Journal of Business and Economics, ISSN 2155-7950, USA
January 2021, Volume 12, No. 1, pp. 36-46
DOI: 10.15341/jbe(2155-7950)/01.12.2021/004

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An Approach to Integrate Multidisciplinary Sustainability: The Case of the Social Center's Information System

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Abstract: Today, most organizations are heavily dependent on Information Systems and Information and Communication Technologies. In this sense, it is considered urgent to study the implementation of sustainability measures when optimizing these technologies in an organizational context.

The aim of the paper is to analyze the contribution to sustainability in the process of optimizing the current Information System of a social organization. The methodology focused on the literature review of the field as well as on international standards, ending with the presentation of the case study. The main conclusions focus on analyzing the impact of including sustainability concerns in the various dimensions of optimizing the Information System in a Social Center — in particular in the human, economic, environmental, technical and social dimensions. In the context of the optimization of the Social Center's information system, the intention is to implement an approach to integrate multidisciplinary sustainability, addressing the challenges from various perspectives.

Key words: sustainability; information systems; software development; information and communication technologies; karlskrona manifesto

JEL code: O32

1. Introduction

The study of sustainability in the field of Information Systems (IS) and Information and Communication Technologies (ICT) is of the utmost importance to address the various areas underlying the theme. The concept of sustainability is often extrapolated to software development with the Karlskrona Manifesto (Becker et al., 2015). This manifesto serves as a guide for designing and developing more sustainable software systems. In the opinion of Grady Booch (Booch, 2015), the nature of the systems we build continues to change and as they cross collectively in our lives, we must attend not only to the technical elements of software development, but also to human needs. In this sense, human needs must be present in the organizations' sustainability policy, in view of the Sustainable Development Goals (SDGs) outlined by the United Nations, which is a reference to improve cooperation and promote development (UNDP, 2015).

On the other hand, knowledge management refers to the creation, identification, integration, recovery,

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sharing and use of knowledge within the organization, which can also be understood as the art of generating value from the organization's intangible assets (Serrano & Fialho, 2003). Indeed, knowledge management techniques can and should be applied to promote IS sustainability and improve software development processes in organizations.

The designation of knowledge management (Figueiredo, 2003), corresponds to the way of managing the processes of social construction of knowledge. The history of knowledge management, over time, has always been built around four factors that are closely linked, namely: domains of knowledge; actors (roles, roles, professions); forms of action and/or intervention and organizational models. Also, according to the same author, whenever the balance between these factors was disturbed, crisis situations were generated, which demanded the search for new balances. New balances have always been found, generating other domains of knowledge. As a result, new forms of action and new organizational models emerged, with new actors, new professions or new functions.

To help understand knowledge in a systematic way, Kim and Park (2003) presented a taxonomy of knowledge. Indeed, knowledge can be computerized or not. Computerized knowledge is what is stored in a computer system, making it possible to process it. Knowledge that is not computerized is in the human brains or is recorded on recorders, but computer processing is not possible (Kim & Park, 2003).

Successful knowledge management is a powerful lever for the company's success, and a positive correlation can be established between greater knowledge management success and the creation of value in the organization (Kluge et al., 2002). It is important to promote knowledge transfer through workshops, conferences and meetings, as well as to evaluate and reward those who share and reuse knowledge.

From the great problems that go beyond the limits of human knowledge, to the daily tasks of research, the software has made an invaluable contribution to the advancement of research (Software Sustainability Institute, 2019). Good software practices will enhance the development of more optimized software, which in turn brings improvements in terms of reproducibility and reuse of research. The sustainability of the software creates reliable, reproducible and reusable software (Hettrick, 2016), namely: the results generated by reliable and well-tested software can be trusted; reusing software has the potential to save a significant amount of resources that can be invested in further research; the software that continues to function allows continuous access and use of research data, aiding in reproducibility and helping to extract the greatest return on the investment made in data collection. In fact, software reuse is the reapplication of a variety of types of knowledge from one system to another similar system in order to reduce the development effort, improving productivity and software quality (Silveira & Vidal, 2002).

The entire organizational context requires rigorous planning, regularity/uniformity of procedures and optimization of existing general resources. These premises require constant and regular access to updated and relevant data, in order to decide which, enable the sustainability and growth of organizations (Lapa, Bernardino, & Figueiredo, 2014).

In this context, it is reinforced the understanding that there is a link between knowledge management and reuse in which its study can contribute to the development of more sustainable systems.

2. State of the Art

Currently, most organizations are dependent on ICT in order to create added value to their business. Enhancing the different types of networks that organizations can use should be a challenge in order to optimize

their resources. Social organizations are faced with a set of specific challenges given their inherent characteristics. In this sense, social networks exist in companies and are responsible for the relationship between the individuals that make up the organization. It remains to be seen whether the organization's structure allows a social information system to be adopted, and whether it will bring added value to the organization about processes, motivation, productivity and knowledge transfer, (Paulino & Reis, 2012). Community environments, which include social networks, have been described as having the highest volume in terms of knowledge sharing. In fact, knowledge increases in value when it is shared - characteristic of self-worth (Kluge et al., 2002). Mutual assistance between the various employees is seen as an essential component for an optimal and more efficient result, with a high degree of discussion and improvement of the final solution.

Thus, it is considered that enhancing ICT in an organizational context implies exploring the constant technological advances (Landum & Reis, 2012), reinforcing the mutations in ICT, also providing, to the academic world and society in general, a great relevance to the concept of cloud computing, assuming itself as an emerging, disruptive paradigm and where the need for research also arises, from its technological component to business models to business models , and it has revolutionized the way ICT is thought.

It is considered this way (Moreno & Reis, 2012), that IS is strategic in organizations, regardless of the area of business in which they fall. The major challenges that are currently present are not only from the ICT available, but from the capacity of organizations to adapt and use ICT correctly in their particular and specific environment, and generate benefits for both their employees and themselves.

Among the many ways in which sustainability has been defined, the simplest and most fundamental is: "the ability to sustain" or, in other words, "the ability to bear" (Sustain Ability, 2018). In this sense, it is considered that the implementation of sustainability measures when optimizing IS and ICT can be an added value in enhancing the reuse of various components underlying the field under study.

The standard (ISO 27004, 2016), states that the measurements or measures necessary for the management of information security, from the point of view of security metrics, should address several concerns, including:

- Justification — explains the value of the measurement, for example increase responsibility and performance;
- Characteristics — what to measure, monitor, analyze and evaluate, when to do and who to do it;
- Types of measures — measures of performance (efficiency) and effectiveness;
- Processes — how to develop, implement and use metrics.

The (ISO 27004, 2016), is applicable to all types and sizes of organizations. In this sense, it is considered to provide guidelines to help organizations assess the performance of information security and the effectiveness of an information security management system in order to meet the requirements of (ISO 27001, 2013), which it mentions in section 9.1: a) the importance of monitoring and measuring information security performance; (b) monitoring and measuring the effectiveness of an Information Security Management System (ISMS), including its processes and controls; (c) the analysis and evaluation of the results of monitoring and measurement.

Information security concerns (Mamede, 2006) should be analyzed and developed from various perspectives. The analysis and definition of information security policies and mechanisms in an organizational context should be studied in its various perspectives. It is intended to promote the practice of development and optimization of policies and practices underlying the theme given its relevance in an organizational context.

The reorganization and optimization of organizational processes (Santos, 2018) have a significant impact on the IS that support them. It is therefore pertinent to establish a relationship between organizations, creativity,

innovation and IS. In this context, the introduction of creativity techniques and strategies in the process of designing IS, with a view to the agile and efficient construction of them, appears to have enormous potential. The ICT sector should have concerns about implementing green IT policies, actively contributing to the sustainability of the sector (Reis & Silveira, 2020). Thus, it is important that, when starting a project, it is underpinned by replicable sustainability policies in the various departments, reinforcing its importance for the organization and relevance of the results achieved from sustainability (Reis, Silveira, Carvalho & Mata, 2020).

3. Sustainability in Information Systems

According to (UNDP, 2015), the definition of the 17 Sustainable Development Goals is the new agenda for action by 2030, which is based on the progress and lessons learned from the 8 Millennium Development Goals between 2000 and 2015. This agenda is the result of the joint work of governments and citizens around the world who want to create a new global model to end poverty, promote prosperity and the well-being of all, protect the environment and combat climate change. In this sense, and based on concerns in the field of the sustainability of IS and ICT, it is considered that the article presented and the theme described therein can contribute to several axes in order to enhance the use of IS and ICT for the benefit of people.

Indeed, ICT sustainability can be considered an added value by proposing actions whose metrics are measurable. Thus, it is suggested to recommend measures that present solutions in order to optimize the operational and professional activities based on sustainability, contributing to green IT.

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Achieving a balance between the environment, society and the economy is considered essential to meet the needs of the present without compromising the capacity of future generations to meet their needs. The goal of sustainable development is achieved by balancing these three pillars of sustainability (ISO 14001:2015).

In this sense, the objective of (ISO 14001:2015), focuses on promoting information to organizations for environmental protection, the possibility of initiating responses to the changing needs of environmental conditions in balance with socio-economic needs. The requirements emanated by the standard allow an organization to achieve the desired and defined results for its environmental management system.

International Standard (ISO 14001, 2015), proposes a systematic approach to environmental management with the commitment of the top policy makers of organizations in order to define strategies and provide information necessary to achieve long-term success and to create alternatives that contribute to sustainable development, through:

- Protection of the environment by preventing or mitigating adverse environmental impacts;
- Mitigation of potential adverse effects of environmental conditions in the organization;
- Assistance to the organization in meeting legal requirements and other requirements;
- Increased environmental performance;
- Control or influence in the way in which the organization's products and services are designed, manufactured, distributed, consumed and discarded, using a life cycle perspective that can prevent the involuntary displacement of environmental impacts within the life cycle;

- Achievement of financial and operational benefits that may result from the implementation of environmental alternatives that reinforce the organization's position in the market;
- Communication of environmental information to relevant stakeholders.

It is argued that, whether by the capacity for investment, the integrated knowledge of the requirements involved, the interpretation of the diversity of existing standards and good practices, the perception of imminent risk or simply the definition of priorities, some organizations have difficulties in the field of ICT optimization, (Russo & Reis, 2019). The numerous emerging technologies that characterize the so-called "Industry 4.0", namely artificial intelligence, internet of things, nanotechnology, quantum computing, augmented reality and virtual reality, drones, 3D printing, blockchain, among others, will have uses increasingly focused on sustainability (Meneses, 2019).

The importance of sustainability is increasingly recognized, but the broader impacts of software systems on sustainability are unknown. To help with this change, the Karlskrona Manifesto proposes the following principles and commitments (Penzenstadler, 2015):

• **Sustainability is systemic:** sustainability is never an isolated property. Systemic thinking should be the starting point for the transdisciplinary common ground of sustainability;

• **Sustainability is multidimensional:** to include the economic, social, environmental, technical and individual (personal) dimensions to understand the nature of sustainability in any situation;

• **Sustainability is interdisciplinary:** working in sustainability means working with people from various disciplines, addressing the challenges from various perspectives;

• **Sustainability transcends the objective of the system:** sustainability must be considered, even if the main focus of system development is not sustainability, because the use of any software can affect your environment;

• **Sustainability applies both to a system and to its broader contexts:** the design of the system involves at least two spheres: the sustainability of the system itself and how it affects the sustainability of the broader system of which it will be part;

• **Sustainability requires action at various levels:** some interventions have more influence on one system than others. Whenever we take steps to sustainability, we should consider opportunity costs: actions at other levels can offer more effective forms of intervention.

• **Sustainability requires multiple time scales:** we must assess the benefits and impacts at various time scales and include long-term indicators in assessments and decisions.

• **Changing the design to consider the long-term effects do not directly imply sacrifices:** innovation in sustainability can be dissociated from present and future needs. Being able to identify opportunities and changes that benefit the present and the future.

• **The visibility of the system is a precondition and facilitator of sustainability design:** the social position and context of the system must be visible at different levels of abstraction and from different perspectives to allow participation and informed responsible choice.

Sustainable development is multidimensional, as it leads to the economic, social, environmental, technical and individual dimensions. Figure 1 shows the impact of a software system considering the economic, environmental, social, individual and technical dimensions of sustainability (Oyedeji, Ahmed, & Penzenstadler, 2017). This analysis is based on business sustainability data on the content of the environment, society, economy, process, value and people. The scheme provides an overview of how the various dimensions of sustainability influence each other and their relationships for a car-sharing system, ShareVoyage, for students in a city (Oyedeji,

Ahmed, & Penzenstadler, 2017). It also includes an online web platform for group shopping and sharing of unused food.

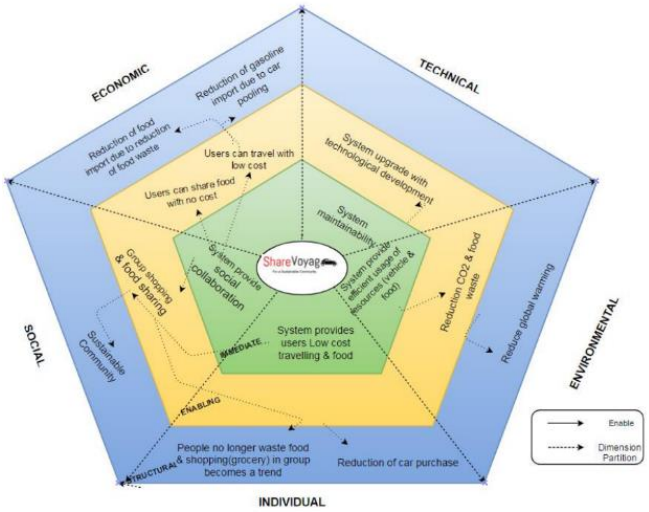

Figure 1 Sustainability Analysis (Business Sustainability Assessment)

Source: Sustainability Quantification in Requirements Informing Design (Oyedeji, Ahmed, & Penzenstadler, 2017)

Other aspects to be considered in development is the need to provide the Software Engineer with a solid ethics based on his own university education, which allows him to face the difficult situations that he will inevitably face in the professional environment. It turns out that sometimes the responsibility is ruled out by assuming Software Engineering as being ethically neutral or simply by dispersing this responsibility for the various elements of the software production process (Caetano & Silveira, 2009). Each Software Engineer is responsible for knowing and putting into practice the codes of conduct, always defending ethics as a fundamental element of social and professional relations. It is also the responsibility of each one to instill and promote compliance with codes of ethics with colleagues in the profession. Ethics, like professional success, will always begin in the individual himself.

In view of the concerns underlying IS and ICT with reference to their effective contribution in a context of sustainability in the various aspects, the definition of a strategy for continuous improvement is advocated. In this sense, (ISO 14001, 2015), it is proposed the approach that supports an environmental management system based on the Plan-Do-Check-Act (PDCA) concept. The PDCA cycle provides an iterative process used by organizations to achieve continuous improvement. The PDCA cycle can be applied to an environmental management system and to each of its individual elements:

• Plan: establish the environmental objectives and processes necessary to deliver results according to the organization's environmental policy;

• Do: implement the processes as planned;

• Check: monitor and measure processes in relation to environmental policy, including their commitments, environmental objectives and operational criteria, and report results;

• Act: take actions for continuous improvement.

Figure 2 shows how the structure presented could be integrated into the PDCA cycle, which can help new or existing users understand the importance of a systems approach.

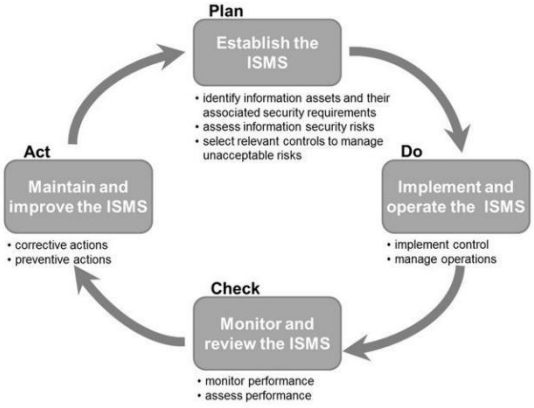

Figure 2 PDCA Cycle in ISO 27002

Source: Information technology - Security techniques - Code of practice for information security controls, ISO/IEC 27002:2013.

The PDCA cycle implicit in (ISO 14001, 2015) has full applicability in ICT, particularly when studying ISO 27002, 2013, in the context of the optimization of information security practices, and (ISO 27001, 2013), about Information Security Management. The standard (ISO 14001, 2015), in section 6 in the planning framework, more specifically regarding 6.1 — refers to actions to address risks and opportunities. In this context, and in the context of ICT, the risk analysis established in ISO 27005:2018 also addresses issues from the perspective of ICT risk management and the concerns of ICT and sustainability can be crossed.

Bearing in mind (ISO14001, 2015), the performance evaluation mentioned in section 9 is part of the PDCA's philosophy of continuous improvement and interconnecting with (ISO27001, 2013) in the context of ICT audits. The analysis of the interconnection between (ISO14001, 2015) and (ISO27001, 2013), allows identifying the necessary requirements to enhance the use of ICT in an organizational context, within the scope of Information Security Management. Indeed, ISO14001(2015) specifies the requirements for an environmental management system that an organization can use to improve its environmental performance. The standard is intended for use by an organization that seeks to manage its environmental responsibilities systematically in order to contribute to the environmental pillar of sustainability.

In this sense, sustainability can be achieved by adding several areas of knowledge, in the field of this theme, in order to enhance various valences in the organizational context, particularly about the optimization of IS/ICT.

4. Case Study

The case study, which is presented, aims to characterize the situation of the Community of Social Center (SC). The characterization from the socio-cultural point of view of the Community was based on the need to optimize the IS and ICT to support the activity of a social organization, here called the Social Center.

The areas involved were analyzed in order to study the various valences supported by a comprehensive strategy, namely: psychology, family situation, social situation, medical care, nursing care, habitability conditions, life experience, education and training, volunteering.

It is also intended to involve the various official entities, namely:

- Public Security Police, in the mission of ensuring democratic legality, ensuring internal security and citizens' rights, in accordance with the Constitution and the Law;
- Foreigners and Borders Service, in the mission of ensuring the control of people at borders, foreigners in

national territory;

- Social Security, as a system that aims to ensure basic rights of citizens and equal opportunities;
- Parish Council, in the mission of ensuring full satisfaction of the needs, expectations and aspirations of its citizens;
- Health Center, in the mission of providing primary health care.

The various entities involved in the process of creating synergies were identified in order to optimize the provision of services to their users. It should be noted that knowledge is creative and should be stimulated to develop (Davenport & Prusak, 1998). In this way, technology is a means to improve communication and collaboration between community elements, and there can be sharing of experience/knowledge and skills.

It is also intended to create a platform in which the various actors can, under their access profile, access the information of the elements of the SC under analysis in order to optimize the services provided. Based on the principles and commitments of the Karlskrona Manifesto (Becker et al., 2015), which provide an overview of the various dimensions of sustainability and their relationships, the corresponding scheme for SC was constructed, as illustrated in Figure 3. It is intended to show the impact that sustainability concerns can have when optimizing an information system.

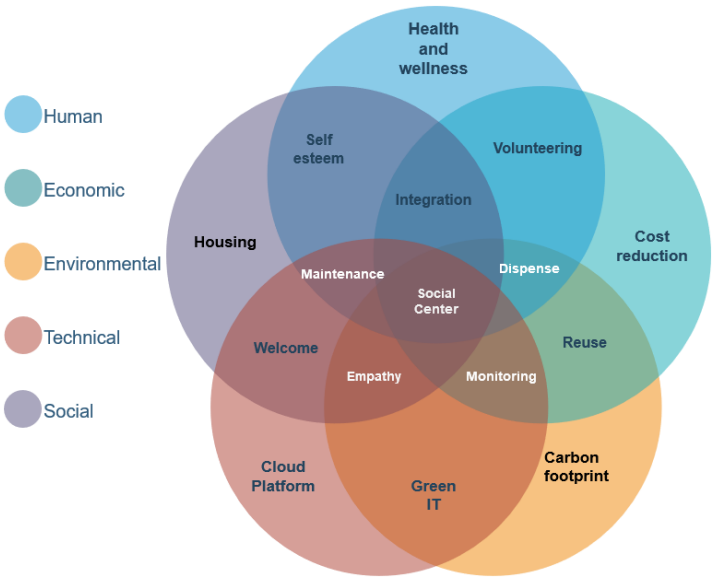

Figure 3 Sustainability in Social Center

The applications of the various dimensions of sustainability are described below:

Human/Individual Sustainability: The information system was designed to promote integration, general improvement of the health of those receiving medical and nursing treatments. As this system is multidisciplinary, improving individual sustainability is the focus of the system. Thus, it will allow personal satisfaction in terms of health, comfort in housing, performance of volunteering tasks (give and receive).

Economic Sustainability: reduction in energy costs, consumer goods (donated and shared); services of volunteers (maintenance of housing, training, among others), reuse of non-perishable goods, among others.

Environmental Sustainability: reduction of energy costs (cloud platform system), reduction of carbon emissions and gasoline consumption (transport sharing). Reuse of non-perishable goods, avoiding the waste of

perishable goods (donation of goods).

Technical Sustainability: The system will be available on a cloud platform, making it compatible with many mobile and desktop devices, without paying licenses, and reducing the need for app users to stop using their older devices.

Social Sustainability: SC satisfaction due to social integration, welcoming, problem solving in housing (aesthetic improvement of housing, for example); sharing of resources and artefacts; community physical activity, biomechanics (monitoring); Psychologist present (improvement of self-esteem).

The development of the prototype can be carried out on the Salesforce platform (Salesforce, 2019a), having as a starting point a package already developed by Salesforce, for non-profit organizations, non-profit. The package, Nonprofit Success Pack (NPSP), is an open source application that begins with an industry-standard data architecture and adds donor management and pre-built constituent components to support programs and outreach. This flexible platform enables non-profit organizations of any size to better manage their activities and engage more with donors. Provides eligible nonprofits with access to Salesforce products and resources. The program includes 10 donated subscriptions and large discounts on additional Salesforce subscriptions, products, and services (Salesforce, 2019b).

On the Salesforce platform you can work with applications provided by various service providers, and these applications can be used together or separately from the Customer Relationship Management (CRM) solution of this platform. Leimeister (Leimester, Riedl, Böhm, & Krcmar, 2010), says Salesforce is both a platform provider and application provider. This platform has made operating costs more flexible, allowing for faster application development. When we are trying to define the requirements of a business, Force.com has a solution that provides us with a basis for defining requirements with the customer. Thus, the development process can start much earlier. This solution consists of packages already developed, which contain basic and very general functionalities, which best adapt to the client's business model (Ramos, Silveira, & Pinheiro, 2013).

The case study, now presented, continues to develop, demonstrating that the inclusion of sustainability factors from the beginning of the process is an added value and promotes the Sustainable Development Goals (UNDP, 2015), in particular with regard to Objective 16 concerns (Promoting peaceful and inclusive societies for sustainable development, providing access to justice for all and building effective institutions , responsible and inclusive at all levels), goal 16.10: ensuring public access to information and protecting fundamental freedoms in accordance with national law and international agreements (UNB, 2019). Achieving the SDGs requires the partnership of governments, the private sector, civil society and citizens to ensure that we leave a better planet for future generations (UNDP, 2015). It is intended to use scientific knowledge, addressing challenges from various perspectives, to help SC improve people's overall satisfaction and internalize the nature of sustainability in any situation.

5. Conclusion

The optimization of the Social Center's IS was the basic objective of this project. For its implementation, the literature was reviewed in this area. This helped include the analysis in the dimensions of sustainability, from several points of view: social, economic, technical, environmental, and individual. With reference to these objectives, the possible impact of the concerns taken from sustainability manifestos on current organizational practices was studied.

The case study allowed to include a set of concerns when optimizing the IS of a social organization in order to define metrics at the level of various sustainability factors, namely carbon emissions, costs of IT, electricity, software licenses, recycling, among others. In this context, sustainability concerns have raised the use of metrics to measure the level of carbon emissions, cost of ICT, electricity consumption, cost of software licensing, reuse of procedures when developing software. In this way, it is possible to establish a program to promote sustainability in the SC from the survey of requirements and identifying opportunities and changes that benefit the present and the future.

It is therefore considered that it was possible to assess that the implementation of sustainability concerns in an integrated aspect when optimizing an IS and business support ICTs can provide added value to contribute to the achievement of gains in several aspects.

As future work perspectives, it is considered relevant to continue the analysis and strategy of policy optimization in this field of knowledge. It is also intended to address the concerns underlying information security, with reference to the specificity of the organization, service levels and access profiles, and how the practices established in order to contribute to the availability of information and ubiquity can be optimized. It is also considered that the dematerialization in the use of paper represents an added value in the optimization of processes and an important reinforcement in sustainability.

Acknowledgements

This article was supported by Polytechnic Institute of Setúbal.

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