faz documentação.

A metodologia de investigação envolve recolha de evidências, através da observação participante, da realização de entrevistas semiestruturadas e da análise de documentação relevante. Através disto é possível conhecer o estado atual da documentação na Efacec. Consequentemente, a investigação identifica os desafios no processo de documentação, com a ajuda do Documentation Maturity Model (DMM), que avalia a eficiência, granularidade/precisão e o formato da documentação.

No geral, os resultados deste estudo destacam algumas áreas críticas de melhoria. Por exemplo, a falta de um modelo e de orientações formais leva a ineficiências, afetando a qualidade da documentação. No entanto, o que mais se nota é a fraca cultura de dados em torno da documentação na Efacec e a falta de motivação para investir tempo nesta prática. Por isso, espera-se que as melhorias sugeridas aperfeiçoem estas áreas e tornem a prática da documentação mais eficiente e agradável para os colaboradores.

Palavras-chave: Documentação, Business Intelligence, Eficiência, Guidelines.

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List of abbreviations

BI - Business Intelligence

BIS - Business Intelligence Systems

BP – Best Practices

BPD – Best Practices Document

BI&A - Business Intelligence and Analytics

DMM – Documentation Maturity Model

EPS - Efacec Power Solutions, SA

ERP – Enterprise Resource Planning

IS - Information Systems

IT - Information Technology

I_i (i = 1:7) - Interviewer i

KPA - Key Process Areas

1. Introduction

In the business world, knowledge is one of the key resources in any organization. Today, knowledge is responsible for the success of an organization within the competitive global system (Alavi & Leidner, 2001). Therefore, it must be transferred or shared with other company members, so the organization does not lose crucial information (King, 2008). Just like organizations carefully manage physical resources, the same must happen with knowledge management, which is not just helpful but necessary in every organization (Alavi & Leidner, 2001).

When knowledge needs to be extensively transferred throughout the organization, organizations find that the better they document that knowledge, the more easily it can be transferred to others (Bloodgood, 2009). Thus, to transfer and store this knowledge to other employees and create collaboration in the organization, a system for documentation is necessary. Organizational documentation is considered a process, where knowledge and information are gathered, edited, and stored (Holsapple & Jones, 2009). Ultimately, it is important to remember that any type of documentation is always designed for humans. Hence, it must be carefully prepared according to its specific audiences who will read, understand, and utilize that information (Broy, 2022).

Overall, according to Haddadpoor et al. (2015), the practice of documentation plays a direct role in improving organizational activities, offering benefits such as recording processes, developments, and various other tasks. Despite this, some individuals still perceive documentation as a costly activity, sometimes considered unnecessary, and challenging to maintain in many projects (Parnas, 2010).

The internship was conducted within the Data Governance and Business Intelligence and Analytics (BI&A) department, more precisely at the Business Intelligence (BI) team, at Efacec, a global technology and engineering company headquartered in Portugal. Efacec has eight business units, each one with national and international clients, resulting in a substantial volume of data being generated and stored in the company's database. The big dimension of this company necessitates robust methods and strategies to access the data required for daily operations and decision-making. In this context, to remain competitive in the market, Efacec must invest in advanced Information Systems (IS) and new technologies. Thus, it has recently,

over the past 2 years, established the Data Governance and BI&A department to tackle these challenges. Nevertheless, the primary issue faced there, by the BI team, was the lack of effective documentation practices. In short, the existing challenge revolves around the team's minimal documentation strategy, which, while initially aiming for simplicity, sometimes hinders the work progress. This lack of comprehensive documentation leads to prolonged meetings and discussions, as team members struggle to gather requirements for daily tasks or any project development.

Therefore, in response to the presented problem, the three main objectives of this study are: 1) investigate the actual state of Efacec's BI team documentation practices; 2) identify possible areas for improvement; and 3) develop a template or a set of guidelines for the BI team to follow when applying documentation practices.

The study presented in this report adopts a qualitative research approach with a single case study. The focus of this case study is the enhancement of the documentation practices within Efacec, specifically targeting the BI team's workflow. The research methodology involves gathering evidence through participant observation, conducting semi-structured interviews, and analyzing relevant documentation from the organization. This includes conducting approximately seven interviews with members of the BI team, to understand current documentation practices, and analyze data and reports from the organization.

The results of the analyses of Efacec's current documentation practices indicate that documentation is at an initial stage, with a poor culture and without adherence to any norms. Therefore, to meet the team's documentation needs and improve this practice, appropriate guidelines have been developed to establish a standardized template and foster a culture that values consistent documentation practices.

This report is organized into six chapters. The first chapter introduces the theme and purpose of the study. The second chapter presents the literature review, which focuses on the role of BI, as well as the role of documentation, within organizations. This includes the evolving concepts and features of documentation, and the critical factors to implement it in a company. The third chapter defines the methodology employed, the methods of data collection, and its analysis. Then, chapter four provides an overview of Efacec Group's history, highlighting its last restructuring, and investment in BI and documentation practices. Chapter five examines the

current state of documentation practices within Efacec's BI team, using a previously selected framework. This chapter also delves into the results obtained from the interviews and provides suggestions for improvements, including the implementation of a standardized template. Finally, the last chapter presents the conclusions, contributions, limitations, and suggestions for future research.

2. Literature review

Most organizations now have dedicated BI teams for several activities, one of which is documentation. Therefore, before delving into the specifics of documentation practices, it is essential to understand why BI has become so crucial in the modern business landscape. This section first explores the growing significance of BI, examining its impact on decision-making, operational efficiency, and competitive advantage. Following this, the focus is shifted to the evolution of documentation within organizations. It traces its development from a rudimentary record-keeping to a sophisticated system that is integral to corporate strategy and operations. It also highlights how documentation should be practiced in order to be effective and have positive results in a business.

2.1. Business intelligence within organizations

BI encompasses a range of skills, tools, techniques, and solutions designed to help managers comprehend the business landscape (Rouhani et al, 2012). Meanwhile, BI has become increasingly important due to the amount of information being collected, processed, and communicated electronically (Nasri, 2012). Consequently, BI is now extremely crucial for various types of companies because information is the most valuable asset, considered essential for companies' development and success (Romero et al., 2021).

Another reason for BI's popularity is the increased global competition and the rapid technological advances. To keep up with those changes, a better use of information is required (Nasri, 2012). BI not only facilitates a deeper comprehension of internal business operations but also the competitive landscape by systematically gathering, analyzing, and interpreting information. As a result, BI transforms the information into strategic insights, thereby enabling it to take a competitive advantage. This valuable practice improves decision-making efficiency and enhances operational effectiveness. (Olszak, 2014).

Thus, a crucial factor for the success of organizations, in today's information and data-rich society, is the ability to use the data available to achieve operational objectives (Tian et al., 2015). As a result, companies now must employ a system that stores and analyzes those large volumes of data in real-time. Those systems can rely on the field of BI, which is necessary for processing information and making correct decisions at the corporate level. Implementing BI Systems (BIS) in organizations can provide several benefits, including customer data management, as well as improved architecture (Romero et al., 2021). Overall, BIS is a set of

technologies that enable organizations to collect and analyze extensive data repositories in order to identify opportunities, and strong and weak points, which reduces uncertainty in decision-making by supporting the decision-makers (Caseiro & Coelho, 2018; Harrison et al., 2015). Consequently, these systems enable employees and organizations to understand their business or market, facilitating timely strategic decisions (Niu et al., 2021).

BI has evolved over time, and, lately, it has been implemented and used at various organizational levels, to facilitate data-driven decision-making (Alpar & Schulz, 2016). At the strategic level, BI facilitates setting goals precisely and monitoring their achievement within the organization. It enables the generation of various comparative reports, such as historical performance, profitability, efficiency of distribution channels, and forecasting future outcomes based on certain assumptions. At the tactical level, BI serves as a decision-making foundation across marketing, sales, finance, management control, and capital management. It aids in optimizing future actions and adjusting organizational, financial, or technological aspects of company performance to better realize strategic objectives (Olszak & Ziemba, 2003).

Furthermore, the importance of BI can lie in its capacity to provide organizations with valuable insights that enhance competitiveness and profitability (Niu et al., 2021). Overall, it helps organizations improve operational efficiency, reduce costs, increase revenue, and discover new business opportunities (Nithya & Kiruthika, 2020). For instance, access to timely and accurate data is a strategy that enables better decision-making by reducing risk and answering effectively to changing market conditions. Hence, in the current fast-paced and data-driven business environment, companies that fail to utilize BI can run the risk of falling behind their competitors and missing out on growth opportunities (Brewis et al., 2023).

In short, by improving the quality of information available to an organization, BI can help create high-performance organizations, using minimal effort to obtain intelligent and targeted knowledge (Tian et al., 2015). It is possible to conclude that BI is essential for modern businesses since organizations can make informed strategic decisions about their internal and external business positions (Muhammad et al., 2014).

2.2. Documentation practices within organizations

2.2.1. The concepts and evolution of documentation

In the 1920s, the word 'documentation' started to be increasingly accepted as a general term. At that time, documentation encompassed bibliographies, scholarly information services, records management, and archival works. It is noteworthy that, beginning as far back as 1950, terms such as "information science" and "information management" have gradually replaced the very known term "documentation". Since then, the role of documentation in enhancing data clarity and reducing ambiguity has been vital. (Buckland, 1997). In essence, documentation encompasses a wide array of materials and aids in facilitating data discovery, which improves organizational productivity (Attard et al., 2015).

Meanwhile, the advent of digitalization has revolutionized governance worldwide, ushering in an era of "e-government" where citizens access administrative services and updated data through online platforms. This has provided a proper and efficient pathway for information and data collection (Yoon & Copeland, 2020). Thus, in this digital landscape, documentation has evolved, with dedicated staff and departments tasked with creating, archiving, reporting, and disseminating information, through various digital channels (Antons et al., 2020). This phenomenon was the result of the COVID-19 pandemic, which accelerated the adoption of digital formats, making documents nearly omnipresent (Amiraslani & Dragovich, 2022).

Nonetheless, documents and documentation have an extensive history before this digital era, as mentioned above. Digitalization of documentation, particularly of rare materials, has only seen a rapid acceleration in recent years. This trend has significantly enhanced the preservation and swift dissemination of knowledge. Yet, it comes with its downsides, notably the largely unregulated landscape of social media in the digital age, which generates a great amount of information (Amiraslani & Dragovich, 2022). For instance, millions of both informal and formal documents, encompassing scientific and non-scientific articles, have been created. This proliferation is accompanied by the spread of numerous myths, inaccurate data, and unverified or speculative information (Fraser-Arnott, 2020).

On the good side, digitalization has minimized the costs incurred in generating, producing, reproducing, analyzing, and distributing documents. This is particularly beneficial for businesses and organizations operating on limited budgets, including libraries, colleges, charities, and small businesses (Amiraslani & Dragovich, 2022). Overall, documentation

practices have undergone significant innovation, with multimedia documents on digital platforms and collaboration channels like Teams, Zoom, and Azure DevOps replacing extensive written documentation. Consequently, current documents have shorter life cycles and are considered dynamic throwaway artifacts (Nakayama et al., 2024).

As it is observed, contemporary documentation practices are evolving to become more dynamic, informal, and real-time. This shift is driven by factors like the digital transformation in organizations, the impact of agile approaches that emphasize less documentation, and the widespread use of communication media, resulting in the creation of more informal and volatile documents (Rueckel et al., 2020). This transformation reflects a new reality where the concept of a documentation system has slowly changed. The traditional notion of documentation as paper-based is now incomplete, as multimedia documentation and communication platforms automatically capture activities like planning and face-to-face meetings. Scholars like Buckland (2016) and Olsen et al. (2012) argue that this expansion beyond paper-based documentation embodies a broader perspective.

As a result, companies are increasingly leveraging cloud solutions and centralized platforms, focusing on increased standardization and decreased customization, which in turn reduces documentation volume. Centralizing information in one place is now crucial for facilitating the search for information (Huang et al., 2021).

For the past decades, across diverse fields, documentation has played a crucial role in enhancing usability, problem-solving, quality control, decision-making, and in addressing the multiplicity of technical and non-technical audiences (Østerlund & Crowston, 2019). For instance, in computer science, documentation ensures software quality and facilitates program comprehension or bug detection, i.e., A novice programmer, with no history in a particular project, may get some sense of the work completed from a report written by a software engineer on the project (Liu et al., 2021). Or in the case of medical sciences, where clinical documentation improves reimbursement procedures and data accuracy (Seligson et al., 2021). Similarly, in large-scale businesses, well-maintained documentation mitigates risks and supports effective decision-making (Nakayama et al., 2021).

Overall, over those years, documents have been serving as crucial channels through which individuals express their understandings and intentions to others. For that reason, documentation practices encompass a wide array of tasks, and they function as a collaborative process of sensemaking. In a paradoxical twist, documentation work is both indispensable to

organizational function and often overlooked as a form of invisible labor (Geiger et al., 2018).

To sum up, although documents are tools of communication that are changing rapidly in nature and quantity, they have always served as repositories of precious knowledge, preserving insights that might otherwise be lost over time, whether it is in old or contemporary contexts. (Amiraslani & Dragovich, 2022).

2.2.2. Features of effective documentation practices

Contrary to what is assumed, the sheer volume of documentation does not guarantee its efficacy. On one hand, if there is a small volume of documentation, those reports and other project documents may lack essential data or provide biased representations of daily activities or project outcomes, such as the actual worker's responsibilities, failures, or successes (Ika & Donnelly, 2017). On the other hand, excessive documentation can overwhelm project managers, impede decision-making processes, and become a time-consuming task (Lappi et al., 2019).

Comprehensive documentation (including technical specifications and financial reports) fosters accountability, transparency, and stakeholder responsibility, leading to a better performance of the organization. Conversely, inadequate and poor documentation poses significant challenges, hindering project implementation and jeopardizing future opportunities, with documents being lost during or after the life of the project (Sung & Lee, 2018). Those documents can be “any source of information, in material form, capable of being used for reference or study, e.g., manuscripts, printed matter, illustrations, diagrams, museum specimens, etc.” (Buckland, 1997, p.805). Through documents of countless forms, knowledge can be retained and shared (Østerlund & Crowston, 2019). They enhance our comprehension by describing events and environments, while also providing instructions and guidelines for the present and future. Moreover, they prove effective in spreading data and information among large audiences (Buckland, 1997).

Yet, to be effective, documentation should be concise, easily digestible, and regularly updated. Halloran et al. (1978) outline nine criteria for assessing the quality of documentation: 1) readability, 2) completeness, 3) accuracy, 4) ease of update, 5) change tracking, 6) functionality, 7) identification of responsibility, 8) identification of authority and 9) standards. These criteria underscore the multifaceted nature of effective documentation, which extends beyond mere content to encompass usability, tracking, and adherence to standards.

Nonetheless, at the end of the day, are the team managers who can play a crucial role in fostering effective documentation practices, by encouraging ongoing dialogues and emphasizing the importance of concise documentation in mitigating the risk of misunderstandings. Additionally, those managers, during the development of projects, should establish guidelines for determining the adequacy of documentation in terms of timeliness, effort required, and quality in order to improve its effectiveness (Nakayama et al., 2024). In such projects, documentation serves as a vital organizational tool, functioning as a dynamic repository that captures every modification made. Collaborators frequently emphasized the challenges of managing daily activities without robust documentation practices. For instance, core developers expressed struggles in recalling past changes, particularly following significant code refactoring. Also, they reported cases where old features remained unused due to the absence of official documentation, necessitating manual inspection to uncover their existence (Geiger et al., 2018).

Recently, according to one of the studies, conducted by Nakayama et al. (2024), the interviewees highlighted the importance of informal documents as an effective documentation practice, since detailed emails or informal specifications, often prove to be more effective in communicating with stakeholders than formalized reports. As attention spans decrease, the efficiency of communication becomes increasingly important, with stakeholders favoring succinct, easily digestible information over lengthy documents. As a result, such documentation can ensure that all stakeholders comprehensively understand the requirements and the development process (Ambler & Lines, 2012).

2.2.3. Documentation barriers

Without a doubt, documentation is a cornerstone of project management and data analytics, yet it often suffers from issues of quality, currency, and participation. According to a GitHub survey conducted in 2017, 93% of respondents identified incomplete or outdated documentation as a pervasive problem. Despite this, only 60% of contributors reported engaging in documentation efforts. This gap highlights a significant challenge in maintaining effective documentation practices. Surveys, such as this one, conducted at a scientific computing conference, reveal that there's a consensus among respondents that more time should be allocated to documentation than is currently practiced. However, contributors often feel undervalued for their documentation contributions or neither enjoy it. This discrepancy underscores a cultural bias toward prioritizing other tasks over documentation (Geiger et al., 2018).

Several studies have extensively examined the primary challenges associated with documentation, encompassing knowledge quality, usability, motivations and consequences, resources, learning, and methodology. The first two challenges primarily concern the content perspective of documentation, although they also intersect with aspects of communication processes and objects. Remarkably, those studies underscore the detrimental impact of undocumented knowledge, caused by those primary challenges, that lead to the loss of valuable insights (Massingham, 2018; Seleim et al., 2005).

Furthermore, within this framework, documentation efforts also demand a diverse set of skills, thus, those contributing to documentation encounter various technical and social obstacles. According to Geiger et al. (2018), the primary obstacle to creating high-quality documentation is the possession of the requisite skills. Not only do tasks like writing, contributing, and reviewing documentation require proficiency in these areas, but they also demand an additional skill set that is rarely overlooked. Those additional skills encompass effective communication, creative writing, empathy, and a solid understanding of language nuances (Geiger et al., 2018).

Moreover, the motivations driving documentation contributors are equally varied (See Table 1). Some find genuine pleasure in documentation work, while others perceive it as a painful task undertaken for the improvement of the library. One of the reasons is that it's a skill often inadequately taught, leading many to believe they're not proficient at it. However, if they felt more confident in their abilities, perhaps there was more enjoyment in doing the task. Yet, as it stands, many perceive it as a daunting process (Geiger et al., 2018).

The other concern raised by Geiger et al. (2018, p. 786) revolves around a deficiency in empathy, particularly because documentation work requires understanding the user's perspective, as it involves “putting oneself into the user’s shoes”. It's crucial to have a deep understanding of the audience and know what information to provide and when. The main barrier arises when what the writer perceives as necessary in documentation may not align with the needs of someone. Additionally, the ability to convey ideas clearly and understandably is crucial. Documentation serves as public material intended for an audience, therefore, several respondents of a survey conducted by Geiger et al. (2018) underscored the significance of storytelling and creative writing skills in crafting effective documentation.

Table 1 - Motivations around documentation work

Motivation	Type	Example
Fully extrinsic	Rewards	Getting paid to contribute documentation
Fully extrinsic	Regulation	Writing documentation because the project's rules require it
Slightly extrinsic	Introjection	Writing documentation to receive thanks, praise, recognition or to avoid guilt, anxiety, shame
Both extrinsic and intrinsic	Identification	Writing documentation because the community needs to be successful, but the work is not enjoyable
Slightly intrinsic	Integration	Writing documentation because it is the right thing to do, getting a sense of satisfaction when complete
Fully intrinsic	Personal enjoyment	Writing documentation because it is enjoyable, fun...

Source: Geiger et al. (2018)

On top of that, another common barrier regarding documentation is the non-existence of standardized criteria for validation. The multitude of tooling options complicates even more this problem, leading to divergent opinions across communities regarding preferred standards. In short, what qualifies documentation as effective can often be subject to subjective interpretation (Geiger et al., 2018).

2.3. Critical factors for a successful implementation of documentation

2.3.1. Documentation maturity model

There is a notable absence of clear standards for evaluating documentation quality or for enhancing the documentation process. This often leads to documentation that is inconsistent, difficult to predict, challenging to evaluate, and that usually falls short of its potential, compromising the quality. As a result, Huang and Tilley (2003) developed a Documentation Maturity Model (DMM) specifically designed to assess the effectiveness of documentation. This framework aims to provide a better understanding of ongoing projects by guiding project collaborators in producing high-quality documentation throughout their development (See table 2).

The maturity levels of the DMM serve as a roadmap for continuous improvement in documentation quality within an organization. In that way, it is possible to know what the actual

state of documentation in a company is and how it should improve. The state of documentation can be distinguished by five different levels, with level 1 being the worst and level 5 the best. Level 1, initial, with an uncontrolled environment, is the baseline for all organizations. The mindset is “write first, ask quality questions later.” Then, level 2, repeatable, where defined procedures are followed based on past experiences. In level 3, defined, the procedures are standardized and consistent, and the documentation is tailored per project as needed, while in level 4, managed, the quality management strategies are defined and used with predictable processes employed. Finally, in level 5, optimizing, the process improvement strategies are also defined, but there is an emphasis on continuously improving by analyzing defects and the root causes, with technology and process enhancements as part of regular operations (Huang & Tilley, 2003).

Within the DMM, the process aspect is structured into those five maturity levels, each associated with key process areas (KPAs) such as efficiency, format, and granularity or precision. In efficiency, it is possible to know the level of direct support provided by documentation, including factors like accuracy, the ease with which the documentation is generated, and completeness. The format refers to the KPA responsible for the types and characteristics of documentation produced. In some cases, document format can be divided into textual or graphical, because sometimes team members prefer documents through graphs or flows, instead of only using text. Finally, granularity or precision indicates the level of detail explained by the documentation. The lower the granularity is, the lower the level of implementation details, since it uses the basic information. Conversely, the higher the granularity is, the closer the documentation is to explaining the full project/task functionality, it captures important information concerning the commonalities and variabilities (Huang & Tilley, 2003).

Therefore, the critical factors for a successful documentation practice would be precision in the details provided, the automatization of the documentation process, and being the most personalized possible to provide a better understanding of the project development. Nevertheless, determining and assessing quality is complex, and no single report and checklist can guarantee the development of quality documents, but it can help (Huang & Tilley, 2003). By following those factors, the implementation of documentation is closer to success.

Table 2 - Documentation Maturity Model - DMM

KPA		Levels				
		1 - Initial	2- Basic	3 - Structured	4 – Managed	5 - Optimized
Format	Text	Informal	Standardized	Hyperlinked	Contextual	Personalized
	Graphics			Animated	Interactive	
Efficiency		Manual	Semiautomatic & Static	Semiautomatic & dynamic	Automatic & Static	Automatic & Dynamic
Granularity / Precision		Source Info	With some design patterns	With some architecture	With all the requirements	Project Lines

Source: Adapted from Huang and Tilley (2003)

2.3.2. Best Practice Documents

As mentioned, knowledge management has become a key instrument for identifying, creating, and sharing organizational knowledge assets. An effective means of sharing knowledge is through the framework of Best Practices (BPs), structured approaches describing methods for specific tasks or processes. Renzl et al. (2006) highlighted that knowledge can be shared efficiently only if it is correctly and completely documented. Such documentation often takes the form of Best Practice Documents (BPDs). In organizations, BPDs exist in various forms, including structured documents in binders, electronic databases, and unstructured formats such as memos, manuals, and notes.

According to Alwazae et al. (2019), a critical tool for supporting the design, evaluation, management, and use of BPDs is the BPD template. This template provides a standardized format for structuring and organizing BPDs through pre-specified attributes or fields. Early work on BPDs proposed a detailed BPD template consisting of 16 fields: name, problem, context forces, solution, rationale, consequences, related information, known applications, author, synonyms, examples, usage elements, type, domain, and keywords. Then, Renzl et al.

(2006) suggested a simpler streamlined BPD template with sections for a) title; b) author; c) context; d) description; e) resources, f) links to resources; and g) tools and techniques.

A well-designed BPD template ensures that users can easily document, thereby achieving specific organizational goals. A clear documentation structure not only organizes information effectively but also enhances the usability and accessibility of knowledge, facilitating better decision-making and continuous improvement within the organization.

3. Methodology

3.1. Research approach

An appropriate research method is crucial for addressing specific research questions and achieving study objectives, which ensures the methodology aligns with the research goals. The choice of strategy is influenced by factors such as the nature of the research questions, the current state of knowledge, available time, and resources, enhancing the feasibility and validity of the study (Saunders et al., 2009). The study objectives of this research are: 1) investigate the actual state of Efacec's documentation practices; 2) identify possible areas for improvement; and 3) develop a template or a set of guidelines for the BI team to follow when applying documentation practices.

Overall, the primary motivation for researchers following a specific methodology is to gather sufficient information for comprehensive and meaningful data analysis. This analysis aims to yield the best possible conclusions, contributing valuable insights to the field (May, 2011). Therefore, for this report, the appropriate methodology is a single case study with qualitative research in order to provide a solution for the actual Efacec's documentation practices. Stake (1995) suggests that multiple cases can be studied simultaneously but emphasizes that each case study should be a focused, holistic inquiry. Thus, according to Siggelkow (2007) and Stake (1995), single case studies can provide compelling data for testing theories, particularly if the case involves a firm with unique characteristics essential for meeting the study's objectives.

Furthermore, Gaya and Smith (2016) discuss how combining qualitative and single case study research designs offers many benefits for researchers. This approach is both systematic and innovative, allowing flexibility and the exploration of more dimensions. Both qualitative research and case studies aim to uncover complexity in natural settings, making them complementary methods that work well together. The qualitative approach is described as:

a form of social inquiry that tends to adopt a flexible and data-driven research design, use relatively unstructured data, emphasize the essential role of subjectivity in the research process, study a small number of naturally occurring cases in detail, and use verbal rather than statistical forms of analysis. (Hammersley, 2013, p. 12).

3.2. Methods of data collection and analysis

The fundamental purpose of collecting data is to enable the researcher to gather sufficient evidence, thereby facilitating the drawing of well-founded inferences. These inferences are essential for making significant decisions about the findings (Tashakkori & Teddlie, 2010). This research uses the analysis of documents, participant observation, and semi-structured interviews as the main data collection methods.

In social science research, interviews are highly valued. Qualitative researchers, who focus on detailed descriptions of individuals and events in their natural settings, often see interviews as essential to their research design. Kvale (1996) notes that since many events are not directly observable, talking to people is one of the most effective ways to explore such constructs. Interviews are interactive, allowing interviewers to ask for complete, clear answers and probe into emerging topics. As a result, interviewing broadens the understanding of the phenomena being studied, providing a naturalistic and flexible method of data collection (Alshenqeeti, 2014).

Therefore, seven interviews were conducted with the members of the BI team since they are the ones who benefit the most from documentation practices and can provide information to understand better about this topic. Every single interviewee (I1-I7) was chosen wisely with the help of the supervisor of the internship at Efacec, the leader of the Data Governance and BI&A Department. The interviews were conducted face-to-face and via Teams during May 2024 (see Table 3).

In this research the interviews were semi-structured. The semi-structured interview is a more flexible version of the structured interview, allowing the interviewer to probe and expand on the interviewee's responses to achieve depth (Alshenqeeti, 2014). In contrast, the structured interview is organized around a set of predetermined direct questions that usually require immediate 'yes' or 'no' responses, giving both the interviewer and interviewees very little freedom (Berg, 2007). Nonetheless, despite the flexibility of semi-structured interviews, it was necessary to develop a script to guarantee the proper questions were asked. To ensure the appropriateness of questions, the questions were adapted to employ the literature review and the research objectives. Therefore, an interview script is provided in the Appendix of this paper. The interview script always covers the main topics and objectives of the case study (Taylor 2005). The respective answers were recorded and then transcribed.

According to Ho (2006), interviews provide in-depth information about participants' inner values and beliefs. Nevertheless, supplementing interviews with participant observations, for example, allows researchers to investigate both external behaviors and internal beliefs. Therefore, although it depends on the research questions, using multiple data collection methods can help obtain richer data and validate the research findings (Alshenqeeti, 2014). For that reason, this study also utilizes participant observation by immersing the researcher in the environment being studied, actively participating in, and observing the behaviors and interactions of the participants over an extended period of 4 months.

Table 3 - Interviewees sample

Interviewees	Duration (minutes)	Position at Efacec	Years at Efacec
I1	37	Senior BI Consultant	32 y 5 m
I2	42	BI Engineer	2 y 6 m
I3	32	Senior BI Consultant	2 y 1 m
I4	56	Data Governance Consultant	5 y 3 m
I5	53	IT Project Manager	23 y 9 m
I6	33	Senior IT Specialist	30 y 5 m
I7	49	Senior IT Specialist	36 y 11 m

Source: Own elaboration

To complement participant observation and semi-structured interviews, the research was also supported through the analysis of various organizational documents. These included:

- 1) Annual reports: For instance, the Efacec Annual Report of 2022 provided insights into the company's performance, strategic direction, and key achievements over the year.
- 2) Presentations: PowerPoint presentations from different business units, created by the marketing team, offered a detailed view of each unit's strategies, goals, and positioning.
- 3) Official guidelines: Documents such as the “Utilization Manual – a Tool for HR Operations” developed by a BI team member to explain the correct procedures during the onboarding process. Additionally, the policy document “Organizational Data Usage and Reporting,” created for the Data Governance and BI&A team, helped to understand how the company formulates norms and guidelines. This was valuable for developing

recommendations for this report, including the suggested template for documentation

- 4) Meeting notes: Weekly notes, including brainstorming ideas for Data Governance and BI&A team projects, providing insight into the ongoing discussions and decisions, and efforts within the teams.
- 5) Other relevant documentation: For example, Excel sheets demonstrating how the data is stored.

With those documents, it is possible to gain a better understanding of how the company is structured, and how it develops policies and communicates internally. This approach allows to verify and reinforce the information obtained through interviews and observations, ensuring a more robust and honest analysis. On top of that, it provided solid examples that support the development of guidelines and recommendations in my report.

To analyze the data, the DMM framework was employed alongside with a comprehensive literature review. The literature review complemented the DMM framework by offering theoretical and empirical insights from existing research. The DMM framework, developed by Huang and Tilley (2003), permits assessment of the maturity and effectiveness of an organization's documentation practices. This framework provides a systematic method for evaluating the current state of the organization's documentation practices and identifying areas for improvement. With the DMM framework, it was possible to identify specific gaps in the organization's documentation maturity, and the literature review offered potential strategies and solutions to address those gaps. By crossing the DMM framework results with the literature review, ensures that the findings are robust and aligned with broader academic research.

4. The setting of the study

4.1. The history of Efacec - a brief overview

Efacec's history is deeply rooted in knowledge and experience, both of which have been consistently applied to drive technological innovation. With a legacy spanning over a century, Efacec traces its origins back to the establishment of "A Moderna" Mechanical Sawmill Society in 1905. Then, in 1921, "A Moderna" evolved into Electro-Moderna, Lda., marking the company's transition into the production of motors, generators, transformers, and electrical accessories. This period saw the development of essential skills that would later support Efacec's growth and expansion. By August 12, 1948, "EFME – Empresa Fabril de Máquinas Eléctricas, SARL" was incorporated, heralding the birth of the Efacec brand and its ambitious projects. Over time, capital distribution underwent several changes, with ACEC - Ateliers de Constructions Électriques de Charleroi emerging as the majority shareholder following the departure of CUF - Companhia União Fabril (Efacec, 2023).

In 1962, the company adopted the name Efacec – Empresa Fabril de Máquinas Eléctricas, SARL. By the end of the 1960s, it became one of the pioneering Portuguese companies listed on the Lisbon Stock Exchange. Subsequent decades witnessed significant growth in international markets and technological advancements across various sectors. Then, in the 21st century, Efacec underwent a strategic repositioning, leading to the establishment of Efacec Power Solutions, SA (EPS) on August 14, 2014. This restructuring aimed to align the corporate structure with target markets and geographies. In October 2015, Winterfell Industries acquired a majority stake in EPS, leading to changes in ownership and governance (Efacec, 2023).

In 2020, the Portuguese government nationalized a significant portion of EPS' share capital to ensure the company's stability amidst shareholder reconfiguration challenges. New governing bodies were elected, reflecting these changes (Efacec, 2023). While under government control in 2020, Efacec's revenue dropped by 39% to 216 million euros due to various factors (Efacec, 2021). Then, in January 2021, the Portuguese government finally approved the privatization process. The goal was to reduce labor costs from around €65 million in 2020 to €50 million in 2021 (Vitorino & Dias, 2021). On June 7th, 2023, the government approved the proposal from the German company Mutares for the privatization of Efacec. It

is now known that the government injected 132 million euros into Efacec, in addition to another 85 million euros in guarantees (Lusa, 2023). Today, the company focuses on shaping a smarter future through integrated solutions in energy, mobility, and the environment, with a global presence spanning 13 countries and sales in 86 (Efacec, 2023).

4.2. The last restructuring of Efacec and its recent documentation practices

Overall, in 2024, under the ownership of the Mutares fund, Efacec experienced a comprehensive restructuring. This restructuring aimed to reduce costs and enhance efficiency, ultimately turning the organization profitable. As part of this transformation, innovative initiatives are highly encouraged, especially those that positively impact Efacec's workflow. One such initiative is the implementation of improved documentation practices within the BI team. This initiative aims to streamline the company's workflow and enhance the quality of the work produced daily.

Efacec has recognized the need to improve how it manages data from its various business units and to organize this data within its system. The company understands the importance of investing in data experts and dedicating time to enhancing its internal processes, particularly by improving its documentation practices. Before the last restructuring, Efacec had already begun investing in the Data Governance and BI departments. For instance, the Data Governance team is a relatively new addition to Efacec, established approximately 2 years ago, and it was created to ensure the quality, security, and proper management of the company's data assets. The BI team, on the other hand, has been part of Efacec for a longer period but has seen substantial growth in recent years. This team has undertaken numerous critical projects, such as implementing an Enterprise Resource Planning (ERP) system across the entire company. This ERP implementation will centralize information and automate many financial operations, greatly improving overall efficiency.

While there are no official documents detailing these changes, this information has been gathered through participant observations and conversations within the company. These insights provide valuable context for understanding the current state of Efacec's data management and BI efforts. This report also demonstrates that the BI team's recent efforts include improving documentation practices to enhance workflow and work quality. This initiative aligns with the broader restructuring goals by promoting efficiency and innovation.

5. Efacec documentation process

This chapter explores the documentation practices within the BI team at Efacec. The purpose is to identify their weaknesses and based on them be able to propose improvements.

First, this section focuses on exploring the state of Efacec's documentation practices through the information gathered from interviews. As a result, it was obtained information related to the culture around documentation and the maturity of the documentation, assessed by following the DMM framework. With the support of the DMM framework it was possible to reach the findings related to three KPAs such as: i) efficiency; ii) format; and iii) granularity or precision. All these KPAs are studied in detail.

Then, after this comprehensive analysis, some enhancements to Efacec's documentation practices regarding the culture, standardization of documentation, and outdated documentation are suggested, with the support of the literature review and the insights gathered during the interviews.

5.1. The state of Efacec's documentation practices

As mentioned in the literature review, according to the DMM framework, the critical factors for a successful documentation practice would be precision on the details provided, the automatization of the documentation process, and being the most personalized possible to have a better understanding of the project development.

Before delving into the KPAs influencing documentation practices at Efacec, it is also crucial to understand the prevailing culture around documentation within the company. In the case of Efacec, there is a shared understanding among all the interviewees of the importance of documenting every project or task, but the practice of thorough documentation is not well-established. The results show that the team members recognize the value of documentation, but they often fail to put it into practice.

This observation aligns with findings by Geiger et al. (2018), who conducted surveys at a scientific computing conference revealing that many individuals acknowledge the need to invest more time and effort into documentation. However, they often feel undervalued for their contributions to documentation or do not enjoy the process, leading them to prioritize other tasks. In Geiger's survey, only 60% reported engaging in documentation efforts, matching the

interview answers in this study, which highlighted a lack of discipline in this practice. This gap, between recognizing the importance of documentation and actually practicing it, underscores a significant challenge in maintaining this practice within an organization.

Overall, the culture around documentation at Efacec is nearly non-existent. Some interviewees (I1, I7) have pointed out the lack of discipline in trying to implement this practice. It is evident that workers in the field of technology understand the significance of documentation and agree that its proper implementation would be beneficial in cases where it does not exist. Many have faced challenges in their daily activities due to inadequate documentation, such as i) repeating tasks that were already done because they didn't know how was the procedure (I2, I4); ii) lacking knowledge when transitioning responsibilities from a departing team member, which delays their activities (I3, I5); iii) wasting time searching for information about the database and data origins (I3). As noted by Sung and Lee (2018), inadequate and poor documentation creates significant challenges, hindering project implementation and compromising future opportunities, with documents often being lost during or after a project's lifecycle.

The results show that the culture around documentation at Efacec is in its initial stages, with little discipline or effort to consistently produce and organize documentation. This deficiency makes some daily activities harder and slower to complete, which can already be considered one of the weaknesses of this practice and deserves to have some improvement suggestions. But, for instance, one solution to change this behavior would be to enlist the support and influence of team managers since they can play a crucial role in fostering documentation practices, by encouraging ongoing dialogues and holding meetings with the team to emphasize the importance of this practices in mitigating the risk of misunderstandings and producing better outcomes (Nakayama et al., 2024). Nonetheless, this report has a dedicated chapter to propose solutions and ways to enhance the fragilities of this practice at Efacec.

5.1.1. The level of maturity of Efacec's documentation

The maturity levels of the DMM framework serve as a roadmap for continuous improvement, in documentation quality, within an organization. In that way, it is possible to know what the actual state of documentation at Efacec is and how it should improve. As referred to in the literature review, the actual state of documentation can be distinguished by five different levels, with level 1 being the worst with a lot of space to improve and level 5 being

the best at its highest level (Huang & Tilley, 2003). Each level of this framework can evaluate three KPAs such as: i) efficiency; ii) format; and iii) granularity or precision; and it is in these parameters that this study is going to focus on knowing the actual state of documentation at Efacec.

5.1.1.1. Format

According to the interviewees, the documentation practices at Efacec are currently at the initial level 1 of the KPA format. Interviewees (I1, I2, I3) mention that documentation is highly informal and lacks standardization across the organization. Each individual creates documentation based on their judgment, without adhering to any common templates or guidelines. There are no established rules or procedures governing documentation practices, resulting in a fragmented approach. Most daily activities that involve documentation are executed in a very informal manner. For example, according to interviewees I1 and I3, employees often take notes using applications like OneNote or Azure DevOps, but there is no consistency in how these notes are structured or stored. This approach leads to significant variability in the quality and completeness of documentation. Only a few specific processes or policies within the company have established guidelines for their documentation. These guidelines are usually limited to particular projects and do not extend to the broader range of daily activities (I2).

Interestingly, the opinions on the importance of standardized documentation at Efacec are divided. Most interviewees (I1-I6) agreed that the lack of a standard affects the consistency and quality of documentation. They recognize that without a unified approach, the documentation produced is often fragmented and with different structures, leading to inefficiencies and misunderstandings. However, one interviewee (I7) argued against standardization for technical documentation, believing it to be a highly personal practice that should be tailored to each different task. This perspective suggests that documentation should be customized to fit the specific needs of each project, a view that aligns with level 5, the best one of the KPA format, which emphasizes the strategy of having personalized documentation to achieve efficiency. However, level 5 in the DMM framework involves more than that, it requires predefined personalization standards that are to be followed accordingly, which would be challenging to implement at Efacec at this stage.

Therefore, given the state of documentation practices at Efacec, it would be appropriate to focus on standardization by creating a template. As noted by Geiger (2018), a common barrier to effective documentation is the absence of standardized criteria for validation. The multitude of tools and methods available for documenting can further complicate the efficacy of this practice, as each individual has their preferred approach. This diversity of opinions across members, regarding preferred standards, can make it more difficult to implement a universally accepted template. However, as the responses to the interviews show (I1-I6), the need for a standardized approach at Efacec is evident, even if there are differing opinions on what the ideal template should look like. The results demonstrate that not having a general template has compromised the documentation quality, leading to misunderstandings and a lack of precision.

As a result, the study shows another weakness to work on, which is the lack of standardization, thus, the next sub-chapter approaches that in more detail. To conclude, regarding the KPA format, Efacec is placed on Level 1 - Informal, which is the lowest on the scale of maturity, this is the baseline for all organizations. It is essentially an uncontrolled environment (Geiger et al, 2018).

5.1.1.2. Efficiency

Now, regarding the KPA efficiency at Efacec. This metric allows us to assess the level of direct support provided by documentation, including how easily this documentation is generated, meaning if it is produced manually or automatically (Huang & Tilley, 2003). According to the research done at Efacec, through the interviews (I1-I7) the entire documentation process is done manually. Although one interviewee (I6) mentioned minor automation efforts at the organization, these are very minimal; thus, nearly all documentation is generated manually.

Therefore, once again, the documentation process at Efacec, but now regarding KPA efficiency, is classified as Level 1 – Manual. This level represents the most inefficient form of documentation. Manual generation of documentation, which is typically text-based, often leads to it quickly becoming outdated relative to the project or activity it describes. This behavior persists unless the documentation is consistently maintained along with the rest, which, according to the respondents of this study, rarely happens: For example, I5 mentions “During a project, people tend to make an effort at the initial stage to take notes and document some

steps. But then, when some changes are made in the future, people leave that habit, therefore, when we pick that project later, things are outdated and sometimes confusing”.

In the real world, synchronization of documentation is uncommon, because employees are rewarded for project outcomes, not for writing or updating documentation, therefore, they don't have incentives for documenting (Geiger et al., 2018). The state at Efacec reflects this inefficiency accurately, even though it is not the desired situation. All interviewees emphasized that the documentation is consistently outdated and there is no synchronization, which diminishes its value significantly. This observation aligns with the literature, which suggests that outdated documentation loses its effectiveness and reliability, leading to inefficiencies in processes and decision-making (Geiger, 2018).

Furthermore, most interviewees believe that automation could substantially improve the efficiency and quality of the documentation. Out of the seven interviewees, five supported this viewpoint, advocating for the potential benefits of automation in improving the documentation process. However, opinions diverge on this matter. One interviewee, I3, contended that documentation will inevitably remain manual since it is created by humans, suggesting that the human element is indispensable in this process. Another interviewee, I4, expressed skepticism about the feasibility of automating documentation. Despite these reservations, the majority consensus among the interviewees is that pursuing automation could be a valuable direction for Efacec, aiming to elevate both the efficiency and quality of its documentation practices.

In summary, while the current manual documentation process at Efacec is inefficient and prone to becoming outdated, there is significant support among interviewees for exploring automation to address these issues. This could lead to more synchronized and valuable documentation, enhancing the KPA efficiency, which at the moment is at Level 1, the lowest maturity level.

5.1.1.3. Precision

Finally, it remains to analyze the KPA granularity or precision from the DMM framework. The parameter granularity refers to the level of abstraction described by the documentation and the levels of detail provided. The higher the granularity level (level 5), the closer the documentation is to explaining the complete functionality of an activity (Huang & Tilley, 2003).

At Efacec, according to five interviewees (I1, I2, I4, I6, I7), the level of precision is a solid 4. Documentation is produced with most of the required details and precision, making it relevant and useful when utilized in projects. Essentially, when documentation is created, which is not very often, it is of high quality (I1, I4). The precision of the documentation often depends on the time available and the mindset of the individual preparing it (I6). Since there are no standardized rules to follow, each person adheres to their parameters, leading to variability in documentation precision.

Furthermore, some interviewees (I2, I5) mentioned that the documentation is balanced, which is an important factor. According to Ika and Donnelly (2017), contrary to common assumptions, the sheer volume of documentation does not guarantee its accuracy. It is crucial to find a balance. For instance, as noted by Lappi et al. (2019) reports and other project documents, when done without precision and with minimal volume, can lack essential data or provide biased representations of daily activities or project outcomes. At the same time, excessive documentation with too much detail can overwhelm the collaborators, which impedes decision-making processes and becomes a time-consuming task (Lappi et al., 2019).

Unfortunately, as might be expected, a lack of precision and inadequate documentation can lead to errors or delays in projects or activities, which can affect productivity, with documents being lost in the future (Sung & Lee, 2018). In the case of Efacec, according to one of the interviewees (I5), there is no quality assurance to monitor the accuracy and relevance of the documentation. Despite this, some respondents believe that while such issues could occur, there have been no significant problems at Efacec so far, and, overall, the precision of this practice is good (I1, I7). It has been well-established that having comprehensive and precise documentation fosters accountability, transparency, and stakeholder responsibility, leading to better organizational performance (Sung & Lee, 2018). To sum up, the precision of Efacec's documentation is good. The primary issue appears to be the lack of a consistent practice of documenting within the team. When documentation is done, which is rare, it is done well. Therefore, precision is not a significant weakness or a problem that needs immediate resolution at Efacec.

5.1.2. Final remarks of the documentation actual state

Efacec's documentation practices exhibit several critical areas in need of improvement, though there are also strengths that can be built upon. Based on the evaluation of KPAs such

as efficiency, precision, and format, it is evident that the documentation process, while effective in some respects, requires significant enhancements to meet the organization's needs more robustly (See table 4).

According to the interviews conducted, the documentation practices at Efacec are currently at the initial Level 1 of the KPA format. This means that documentation is highly informal and lacks standardization across the organization (Huang & Tilley, 2003). Each individual creates documentation based on their judgment, without adhering to any common templates or guidelines, as referred by I3. There are no established rules or procedures governing documentation practices. Most daily activities that involve documentation are executed in a very informal manner (I3).

The state of documentation at Efacec is largely manual, positioning it at Level 1 on the KPA efficiency scale - the most inefficient level. Manual documentation is prone to becoming quickly outdated unless meticulously maintained, which, according to the interviewees (I1-I7), rarely happens. Employees are primarily rewarded for project outcomes, not for the documentation they produce, resulting in documentation that often lags behind actual project progress (Geiger et al., 2018).

In terms of precision, Efacec's documentation is rated at a solid Level 4. When documentation is produced, it is done with a high degree of detail and accuracy, making it relevant and useful for projects, as mentioned by five interviewees. However, the infrequency of documentation efforts means that valuable information is often missing or outdated. Overall, balanced documentation is appreciated and has been noted as a strength at Efacec (I2, I5).

The documentation state of Efacec is summarized in the following table:

Table 4 - Efacec's documentation state

KPA	Levels	
	1 - Initial	4 – Managed
Format	Informal	—
Efficiency	Manual	—
Granularity / Precision	—	With all the Requirements

Source: Own elaboration.

5.2. Suggested enhancements to Efacec's documentation practices

In this sub-chapter, several recommendations are presented to improve Efacec's documentation practices. Based on the evaluation of KPAs, and insights from interviews and literature, it is evident that there are significant opportunities for enhancing the i) culture; ii) standardization of documentation; and iii) efficiency and outdated documentation. These enhancements not only streamline the documentation process but also improve its overall quality and relevance, ultimately contributing to the development of daily activities and organizational performance.

5.2.1. Culture

As observed during the interviews and personal observations throughout the internship, the culture at Efacec regarding documentation is in its initial stages. There is a notable lack of discipline and consistency in producing documentation. One solution to address this issue is to involve team managers in the process, as they can significantly influence team members and instill a culture of documentation. Therefore, team managers should take an active role in promoting the importance of documentation. This can be achieved through several strategies: i) support from leadership; ii) encouraging communication; iii) booking frequent meetings; and iv) accountability within the team.

i) Support from leadership - managers must lead by example and demonstrate a commitment to proper documentation. They should regularly communicate the value of documentation for the success of the company and how it contributes to improved project outcomes and organizational efficiency.

ii) Encouraging communication - managers should engage in encouraging dialogues with their teams, explaining the importance of documentation and how it supports the overall goals of the organization. This can help employees understand the direct impact of their documentation efforts on the company's success.

iii) Frequent meetings - scheduling regular meetings dedicated to discussing documentation practices can reinforce their importance. During these meetings, managers can provide feedback, share best practices, and address any challenges team members might face. Or, instead, they could allocate just a few minutes in every team meeting to review progress on documentation, which can keep the practice top of mind for all team members.

iv) Accountability - establishing accountability within the team is essential. Managers should set clear expectations for documentation and monitor compliance. By holding team members accountable for their documentation efforts, managers can ensure that documentation becomes a routine part of the workflow. This allows for the promotion of a mindset of continuous improvement, with employees encouraged to regularly refine and enhance their documentation practices. This can be facilitated through training sessions, workshops, and sharing of success stories within the team.

By implementing these strategies (see table 5), Efacec can cultivate a robust documentation culture that supports organizational goals, enhances project outcomes, and fosters a mindset of continuous improvement among employees.

5.2.2. Standardization of documentation

At Efacec, the state of documentation is characterized by a high degree of informality and a significant lack of standardization. This has led to several issues, as most interviewees (I1-I6) highlighted that the absence of standardized documentation practices negatively impacts the consistency and quality of the documents produced. This inconsistency not only results in inefficiencies but also fosters misunderstandings and miscommunications within the organization. Consequently, there is a pressing need to establish clear guidelines and standardized practices for documentation across the organization.

To address these challenges, this study proposes in sub-chapter 5.3 a template, based on a set of guidelines, specifically designed for the BI team to use during documentation. This template aims to provide a structured format that outlines the essential components and details that need to be included in every document. By implementing and adhering to this standardized template, Efacec can achieve several key benefits: i) consistency; ii) clarity; iii) efficiency by saving time and reducing the likelihood of errors; iv) organization; and v) quality. As a result, Efacec can mitigate the issues arising from heterogeneous writing styles and disorganized documentation practices.

5.2.3. Efficiency and outdated documentation

According to the evidence, the entire documentation process at Efacec is currently performed manually rather than automatically, leading to documentation that quickly becomes outdated. According to Geiger et al. (2018), this is a common issue in the real world, as employees are typically rewarded for project outcomes rather than for writing or updating documentation. As a result, there is little incentive for employees to maintain current documentation. In the case of Efacec, this lack of motivation among employees to keep documentation up to date is a significant area for improvement.

To address this issue, Efacec should consider implementing a system of incentives to encourage better documentation practices. This suggestion is inspired by the research of Geiger et al. (2018) regarding the motivations around documentation work (See table 1 of the Literature Review). Several possible approaches include: i) financial rewards by offering bonuses; ii) recognition by highlighting and rewarding employees; and iii) integrating documentation efforts into performance evaluations (see table 5). These incentives would encourage employees to prioritize documentation, ensuring that it remains current and aligned with ongoing projects.

Another strategy to enhance documentation practices could be to make the task itself more manageable and enjoyable, reducing the need for external incentives. For instance, the documentation process at Efacec is entirely manual, so automating could be an option, despite not being easy. Hence, according to some insights gathered from the interviewees (I1, I2, I5) automating this practice presents a significant opportunity to improve the efficiency of Efacec's documentation practices by reducing the manual workload on employees, minimizing the risk of outdated information, and ensuring consistency across documentation.

Table 5 - Suggested enhancements

Areas	Suggested Enhancement
Culture	1. Support from leadership 2. Encouraging communication 3. Booking frequent meetings 4. Accountability within the team
Standardization of documentation	1. Implement a template
Efficiency and outdated documentation	1. Implementing a system of incentives a. Financial rewards b. Recognition c. Integrating efforts into performance evaluations 2. Automating documentation

Source: Own elaboration

5.3. Suggested guidelines for documentation

Effective documentation is critical to the success and efficiency of any organization. Based on evidence gathered from interviews and observations at Efacec, there is significant room for improvement in how project documentation is handled. At Efacec, as mentioned before, the documentation practices are informal and lack standardization, leading to inefficiencies. To address these challenges, it is essential to establish comprehensive guidelines that standardize the documentation process and then, implement a template based on that.

This sub-chapter outlines suggested guidelines for documentation at Efacec. These guidelines aim to enhance the quality, consistency, and usability of documentation across the organization, contributing to improved project outcomes and organizational performance. The following guidelines, grounded in data collected during the study, are designed to address current challenges and establish best practices for comprehensive and effective project documentation. By gathering all the interviewees' suggestions, and using as a guide the BPD template suggested by Renzl et al. (2006), this is the final list of the most important components to have in the documentation:

i) Description of the work by providing its overview. It must also include its objectives and what it aims to achieve.

For example: This work aims to develop a new BI report that analyzes data from the suppliers. The purpose is to develop a user-friendly and easy-to-read report to analyze the purchases of the company.

ii) Information about the people involved, including their roles and contacts.

For example: Document created by John, BI Analyst, john@company.com

iii) Information about the tools.

For example: The tools used are Microsoft Power BI, SQL Server, and Azure DevOps.

iv) Step-by-step description by documenting the stages of the activity developed.

For example: Step 1 - Gathering, Step 2 - Design, Step 3 - Development, 4 - Test.

v) Date of revision and updates. Keep a record of document revisions, including the date of updates and a summary of changes made.

For example: Date of Update: May 22, 2024 – Added new feature to the dashboard.

vi) Recommendations and next steps.

For example: Recommendation: Next, implement additional features to easily visualize the data from a report.

Based on the above components and best practices, the following documentation template is proposed for the BI team at Efacec (See table 6). This template incorporates the essential elements identified through interviews and it is inspired by the BPD template of Renzl et al. (2006) to standardize documentation practices.

This template is designed to facilitate the practice of documentation within the BI team, making it more straightforward and efficient. To ensure the successful implementation of these guidelines, the following steps are recommended: i) conduct training sessions to familiarize employees with the new documentation guidelines and templates; ii) ensure that managers support and enforce the use of the template in documentation practices; and iii) establish channels for employees to provide feedback on the new guidelines and suggest improvements.

Table 6 - Final template

Components	Description
Task title	enter the title
Date	enter the date of document creation
Authors	names and roles of authors
Overview and Objectives	overview of the task and specific objectives
Tools	tools, technologies, and software used
Step-by-step description	the methodology and steps taken
Revision and Updates	record the date of revisions and a summary of changes made
Recommendations	provide recommendations based on outcomes
Appendix	extra notes that the author finds relevant

Source: Own elaboration

By following these suggested guidelines, Efacec can significantly improve its documentation practices, as indicated in the literature by Nakayama et al. (2024). The proposed components and best practices address the current issues of informality and inconsistency, providing a structured approach to creating and maintaining high-quality documentation.

6. Conclusion

This report's first objective was to examine the state of documentation practices within Efacec, particularly focusing on the BI team. As a result of an extensive study that included interviews, documents, and personal observations during the internship, several key findings and areas for improvement could be identified. Overall, the investigation revealed that documentation at Efacec is conducted informally and lacks standardization. Additionally, the organization suffers from a poor culture surrounding documentation, where employees are not incentivized to maintain comprehensive and up-to-date records. This situation is exacerbated by the fact that documentation is currently done manually, making it prone to becoming quickly outdated and out of sync with ongoing projects. Consequently, it was possible to achieve the second objective, which is to identify possible areas for improvement, and then propose some solutions to solve the current issues. Lastly, the third objective involves implementing structured guidelines or a template, based on the information gathered by the interviewees and the literature review.

Based on the findings achieved during the first objective of this study, several recommendations are proposed to improve documentation practices at Efacec. It is recommended that the company develop and enforce a standardized template for documentation that would ensure consistency and completeness. This template should include essential fields such as title, author, date, objectives, steps, and tools used. Furthermore, management could promote the importance of documentation through regular communication, training sessions, and meetings. Recognizing and rewarding employees who excel in maintaining high-quality documentation can also motivate others to follow this practice. Also, having automated documentation processes could reduce the manual workload, minimize the risk of outdated information, and ensure a more streamlined approach.

In conclusion, by addressing the identified issues and implementing the recommended strategies, Efacec can significantly improve its documentation practices. These improvements can enhance organizational efficiency, ensure better knowledge retention, and ultimately contribute to the company's success. It would also be beneficial, in future research, to investigate other departments beyond the BI. This broader scope would help to better understand if those documentation issues are systemic across the organization or only happen in the BI team. Thus, by comparing departments, it is possible to have a clearer picture of how documentation

impacts each team's workflow, and each department can learn from the others, leading to more tailored and effective solutions. Overall, by not being confined to the BI team, this approach can capture the full scope of the documentation issues across the entire organization, because studying only the BI team can have its own limitations, such as the potential bias introduced by the interviewees' perspectives. Their views may not fully represent the experiences and opinions of all employees involved in documentation practices at the organization.

Moreover, it would be useful to conduct comparative studies with other organizations from different sectors and industries, in order to understand if the documentation practices within those organizations have different impacts and importance, or if they are equally important for any kind of business, regardless of the sector or industry. Besides, this would be a great opportunity to learn how other companies develop their documentation practices, and what approaches and practices have been highly successful when it comes to the general scope of business. These studies can provide benchmarks and best practices that could be adapted and used by every company.

As noted, the limitations of this research are a few, such as focusing only on one department and one company, in the industrial sector. So, while this study provides valuable insights into the documentation practices at Efacec, it is not without limitations. For instance, it also relies heavily on interviews and personal observations, which once again can introduce potential biases. The answers obtained during the interviews can be influenced by individual perspectives and experiences. There is subjectivity in the responses of the interviewees since employees can have different views on what is more effective for documentation, based on their roles or even personal preferences. Therefore, it is crucial to carefully balance those results with information from other studies, gathered in the literature review, in order to validate the findings from the interviews.

Appendix

A. Interview script in the original language

Como descreve a importância da prática de documentação na vossa equipa?

Quando há falta de documentação, como é que isso afeta o trabalho e a conclusão bem-sucedida dos projetos?

Portanto, no caso onde não há documentação sente que beneficiaria se houvesse?

Tem conhecimento de algum processo formal ou de diretrizes estipuladas pela empresa, para criar e gerir documentação?

Se sim, quais são as diretrizes?

E se não, já chegou a encontrar alguma padronização na documentação usada aqui na empresa?

Como é que isso afeta a consistência e a qualidade da documentação produzida?

Agora, como avalia a precisão e a relevância da documentação que utiliza durante os seus projetos?

Existem casos em que a falta de precisão ou relevância na documentação levou a erros ou atrasos no projeto?

Tem alguma sugestão de que informação sobre um projeto (ex.: autores, finalidade, período de atividade, etc.) deveria ser criada e mantida em documentação?

De que forma isso melhora a compreensão e a colaboração dentro da equipa?

Sabe dizer como são realizados os processos de revisão e aprovação da documentação? Existe um fluxo claro para revisar e atualizar documentos?

Como é que isso afeta a precisão e a integridade da documentação?

Está ciente de alguma ferramenta ou tecnologia utilizada para automatizar os processos de documentação? Qual é o nível de automatização do processo de documentação? Continua a ser uma prática manual?

Como essa automatização pode melhorar a eficiência e a qualidade da documentação produzida?

Há algum esforço visível para melhorar continuamente a qualidade e a eficiência da documentação? Já viu alguma iniciativa para inovar como a documentação é criada ou gerida?

Podia então me dizer o que gostaria de melhorar nas práticas de documentação? Existem áreas específicas que precisam de atenção imediata?

B. Interview script in English

How would you describe the importance of practicing documentation on your team?

When there is a lack of documentation, how does this affect work and the successful completion of projects?

So, in the case where there is no documentation, do you feel you would benefit if there was?

Can you tell me if you are aware of any formal process or guidelines stipulated by the company to create and manage documentation?

If so, what are the guidelines?

And if not, have you found any standardization in the documentation used here at the company?

How does this affect the consistency and quality of the documentation produced?

Now, how do you evaluate the accuracy and relevance of the documentation you use during your projects?

Are there cases where a lack of accuracy or relevance in documentation has led to errors or project delays?

Do you have any suggestions for what information about a project (e.g. authors, purpose, period of activity, etc.) should be created and maintained in documentation?

How does this improve understanding and collaboration within the team?

Can you also tell me how the documentation review and approval processes are carried out? Is there a clear flow for reviewing and updating documents?

How does this affect the accuracy and completeness of documentation?

Are you aware of any tools or technologies used to automate documentation processes? How automated is the documentation process? Is it still a manual practice?

How can this automation improve the efficiency and quality of documentation produced?

Are there any visible efforts to continually improve the quality and efficiency of documentation? Have you seen any initiatives to innovate the way documentation is created or managed?

Could you tell me what you would like to improve in documentation practices? Are there specific areas that need immediate attention?

References

- Alavi, M., & Leidner, D. E. (2001). Review: Knowledge Management and Knowledge Management Systems: Conceptual foundations and research issues. *MIS Quarterly*, 25(1), 107. <https://doi.org/10.2307/3250961>
- Alpar, P., & Schulz, M. (2016). Self-Service Business Intelligence. *Business & Information Systems Engineering*, 58(2), 151–155. <https://doi.org/10.1007/s12599-016-0424-6>
- Alshenqeeti, H. (2014). Interviewing as a Data Collection Method: A Critical review. *English Linguistics Research*, 3(1). <https://doi.org/10.5430/elr.v3n1p39>
- Alwazae, M. M., Perjons, E., & Johannesson, P. (2019). Template-driven best practice documentation. *Knowledge Management Research & Practice/Knowledge Management Research and Practice*, 18(3), 348–365. <https://doi.org/10.1080/14778238.2019.1678411>
- Ambler, S. W., & Lines, M. (2012). Disciplined agile delivery: A practitioner's guide to agile software delivery in the enterprise. *IBM press*.
- Amiraslani, F., & Dragovich, D. (2022). A Review of Documentation: A Cross-Disciplinary Perspective. *World*, 3(1), 126–145. <https://doi.org/10.3390/world3010007>
- Antons, D., Grünwald, E., Cichy, P., & Salge, T. O. (2020). The application of text mining methods in innovation research: current state, evolution patterns, and development priorities. *R&D Management*, 50(3), 329–351. <https://doi.org/10.1111/radm.12408>
- Attard, J., Orlandi, F., Scerri, S., & Auer, S. (2015). A systematic review of open government data initiatives. *Government Information Quarterly*, 32(4), 399–418. <https://doi.org/10.1016/j.giq.2015.07.006>
- Berg, B. L. (2007). Qualitative research methods for the social sciences. *London: Pearson*.
- Bloodgood, J. M. (2009). Organizational routines as mechanisms for knowledge creation, utilization, and storage. In *Annals of information systems* (pp. 41–58). https://doi.org/10.1007/978-1-4419-0011-1_4
- Brewis, C., Dibb, S., & Meadows, M. (2023). Leveraging big data for strategic marketing: A dynamic capabilities model for incumbent firms. *Technological Forecasting and Social Change*, 190,

122402. <https://doi.org/10.1016/j.techfore.2023.122402>

Broy, M. (2022). Software system documentation: Coherent description of software system properties. In *Lecture notes in computer science* (pp. 10–27). https://doi.org/10.1007/978-3-031-19756-7_2

Buckland, M. K. (1997). What is a “document”? *Journal of the American Society for Information Science*, 48(9), 804–809. [https://doi.org/10.1002/\(sici\)1097-4571\(199709\)48:9](https://doi.org/10.1002/(sici)1097-4571(199709)48:9)

Buckland, M. K. (2016). The physical, mental and social dimensions of documents. *Proceedings From the Document Academy*, 3(1). <https://doi.org/10.35492/docam/3/1/4>

Caseiro, N., & Coelho, A. (2018). Business intelligence and competitiveness: the mediating role of entrepreneurial orientation. *Competitiveness Review*, 28(2), 213–226. <https://doi.org/10.1108/cr-09-2016-0054>

Efacec. (2021). Annual Report and Accounts 2020. *Efacec*. https://www.efacec.pt/en/wp-content/uploads/2021/04/Efacec_RC2020_EN_16.04.2020.pdf

Efacec. (2023). Quem Somos. *Efacec*. <https://www.efacec.pt/quem-somos/>

Fraser-Arnott, M. (2020). Academic Library COVID-19 subject Guides. *The Reference Librarian*, 61(3–4), 165–184. <https://doi.org/10.1080/02763877.2020.1862021>

Gaya, H., & Smith, E. (2016). Developing a Qualitative Single Case Study in the Strategic Management Realm: An Appropriate Research Design? *International Journal of Business Management and Economic Research*. <https://www.ijbmer.com/docs/volumes/vol7issue2/ijbmer2016070201.pdf>

Geiger, R. S., Varoquaux, N., Mazel-Cabasse, C., & Holdgraf, C. (2018). The types, roles, and practices of documentation in data Analytics open-source software libraries. *Computer Supported Cooperative Work*, 27(3–6), 767–802. <https://doi.org/10.1007/s10606-018-9333-1>

Haddadpoor, A., Taheri, B., Nasri, M., Heydari, K., & Bahrami, G. (2015). Process documentation: A model for knowledge Management in organizations. *Materia Socio Medica*, 27(5), 347. <https://doi.org/10.5455/msm.2015.27.347-350>

Halloran, D., Manchester, S., Moriarty, J., Riley, R., Rohrman, J., & Skramstad, T. (1978). Systems development quality control. *MIS Quarterly*, 2, 1–13.

Hammersley, M. (2013). What is qualitative research? *Bloomsbury Academic*.
<https://doi.org/10.5040/9781849666084>

Harrison, R., Parker, A., Brosas, G., Chiong, R., & Tian, X. (2015). The role of technology in the management and exploitation of internal business intelligence. *Journal of Systems and Information Technology*, 17(3), 247–262. <https://doi.org/10.1108/jsit-04-2015-0030>

Ho, D. (2006). The focus group interview: Rising the challenge in qualitative research methodology. *Australian Review of Applied Linguistics*, 29(1): 5. 1-19.

Holsapple, C. W., & Jones, K. G. (2009). Knowledge Chain Activity Classes. In *IGI Global eBooks* (pp. 68–88). <https://doi.org/10.4018/978-1-60566-140-7.ch005>

Huang, P., Niu, B., & Pan, S. L. (2021). Platform-based customer agility: An integrated framework of information management structure, capability, and culture. *International Journal of Information Management*, 59, 102346. <https://doi.org/10.1016/j.ijinfomgt.2021.102346>

Huang, S., & Tilley, S. (2003). Towards a documentation maturity model. In *21st annual international conference on Documentation*. <https://doi.org/10.1145/944868.944888>

Ika, L. A., & Donnelly, J. (2017). Success conditions for international development capacity building projects. *International Journal of Project Management*, 35(1), 44–63. <https://doi.org/10.1016/j.ijproman.2016.10.005>

King, W. R. (2008). Knowledge management and organizational learning. *Omega*, 36(2), 167–172. <https://doi.org/10.1016/j.omega.2006.07.004>

Kvale, S. (1996). *InterViews: An introduction to qualitative research interviewing*. Thousand Oaks, CA: Sage

Lappi, T. M., Aaltonen, K., & Kujala, J. (2019). Project governance and portfolio management in government digitalization. *Transforming Government: People, Process and Policy*, 13(2), 159–196. <https://doi.org/10.1108/tg-11-2018-0068>

- Liu, S., Guo, Z., Li, Y., Lü, H., Chen, L., Xu, L., Zhou, Y., & Xu, B. (2021). Prioritizing code documentation effort: Can we do it simpler but better? *Information & Software Technology*, 140, 106686. <https://doi.org/10.1016/j.infsof.2021.106686>
- Lusa. (2023). Mutares finaliza compra da Efacec ao Estado. *Empresas - Jornal De Negócios*. <https://www.jornaldenegocios.pt/empresas/detalhe/mutares-finaliza-compra-da-efacec-ao-estado>
- Massingham, P. (2018). Measuring the impact of knowledge loss: a longitudinal study. *Journal of Knowledge Management*, 22(4), 721–758. <https://doi.org/10.1108/jkm-08-2016-0338>
- May, T. (2011). Social research: Issues, methods and process. 4th edition. <https://usir.salford.ac.uk/id/eprint/9314/>
- Muhammad, G., Ibrahim, J., Bhatti, Z., & Waqas, A. (2014). Business Intelligence as a knowledge management tool in providing financial consultancy services. *American Journal of Information Systems*, 2(2), 26–32. <https://doi.org/10.12691/ajis-2-2-1>
- Nakayama, M., Hustad, E., & Sutcliffe, N. (2021). Agility and system documentation in large-scale enterprise system projects: a knowledge management perspective. *Procedia Computer Science*, 181, 386–393. <https://doi.org/10.1016/j.procs.2021.01.181>
- Nakayama, M., Hustad, E., Sutcliffe, N., & Beckfield, M. (2024). Organic transformation of ERP documentation practices: Moving from archival records to dialogue-based, agile throwaway documents. *International Journal of Information Management*, 74, 102717. <https://doi.org/10.1016/j.ijinfomgt.2023.102717>
- Nasri, W. (2012). Conceptual Model of Strategic Benefits of Competitive Intelligence Process. *International Journal of Business and Commerce*, 1(6), 25–35. <https://www.ijbcnet.com/1-6/IJBC-12-1602.pdf>
- Nithya, N. R., & Kiruthika, R. (2020). Impact of Business Intelligence Adoption on performance of banks: a conceptual framework. *Journal of Ambient Intelligence and Humanized Computing*, 12(2), 3139–3150. <https://doi.org/10.1007/s12652-020-02473-2>
- Niu, Y., Ying, L., Yang, J., Bao, M., & Sivaparthipan, C. B. (2021). Organizational business intelligence and decision making using big data analytics. *Information Processing and Management*,

58(6), 102725. <https://doi.org/10.1016/j.ipm.2021.102725>

Olsen, B. I., Lund, N., Ellingsen, G., & Hartvigsen, G. (2012). Document theory for the design of socio - technical systems. *Journal of Documentation*, 68(1), 100 – 126. <https://doi.org/10.1108/00220411211200347>

Olszak, C. M. (2014). Business intelligence and Analytics in organizations. In *Studies in computational intelligence* (pp. 89–109). https://doi.org/10.1007/978-3-319-11328-9_6

Olszak, C. M., & Ziemba, E. (2003). Business intelligence as a key to management of an enterprise. *Informing Science and IT Education Conference*. <https://doi.org/10.28945/2672>

Østerlund, C., & Crowston, K. (2019). Documentation and access to knowledge in online communities: Know your audience and write appropriately? *Journal of the Association for Information Science and Technology*, 70(6), 619–633. <https://doi.org/10.1002/asi.24152>

Parnas, D. L. (2010). Precise documentation: the key to better software. In *Springer eBooks* (pp. 125–148). https://doi.org/10.1007/978-3-642-15187-3_8

Renzl, B. Matzler, K. and Hinterhuber, H. (2006). The Future of Knowledge Management. *Palgrave Macmillan, New York*.

Romero, C. a. T., Ortíz, J. H., Khalaf, O. I., & Prado, A. R. (2021). Business Intelligence: Business Evolution after Industry 4.0. *Sustainability*, 13(18), 10026. <https://doi.org/10.3390/su131810026>

Rouhani, S., Asgari, S., & Mirhosseini, S. V. (2012). Review study: business intelligence concepts and approaches. *American Journal of Scientific Research*, 50(1), 62-75.

Rueckel, D., Mühlburger, M., & Koch, S. (2020). An updated framework of factors enabling digital transformation. *Pacific Asia Journal of the Association for Information Systems*, 12, 1–26. <https://doi.org/10.17705/1thci.12401>

Saunders, M., Lewis, P., & Thornhill, A. (2009). Research Methods for Business Students (5th ed). In *Pearson Education eBooks*. <https://epubs.surrey.ac.uk/816026/>

Seleim, A., Ashour, A., & Khalil, O. E. M. (2005). Knowledge documentation and application

- in Egyptian software firms. *Journal of Information & Knowledge Management*, 04(01), 47–59. <https://doi.org/10.1142/s0219649205001043>
- Seligson, M. T., Lyden, S. P., Caputo, F. J., Kirksey, L., Rowse, J. W., & Smolock, C. J. (2021). Improving clinical documentation of evaluation and management care and patient acuity improves reimbursement as well as quality metrics. *Journal of Vascular Surgery*, 74(6), 2055–2062. <https://doi.org/10.1016/j.jvs.2021.06.027>
- Siggelkow, N. (2007). Persuasion with case studies. *Academy of Management Journal*, 50(1): 20-24. <https://doi.org/10.19177/reen.v1e120081-9>
- Stake, R. E. (1995). The art of case study research. *Thousand Oaks, CA: Sage*.
- Sung, H., & Lee, D. G. (2018). Framework based on building information modelling for information management by linking construction documents to design objects. *Journal of Asian Architecture and Building Engineering*, 17(2), 329–336. <https://doi.org/10.3130/jaabe.17.329>
- Tashakkori, A., & Teddlie, C. (2010). SAGE Handbook of Mixed Methods in Social & Behavioral Research. In *SAGE Publications, Inc. eBooks*. <https://doi.org/10.4135/9781506335193>
- Taylor, M. C. (2005). Interviewing. *Qualitative research in health care*, 39-55.
- Tian, X., Chiong, R., Martin, B., & Stockdale, R. (2015). Introduction to the special issue of the Journal of Systems and Information Technology on Business Intelligence. *Journal of Systems and Information Technology*, 17(3). <https://doi.org/10.1108/jsit-04-2015-0032>
- Vitorino, A. D. M., & Dias, A. V. (2021). When will Portuguese power systems manufacturer, EFACEC, be sold? *MACEDO VITORINO*. https://www.macedovitorino.com/xms/files/20210427-Portuguese_Insights-Sale_of_EFACEC.pdf
- Yoon, A., & Copeland, A. J. (2020). Toward community-inclusive data ecosystems: Challenges and opportunities of open data for community-based organizations. *Journal of the Association for Information Science and Technology*, 71(12), 1439–1454. <https://doi.org/10.1002/asi.24346>