Knowledge Gains and Losses to Organizational Resilience, from Intellectual Capital

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Abstract: Understood that knowledge loss is an imminent risk to organizations as it occurs when employees with valuable knowledge leave the organization, when there are problems with codified knowledge or when the organization does not properly manage knowledge. In this context, organizational resilience can be affected, since intangible resources enable organizational responses to the unexpected. Considering that the aspects that generate losses can be common to organizations, it is also important to identify what are the possible gains that the system has, as a result of these situations. Thus, the objective of this article is to understand the state of the art under knowledge loss in the context of organizational resilience and to identify the possible gains arising from these critical situations. As a proposal, a classification according to the concept of Intellectual Capital based on the three main dimensions: Human Capital, Structural Capital and Relational Capital. Thus, a literature review was carried out in order to identify the impacts of the loss of knowledge on resilient responses, as well as the gains for the organizational system. This theoretical study aimed to contribute to the scientific advancement of knowledge loss, to the advancement of organizational resilience aspects, as well as to Intellectual Capital. Also, it was proposed to advance in the understanding of knowledge gains, since regular aspects to organizations such as turnover, waste of knowledge, low volume of specialists and absences from work generate risks to critical knowledge. These, in turn, affect the resilience and structures of the IC. Presenting knowledge vulnerabilities makes it possible to identify possible positive impacts, in order to ensure proper knowledge management, in favor of organizational resilience and its sustainability. As a result, the study showed that the loss of knowledge is mainly from Human Capital, however there are direct and positive impacts on the structural and relational capital of the organization, as loss mitigation strategies lead to strategies for strengthening relationships and internal improvements in its structure. Furthermore, the creation of unlearning and organizational learning environments can contribute to the resilience of the system.

Keywords: Organizational resilience; Knowledge loss; Knowledge waste; Knowledge gain; Intellectual capital

1. Introduction

In recent years, a new approach to the focus of operational safety management has proposed replacing failure-based analysis with a more systemic perspective, redefining successful or failed performance as a complex and emergent event rather than a conclusion of singular errors or root causes. This new paradigm, called Safety II, was theorized and instrumentalized by resilience engineering (Hollnagel et al., 2006; Leveson et al., 2006; Dekker et al., 2008; Hollnagel, 2015; Patriarca et al., 2017; Slim & Nadeau, 2020).

In this sense, resilience engineering seeks ways to increase the resilience potential of systems, giving them the ability to preserve operations even in the face of threats. The resilience of sociotechnical systems depends on how well they can adjust to the specific context around them. In other words, verification and validation of approximate fits, which is the second security principle, play vital roles in the design of resilient sociotechnical systems (Hirose & Sawaragi, 2020).

One of the ways to build and/or develop security is to obtain a resilient organization. Some organizational practices and routines involving the knowledge resource, such as the focus on values of cooperation, communication and learning, as well as knowledge sharing, can be strategies adopted and used in order to increase the level of security (Storseth, Tinmansvik). & Oien, 2010).

Intangible assets, such as knowledge, are valuable resources for creating value, and also act as a determining factor for organizational success and sustainability (Nonaka & Takeuchi, 1995; Sveiby, 2001; Arisha & Ragab, 2013). Therefore, it makes sense that they are applied and exploited to raise the level of organizational security.

In this way, the main objective of this work is to contribute to the scientific advance of knowledge loss, to the advancement of aspects of organizational resilience, as well as to Intellectual Capital. Also, it was proposed to advance in the understanding of knowledge gains, since regular aspects to organizations such as turnover, waste of knowledge, low volume of specialists and absences from work generate risks to critical knowledge. These, in turn, affect the resilience and structures of the IC. Presenting knowledge vulnerabilities makes it possible to identify possible positive impacts, in order to ensure proper knowledge management, in favor of organizational resilience and its sustainability.

It is important to highlight that the main assumption that permeates this article is that the loss and waste of knowledge impact organizational resilience, since knowledge is a resource for the system to respond to expected or unexpected threats. However, when analyzing the impacts of the loss, it is important to understand the negative effects - to mitigate them - but also the gains to the organizational system, in order to highlight them and also use them as mitigation resources.

2. Concepts

2.1 Resilience

The origin of the term resilience comes from the Latin, “resiliere”, and means “to recover.” This definition applies to several areas of knowledge, such as: materials science, psychology, ecology, among others (Hosseini, Barker & Ramirez-Marquez, 2016) The more technical areas of knowledge, such as engineering and safety management, work with the term resilience applied to systems.

With the introduction of digital technology, with the information revolution and the complications of society, systems have become increasingly complex (Hirose & Sawaragi, 2020). According to Folke (2006), the complexity of systems, characterized by the great diversity of interactions, is a determining factor for resilience due to its ability to absorb changes and reorganize itself.

Hollnagel (2014) uses the terms Safety I and Safety II to differentiate two views on safety in complex systems. The Safety I perspective is associated with a preoccupation with things that go wrong. Adverse events are analyzed retrospectively to understand what went wrong and to define measures to avoid similar outcomes in the future. As a complementary perspective, it is suggested to include knowledge about how and why things work out. This perspective has been labeled Safety II (Wahl, Kongsvik & Antonsen, 2020). Similarly, the term resilience engineering refers to this new Safety II paradigm.

Therefore, Hollnagel et al. (2006) define resilience as the intrinsic ability of a system to regulate its operation before, during and after disturbances, so that it can maintain the necessary operations, even after a serious accident or in the presence of a continuous voltage. More recently, Gao, Barzel and Barabási (2016) state that resilience provides organizations with an adaptive capacity, which enables their continuous development.

Hollnagel et al. (2006) defined four essential capabilities that characterize a resilient system: (1) knowing what to do, that is, how to respond to regular and irregular interruptions and disturbances, either through a set of prepared responses or by adjusting the normal functioning of the system. ; (2) know what to look for. That is, how to monitor what is or could become a threat in the short term; (3) knowing what to expect. Or rather, how to anticipate future events, threats and opportunities, such as possible changes, interruptions, pressures and latent threats; and finally (4) know what happened. Which is how to learn from experience, in particular, how to learn the right lessons from the right experience; learn from successes and failures.

2.2 Knowledge Waste, Loss and Gain

Since knowledge is a strategic resource for the organization (Grant, 1996), it is important to understand the risks associated with it. According to Sarkheyli, Alias and Ithni (2014), different sources can be used to identify knowledge risks and, when identifying threats, it is important to assess the probability of occurrence and its severity. Above all, the knowledge loss and waste are considered risks, as both can impact organizations.

According to Ferenhof (2011), it is considered waste of knowledge the non-use of the full capacity to use knowledge and when there are failures or negligence in the knowledge conversion processes. Knowledge waste affects organizational performance (Locher, 2008; Ferenhof, 2015). Still, Bauch (2004) states that there is a

waste of knowledge when organizations do not take advantage of the knowledge acquired or created through their experiences, projects and solutions.

Knowledge loss is "the diminished capacity for effective action or decision making in a specific organizational context" (p. 13), which occurs at the organizational or group level (Delong & Storey, 2004). It occurs when employees with important knowledge leave the organization, when codified knowledge (e.g. documents and databases) is lost or even when knowledge decays (Massingham, 2018). Also, it can occur through failures in the reorganization of the work environment and the difficulty in accessing knowledge files due to lack of maintenance, improper maintenance or obsolete database (Delong & Storey, 2004).

Although the knowledge loss and waste are referred to as risks to organizations, some studies point to some gains arising from these situations. Wensley and Navarro (2015) state that these risks are a source for the creation of new knowledge structures. However, this will only occur through the recognition of losses and the intentional knowledge management.

By identifying organizational knowledge losses, management can counteract the negative consequences of this risk, serving as a motivation for change processes and the incorporation of strategic knowledge (Wensley & Navarro, 2015). Still, from the departure of employees, there is the growth of the remaining employees and the arrival of new ones, causing knowledge gains to organizational structures (Massingham, 2018).

2.3 Capital intelectual

Capital Intelectual (CI) pode ser definido de diferentes formas, não possuindo uma conceitualização única. Entretanto, trata dos componentes intangíveis das organizações. Segundo Sveiby (2001), um dos principais autores da área, o CI é composto pela combinação de ativos intangíveis, nos quais geram crescimento, eficiência, renovação e estabilidade organizacional. Estes recursos crescem na medida em que os conhecimentos pertencentes a eles são compartilhados.

Alguns autores compreendem o CI como os recursos de conhecimento organizacional, que geram valor para as organizações (Edvinsson & Sullivan, 1996; Stewart & Ruckdeschel, 1998; Stewart, 2007; Urban & Joubert, 2017). Para Stewart (2007), este valor é criado a partir dos conhecimentos que transformam a matéria-prima - física ou intangível (como informação) - em algo mais valioso para as organizações. Por sua vez, Edvinsson e Sullivan (1996), afirmam que o valor é determinado a partir do conhecimento organizado, que é utilizado para algum propósito.

Além disso, o Capital Intelectual possibilita que as organizações mantenham-se atrativas e sustentáveis no mercado. Mas para isto é necessário identificar os fatores dinâmicos ocultos (Edvinsson & Malone, 1998). Para estes autores, o CI também se origina do conhecimento, no qual compõe os ativos imateriais, ocultos e invisíveis. Estes ativos de conhecimento pertencem, principalmente, a três dimensões específicas, com suas devidas características. Estas, compõem as principais estruturas do CI. São elas: Capital Humano, Capital Estrutural e Capital Relacional.

Capital Humano (CH), segundo Sveiby (2001), é o recurso intangível primário. Pois, segundo o autor, todas as relações intangíveis e todos os bens são resultados da ação das pessoas. Assim, o CH nada mais é que os recursos humanos da organização (Petty & Guthrie, 2000). Dos recursos humanos, estão os conhecimentos e experiências individuais, as habilidades, as capacidades humanas, as competências relacionadas ao trabalho e a qualificação vocacional (Sveiby, 2001; Edvinsson & Malone, 1998; Petty & Guthrie, 2000). Para Bontis (1998), o CH é difícil de ser codificado por se tratar, especialmente, pelo conhecimento tácito das pessoas.

O Capital Estrutural (CE) diz respeito à capacidade organizacional e sua infraestrutura, que apoia a produtividade dos funcionários. Trata-se de tudo aquilo que fica na organização quando os funcionários vão embora (Evinsson & Malone, 1998). Ou seja, diz respeito a marcas registradas, patentes, cultura, sistemas de informação e de rede, processos gerenciais, filosofia da gestão, processos direcionados à ampliação da eficiência, entre outros elementos (Edvinsson & Malone, 1998; Petty & Guthrie, 2000).

Por fim, o Capital Relacional (CR) refere-se às relações externas da organização. Ou seja, com os clientes, *stakeholders*, parceiros estratégicos. Nestas relações permeiam conhecimentos que geram valor para a

organização (Edvinsson & Malone, 1998). Para os autores, uma das medidas de medir o CR se dá através da longevidade das relações e das medidas de satisfação.

3. Method

3.1 Identifying the research question

The research question guiding this study was the following: What is the evidence between knowledge loss, waste and gain, and resilience, from the perspective of resilience engineering? These evidences were identified according to the perspective of Intellectual Capital and its main dimensions: Structural capital; Human capital; relational capital.

The central topics of each study were also the object of study of this article, but analyzed in a secondary way.

3.2 Selection of studies and exclusion criteria

In order to answer the main research question, a bibliographic search of articles was carried out using four electronic databases: IEEE Xplore, Scopus, Web of Science and Scielo. The choice of search terms are shown in Table 1. The search took place in the titles, abstracts and keywords of the articles. This search was carried out between April and May 2021 and had the following exclusion and eligibility criteria established: (i) studies from any segment or sector; (ii) publications in any language, in any location and also in any publication period; and (iii) the studies should contain evidence relating knowledge loss, gain and waste with resilience.

Table 1: Selection of studies.

String de busca	Data base			
	Scopus	*Web of Science*	*IEEE Xplore*	*Scielo*
("knowledge loss" OR "loss of knowledge") AND "organi*ational resilience"	1	1	0	0
("knowledge loss" OR "loss of knowledge") AND ("resilience engineering" OR "Safety II")	0	0	0	0
"knowledge waste" AND ("resilience engineering" OR "Safety II")	0	0	0	0
"knowledge waste" AND "organi*ational resilience"	0	0	0	0
("knowledge loss" OR "loss of knowledge" OR "knowledge waste") AND resilience	8	8	0	1

Source: authors (2022).

EndNote and Rayyan tools were used to manage publications. Thus, of the 19 selected studies, repeated articles were excluded, as well as studies that were not part of the eligibility criteria. Thus, the final bibliographic portfolio of this research had only 3 articles. Table 2 presents the studies.

Table 2: Portfolio.

Year of publication	Title	Authors
2018	Resilience beyond formal structures: A network perspective towards the challenges of an aging workforce in the oil and gas industry	Bento & Garotti.
2010	Strategic intent: Guiding port authorities to their new world?	Haugstetter & Cahoon.
2006	Leveraging Information Technology for Organizational Resilience in Design of Complex Products: A Case Study	Lal & Samrit.

Source: authors (2022).

4. Findings and Discussion

In order to answer the research question, we sought to identify the common elements of the articles, which touch the objective of this study. It was verified the reasons for the knowledge loss or waste, if these, in turn, directly impact resilience, and, finally, what are the possible gains from loss/waste, for the resilience of organizations. With this, we tried to classify the knowledge loss and/or waste and the gains, according to the IC

structures. It is important to note that only one study was practical, the others are theoretical and conceptual research.

The article by Lal and Samrit (2006) is a case study, which presents the development and application of a tool created for knowledge retention. The authors suggest that the departure of employees who have specialized knowledge generates a significant impact on the organization. In this study, resilience is not a central topic of analysis, but it considers the departure of employees a great risk, for which organizations must be prepared and be resilient. To this end, the study recognizes that organizational structure is critical to resilience. This structure should enable new employees to acquire the necessary knowledge quickly and effectively. That is, the resilience of the organization will be given from the creation of an organizational structure that recovers the skills and knowledge, in a short term.

Sudden departures and retirements generate adverse conditions and important changes, as there is a knowledge loss on the part of specialists about the development of the product. In order to mitigate the impact and to leverage the experiences and lessons learned, the company sought to develop a system that identifies and converts employee knowledge, skills and experience into organizational resources. This system integrated and formalized the knowledge involved, and was used as a technological tool for capturing, organizing and sharing organizational knowledge (Lal & Samrit, 2006). To this end, the tool's functionality consisted of a knowledge repository; a design process that specifies and designs the work process; a visual representation, through diagrams and flowchart, to better communicate the process and its components; standardization of process representation, documents and project rules; and a simple, accessible workflow.

To make this possible, a specialized information technology team was created, adept at new technologies. This resource was developed from an easy-to-learn and globally deployable framework. The implementation of this feature allowed a significant increase in productivity as it facilitated access to information for workers and managers, reduced rework, as the instructions were previously accessible and it facilitated the storage of results of previous works for verification and validation. It also had a positive impact on organizational resilience as this tool facilitated and made available individual knowledge to circulate in the organization. Thus, knowledge was retained in the organization even if the holders of it left (Lal & Samrit, 2006).

Likewise, the study by Bento and Garotti (2018) states that the oil and gas industry has been impacted by the knowledge loss due to retirements. Through theoretical analysis, it presents loss mitigation strategies. According to the authors, as presented by the literature, mapping knowledge across the organization, codifying knowledge in databases, properly orienting new employees, replacing departing employees with other professionals with similar knowledge/experiences, creating people retention strategies reduces the risk of loss. However, these may be limited means as they may not include the tacit knowledge of professionals and knowledge networks. Therefore, there is a need for innovative knowledge management practices (Bento & Garotti, 2018).

As an alternative, the authors suggest that social network analysis is a strategy to contribute, as network analysis helps to map knowledge in the organization, engages professionals in transdisciplinary cooperation, preserves communication flows, increases connectivity between individuals. , reallocates access to information and increases network redundancy. Thus, network analysis is a way of anticipating the risks of knowledge loss by identifying knowledge, and facilitates the sharing of complex information, thus contributing to the adaptation of the system.

For the authors, employee knowledge is highly tacit and experiential, which makes it impossible to store and code it. However, the knowledge loss is inevitable. Therefore, for resilience in the oil and gas industry, the organization cannot depend on individual knowledge, but rather develop network structures that create, share and disseminate new knowledge. For this reason, there is an organizational change in this sector, which consolidates new forms of collaborative work in integrated production processes, creating clusters of knowledge.

From another perspective, the study by Haugstetter and Cahoon (2010) analyze aspects that exist between commercial networks, and claim that seaports are key elements for these networks, as they act as a link between the various supply and logistics chains. According to the authors, the impact of the “financial tsunami” on these organizations required them to develop their resilient capabilities, needing to develop strategies to reduce organizational risks.

In this scenario, port authorities are key actors as they enable integration between organizations, and contribute to resilience through innovation, which is developed by learning in the network. In addition, they must play a central role in integrating the network's knowledge, managing learning opportunities. For this integration of knowledge to occur, it is necessary to identify the levels of common knowledge, which enable effective communication. It is also necessary for organizations to promote knowledge sharing based on structured organizational routines. And finally, efficient structures of the port authority maintain assertive communication in order to minimize the knowledge loss in the integration (Haugstetter & Cahoon, 2010).

Strategic collaborations in these organizational networks offer lessons that can be used strategically for growth, innovation and risk reduction from the financial tsunami, impacting organizational resilience. To successfully integrate knowledge, it is necessary to develop social networks with other organizations, reducing the risk of knowledge loss as communication increases. Also, establishing routines that promote knowledge sharing can help in the integration of knowledge (Haugstetter & Cahoon, 2010).

The analysis of the three articles shows that the knowledge loss is a factor that impacts organizational resilience, the main reason for the loss being the departure of employees. This is in agreement with other authors who, when analyzing organizational loss, identified that retirement and turnover generate organizational loss knowledge (Delong & Storey, 2004; Sulaiman, Nordin & Noor, 2016; Rashid, Clarke & O'Connor, 2017; Su, Yang & Li, 2017; Sumbal et al., 2018, Geeraerts, Tynjälä & Heikkinen, 2018). Thus, considering the structures of Intellectual Capital, Human Capital has a greater implication in terms of knowledge loss and resilience. However, although the waste of knowledge is also a risk that impacts resilience, none of the articles brought elements that referred to waste.

In order to mitigate this risk and strengthen resilience, organizations develop strategies that directly impact the organization's structure, such as creating knowledge repositories and establishing internal social networks, for sharing and creating knowledge. They also strengthen inter-organizational relationships for the same purpose. That is, although human capital is negatively impacted by the knowledge loss in the face of resilience, structural and relational capital are strengthened and improved. In terms of resilience, they provide the resources for the organization to respond to the unexpected. This happens because by strengthening relationships and creating internal structures that aim to mitigate loss or even deal with it, knowledge is retained. Thus, the results indicate that loss mitigation actions generate gains for structures, as these actions reinforce relationships, sharing, interpersonal contact and the reinforcement of internal structures.

Although not cited by the articles in this sample, organizational learning processes are also effective strategies in mitigating loss. These, in turn, generate gains for the organization because from organizational learning, they create new knowledge for the institution and retention of the same because, according to Crossan, Lane and White (1999), organizational learning is the institutionalization of knowledge from routine actions and incorporation of the learning that occurred in individuals and groups. There are changes in systems, structures, procedures and even strategy.

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Also, organizational unlearning can be a strategy in the face of knowledge loss and its impact on resilience. Organizational unlearning, according to Tsang and Zhara (2008), is the discarding of old routines so that new routines are incorporated, if necessary. These new routines, if they allow for more action to respond to controversial events, will generate gains for the organization considering resilience.

In this sense, Wensley and Navarro (2015) already proposed that organizational unlearning is a way of dealing with knowledge loss, as this will lead to the development of new adaptive capabilities of the organization (Nystrom & Starbuck, 1984) in the face of its risks. Knowledge loss is a risk, and therefore Wensley and Navarro (2015) suggest that it is necessary to create an unlearning context for the corporation to recover from the loss,

identifying learning opportunities (which in turn will incorporate new knowledges). Unlearning, according to the authors, makes it possible to create and review their knowledges.

To summarize the research findings by samples, Table 3 provides an overview of the results.

Table 3: Presentation of findings

Article	Topic central	Loss and/or Gain	IC dimension
Lal & Samrit (2006)	Development of a technological tool for knowledge retention	**(LOSS)** Sudden departures of employees and retirement	Human capital
		(GAIN) Development of a technological tool for capturing, organizing and sharing knowledge	Structural Capital
Haugstetter & Cahoon (2010)	Inter-organizational strategic networks in the logistics sector	**(GAIN)** Development of social networks with other organizations; development of structured organizational routines that promote knowledge sharing and creation	Structural Capital e Relational Capital
Bento & Garotti (2018)	Resilience in the oil and gas industry	**(LOSS)** Retirement	Human capital
		(GAIN) Analysis of social networks and creation of knowledge clusters	Structural Capital e Relational Capital

Source: authors (2022).

5. Conclusion

This literature review provided an overview of the relationship between knowledge loss and resilience (from the perspective of resilience engineering), basically focusing on advancing the understanding of knowledge gains, since regular aspects to organizations such as turnover, waste of knowledge, low volume of specialists and absences from work generate risks to critical knowledge. These, in turn, affect the resilience and structures of the IC. The analysis of the articles selected for the portfolio share a perspective on the relationship between the knowledge loss and resilience engineering constructs.

The objective was achieved, as it was possible to identify and extract knowledge losses and gains and associate the classifications of intellectual capital. The study showed that, given the perspective of gaining knowledge, there is a direct impact on the structural and relational capital of the organization. This means that, even in the face of an imminent knowledge loss, gains in knowledge also occur.

Therefore, it is reinforced that the investment in interpersonal relationships and the creation of internal structures are fundamental for retention, recovery and loss mitigation. Thus, knowledge can be stored in organizational processes, databases, workgroups and even customers. To recover them, you can review the processes, search the bases and approach the people who have such knowledge. In addition, reviewing the processes and seeking to understand the weaknesses of the system, there are the needs for unlearning and organizational learning, in order to create specific conditions for the organization to respond quickly and effectively to unexpected and expected situations. In other words, managers are recommended to create environments and spaces for new knowledge to be incorporated, based on organizational learning and unlearning.

Although the literature already recognizes that knowledge is a key factor for resilient responses (Apgar, 2013; Salgado, 2013; Umoh, Amah & Mnim, 2014, Lundberg & Johansson, 2015), it is noted that few studies delve into the aspects of knowledge loss (nor waste) in the context of resilience, identifying the risks and impacts for this. In addition, only one article in the portfolio is the result of a practical study.

Therefore, this article recognizes its limitation and suggests that future studies analyze more deeply the relationship between risks associated with knowledge, such as loss and waste, in the context of organizational resilience. This is because, when there is a knowledge loss, it is important to identify whether there will be impacts on the structure (CR), on people (CH) or on external relations (CR), so that organizations can create preventive actions to knowledge, considering their need to monitor, respond, adapt and learn from imminent risks.

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