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Knowledge Retention and Loss in Brazilian Public Administration

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Abstract:

Purpose: *The loss of knowledge poses a significant threat to organizational performance. Thus, this study examines the intricate dynamics of knowledge retention and the mitigation of knowledge loss within the context of a Brazilian national public organization operating in multimodal transportation infrastructure.*
Design/Methodology/Approach: *Using a qualitative approach, we reviewed documents, conducted interviews with managers, and employed observational techniques, subsequently subjecting the gathered data to content analysis and triangulation.*
Findings: *Our investigation unveiled that critical knowledge is lost primarily due to the departure of individuals from the organization or its respective units, coupled with deficiencies in the various stages of the knowledge retention process. Furthermore, we*

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identified environmental, organizational, individual, and technological aspects as notable impediments to the effective execution of knowledge retention initiatives.
Practical Implications: *Our findings underscore the critical importance of managers understand and address this multifaceted set of aspects surrounding knowledge retention in the realm of public administration.*
Originality/Value: *The value of the research lies in its exploration of how the knowledge retention process can either generate or mitigate knowledge loss within Brazilian public administration.*

Keywords: *Knowledge retention, knowledge loss, knowledge management, public administration, organizational performance, transportation.*

JEL codes: *H83.*

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1. Introduction

Knowledge management is a strategic process with the potential to influence organizational performance (Cardoni, Zanin, Corazza, and Paradisi, 2020; Daghfous, Belkhodja, and Linda, 2013; Levallet and Chan, 2019). The view of knowledge as a strategic resource that needs to be managed is advocated by the knowledge-based view theory (Grant, 1996).

Researchers recognize public organizations as knowledge-based and advance their studies through various processes or approaches related to knowledge management (Adobor, Kudonoo, and Daneshfar, 2019; Balasubramanian, Al-Ahbabi, and Sreejith, 2019; Harvey, 2012; Henttonen, Kianto, and Ritala, 2016; Levallet and Chan, 2019; Massingham, 2018; Razzaq *et al.*, 2019; Tseole and Marutha, 2022).

Knowledge loss is one of the concerns of knowledge management and can occur due to various causes such as retirement, departures, turnover, disruptions in information technology systems, and health issues of individuals (Daghfous *et al.*, 2013; Durst and Zieba, 2019; Levy, 2011; Galan, 2023; Daghfous *et al.*, 2023). Knowledge can also be lost due to reasons involving the failure to capture critical knowledge, problems with its transfer at the individual and organizational levels, difficulties with its storage, and barriers to the reuse of retained critical knowledge (Levallet and Chan, 2019).

However, researchers point out that it is possible to mitigate knowledge loss through the knowledge retention process (Daghfous *et al.*, 2013; Levy, 2011; Razzaq *et al.*, 2019; Muhammad *et al.*, 2020). This process aims to avoid losing strategic organizational knowledge by making it available to people within the organization (Levallet and Chan, 2019; Levy, 2011; Martins and Meyer, 2012; Tseole and

Marutha, 2022).

However, not all knowledge can be retained (Levallet and Chan, 2019; Levy, 2011). This aspect highlights the need to prioritize the knowledge to be retained (Daghfous *et al.,* 2013; Wikström, Eriksson, Karamehmedovic, and Liff, 2018) and identify critical areas for knowledge loss in organizations (Jennex, 2014; Massingham, 2018).

By mitigating loss, the retention of organizational knowledge provides the potential for improved institutional performance (Levallet and Chan, 2019). In public organizations, this improved performance contributes to achieving public interest objectives (Tseole and Marutha, 2022).

Although previous studies have contributed to advancing knowledge on the topic in organizations in general, researchers emphasize the scarcity of research on knowledge retention in public organizations, highlighting the need for further research in this area of government management (Adobor *et al.,* 2019; Al Yami and Ajmal, 2019; Balasubramanian *et al.,* 2019; Durst, Bruns, and Edvardsson, 2017; Levallet and Chan, 2019).

Additionally, most of the studies identified in these organizations do not delve into understanding how the retention process can generate or mitigate knowledge loss, with few exceptions such as Daghfous *et al.* (2013) and Levallet and Chan (2019). This gap is even greater when considering the process of retaining organizational knowledge as a mitigator of knowledge loss in emerging countries (Arruda, Casagrande, Dutra, Ensslin, and Mussi, 2023; Arruda, Dutra, and Mussi, 2022; Souto and Bruno-Faria, 2022).

Therefore, this study aims to analyze the retention of organizational knowledge as a possibility to mitigate knowledge loss in a Brazilian public institution in the transportation infrastructure sector. In addition to addressing the identified gap, the findings of this study have the potential to yield significant practical impacts within the public organization and positively influence the society of a emerging country.

2. Literature Review

Knowledge is understood as a combination of experiences, values, information, and ideas that originate and are applied in people's minds, and can be found in documents, repositories, routines, processes, practices, and norms (Davenport and Prusak, 1998).

Tacit knowledge, which exists at an individual's internal consciousness level, is characterized by complex communication and externalization (Polanyi, 1966). This type of knowledge holds greater value for the organization but poses a greater organizational challenge in terms of its identification, retention, and reuse by others

(Grant, 1996; Nonaka and Takeuchi, 1995).

Explicit knowledge can be codified and made available to people through documents, reports, policies, systems, and information technologies, making it easier to manage and retain (Massingham, 2010; Nonaka and Takeuchi, 1995). Knowledge loss occurs when an organization loses access, either partially or completely, to the knowledge it previously utilized (Durst and Zieba, 2019; Massingham, 2018).

Although some degree of knowledge loss is inevitable, awareness of this fact should drive efforts to mitigate such loss, ensuring that the organization's future is not impacted (Abdillah, Lin, Anita, Suroto, and Hadiyati, 2018; Levy, 2011; Martins and Meyer, 2012). However, there are organizations that do not respond with effective actions to reduce the impact of these losses (Levy, 2011; Martins and Meyer, 2012).

The loss of specialized knowledge in critical areas for the organization has the potential to decrease organizational performance and results (Levy, 2011; Muhammad *et al.*, 2020; Daghfous *et. al.*, 2023). The critical areas of knowledge, relevant to the business focus, may include specialized technical knowledge, management knowledge, organizational process knowledge, among others (Muhammad *et al.*, 2020).

Knowledge retention, as a process, aims to transform valuable knowledge held by an expert into an organizational resource that is available to others for future reuse in organizational processes and decisions (Levallet and Chan, 2019; Levy, 2011; Martins and Meyer, 2012). Thus, the knowledge retention process focuses on capturing critical knowledge, internalizing, and making it available within the organization (Levy, 2011; Wikström *et al.*, 2018).

The process of organizational knowledge retention (Figure 1) is represented by the capture, storage, and retrieval of knowledge for its reuse (De Long, 2004; Levallet and Chan, 2016, 2019).

Figure 1. *Knowledge Retention Process*

Source: *Adapted from De Long (2004) and Levallet and Chan (2019).*

The relationship between these stages indicates that retention is effective when critical or strategic knowledge is captured and stored within the organization,

enabling its retrieval and subsequent reuse. From this retention process, it can be understood that an expert individual who originally possessed the knowledge targeted by the retention stages, subsequently, he will still retains this knowledge. Simultaneously, the organization also gains others individuals who can access and reuse this resource (Levallet and Chan, 2019).

The knowledge capture stage involves the initial acquisition of tacit or explicit knowledge so that it can be incorporated into the organization, its processes, documents, information systems, and other professionals, leading to the next stage of the process (Levallet and Chan, 2019).

To achieve this, knowledge capture involves practices and routines that allow knowledge to be kept available for retrieval (De Long, 2004). In this perspective, capture occurs through mechanisms of knowledge transfer, making this knowledge socially available (Levallet and Chan, 2019).

The storage stage refers to the maintenance of the captured critical knowledge within the organization, utilizing information technology-based tools or otherwise. Knowledge can be stored in individuals, groups, culture, processes, documents, information systems, and databases (De Long, 2004; Levallet and Chan, 2016; 2019).

The knowledge retrieval stage, on the other hand, is linked to practices and processes that enable people within the organization to access the knowledge to be reused in a new context. In this sense, knowledge retrieval is facilitated by people's awareness of the existence of stored knowledge and their search for that knowledge, which can be supported by information technology mechanisms or other tools (De Long, 2004; Levallet and Chan, 2016; 2019).

The reuse of knowledge adheres to the perspective that the knowledge retention process aims to make knowledge available for subsequent application (Alavi and Leidner, 2001; Levy, 2011).

Failures in the stages of the retention process can lead to knowledge loss (Levallet and Chan, 2019). This reinforces the understanding that it is important for organizations to plan and take proactive steps in developing knowledge retention to prevent and mitigate the loss of this critical specialized resource (Levy, 2011; Martins and Meyer, 2012).

Therefore, organizations need to provide the means and structures for the continuous development of the retention process, considering the types of knowledge and their relationship with information technology (Levallet and Chan, 2019).

Thus, the efforts for the effectiveness of the organizational knowledge retention process involve a holistic view of the organization. This view relates to the

integration of different elements or factors (e.g., structure, infrastructure, culture, people management policies, managerial commitment, knowledge transfer mechanisms, and information technologies) (Al-Dmour, Al-Dmour, and Rababeh, 2020; De Long, 2004; Levallet and Chan, 2019; Martins and Meyer, 2012; Wikström *et al.,* 2018) in order to support the knowledge retention process.

Thus, this research is based on the assumption that the knowledge retention process has the potential to mitigate knowledge loss and that this process is influenced by a set of aspects of different nature. From this perspective, the aim is to investigate the relationship between the retention process and knowledge loss by understanding the causes of knowledge loss and the aspects that can affect knowledge retention in a Brazilian federal public administration agency, adopting an inductive logic.

3. Research Methodology

This research is grounded in a qualitative approach and employs an exploratory and descriptive case study strategy (Creswell, 2014; Yin, 2016). The case studied is a national public organization operating in the transportation infrastructure sector in Brazil, referred in this manuscript as "National Transportation Infrastructure Organization" (NTIO) for confidentiality reasons. The unit of analysis under investigation is responsible for project execution, maintenance, operation, construction, and expansion of transportation infrastructure in the Brazilian state where it operates.

The specific and critical knowledge for organization NTIO is related to the field of multimodal transportation infrastructure engineering (land and water), which is responsible for organizational processes directly linked to the strategic objectives of NTIO and its raison d'être.

In order to understand the loss and retention of this critical knowledge, the area of infrastructure engineering was the focus of this research. Suggestions have been made for future research to delve further into managers' perceptions with the aim of comprehending knowledge loss resulting from turnover (Galan, 2023).

All managers working in the infrastructure engineering area of the researched unit participated in the study, totaling 10 managers, referenced in this manuscript as M1 to M10. All participating managers hold a degree in civil engineering, with 3 of them having a postgraduate specialization and 4 holding a master's degree. These managers have been working in NTIO for a period ranging from 9 to 20 years.

Data collection was conducted using multiple sources of evidence: a) documentation, b) semi-structured interviews with the participating managers, and c) direct and participant observation. The following documents were analyzed: official letters, emails, memoranda, announcements, reports, news articles, regulations, normative instructions, technical studies, strategic plans, internal regulations,

organizational charts, and technical yearbooks.

This approach allowed for the use of one type of document to corroborate evidence found in another type of document or another source of evidence, complementing, corroborating, or contradicting the initial evidence (Yin, 2015).

Semi-structured interviews (Creswell, 2014) were conducted using an interview guide that included four main sections (Table 1).

Table 1. *Structure of the interview guide*

Section	**Content**
Preliminary	**Identification of the interview, date, location, time, duration, recording system.**
1	Presentation of the informed consent form. Explanation of terms/expressions used, such as: knowledge, knowledge loss, knowledge retention.
2	Participant characterization: academic and professional background, position held in the organization, role in the organization, years of service in the organization, years in managerial position.
3	Topics and guiding questions on the research theme related to: knowledge sources, updating, transfer mechanisms and ease of access, reuse, occurrences of knowledge loss, moments and reasons for loss, influence of loss on organizational outcomes, actions to minimize loss, facilitators/barriers to retention.
4	Suggestions and additional information. Opportunity for interviewees to propose suggestions to the organization regarding the research theme, if desired.

Source: *Own study.*

For all interviews, the Informed Consent Form (ICF) was provided, incorporating the ethical principles governing the research. The interviews had an average duration of 90 minutes, resulting in a total 15 hours of recording and 395 transcribed pages. Direct and participant observation (Cooper and Schindler, 2016) took place in the research unit's environment over a period of three months.

Field notes were recorded for subsequent analysis. Each note included information such as date, location or situation, people involved, and the researcher's perception to the observed context. The data were analyzed through content analysis, involving pre-analysis, material exploration, and treatment of results, inference, and interpretation (Bardin, 2016).

The pre-analysis involved organizing the collected data (transcribed interviews, documents, and observation notes) in the NVivo software. Material exploration (the core of content analysis) included data coding and categorization, considering three main dimensions of analysis: causes of knowledge loss, knowledge retention process (capture, storage, and retrieval), and aspects affecting knowledge retention. An

inductive analysis logic (Eisenhardt, 1989) was adopted to identify categories/subcategories linked to each of these dimensions.

The analyzed data were treated and interpreted to address the research question. Additionally, the methodological triangulation procedure (Yin, 2015) was adopted, integrating information collected from interviews, documentary research, and observation.

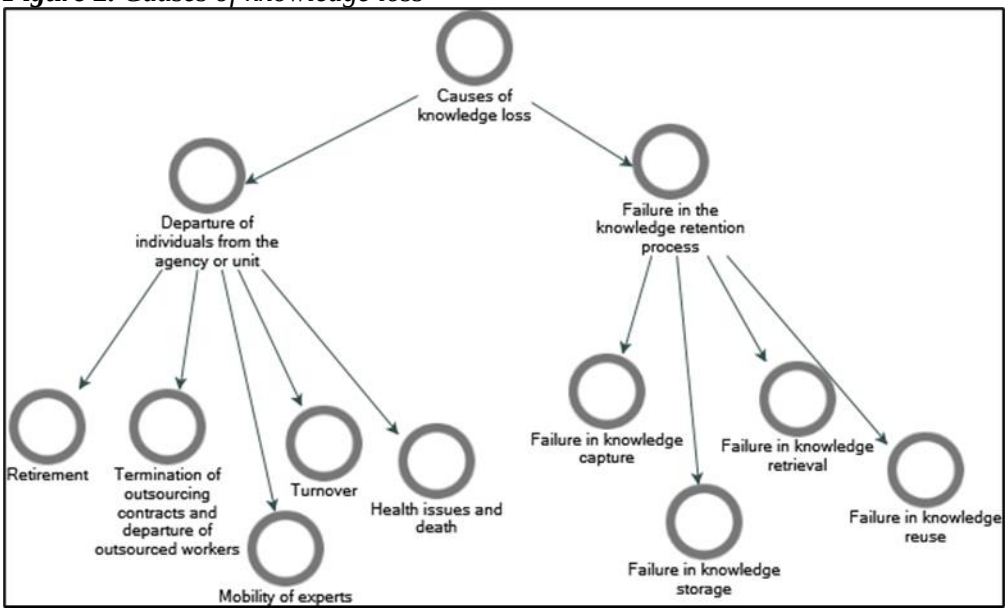
4. Research Results and Discussion

4.1 Causes of Knowledge Loss

The occurrence of knowledge loss in NTIO is perceived by all participants in this research. This knowledge loss encompasses both explicit and predominantly tacit knowledge: "Certainly, this [knowledge loss] happens, we see it with the staff, especially with the older ones who retired, and a lot has been lost." (M3), and "It happens, and it happens quite a lot, both partially and completely. [...] indeed, personal knowledge is lost." (M5).

The analysis of the data allowed the identification of causes of knowledge loss, which are linked to the departure of individuals from NTIO or their respective departments, as well as failures in the knowledge retention process. The departure of individuals refers to definitive or temporary situations, such as resignations, transfers to other areas, or absences due to health reasons (Figure 2).

Figure 2. *Causes of knowledge loss*



Source: *Own study.*

Retirement is identified as a predominant form of knowledge loss in NTIO. The perception is that professionals who are about to retire possess a significant amount of tacit knowledge that they take with them when they leave: "When someone leaves, most of the time, the knowledge goes along with them, goes with them, and I think that the experience of years was that a lot of knowledge went with the majority who retired, who left the organization..." (M2).

The termination of outsourcing contracts and the departure of outsourced workers also emerge as a cause of knowledge loss in NTIO: "You have many employees who come and go. It's very rotating. Being rotating, that tacit knowledge goes away... I think one of the main reasons for losing this knowledge is the issue of outsourced workers... they usually don't stay for long, the contract is short-term" (M8).

The mobility of specialized individuals is evidenced by the relocation of professionals with strategic knowledge among the units of NTIO. These changes result in knowledge loss, even though the professionals are still within the company: "When there is an internal change or people move to different areas, there is also this loss of knowledge. We have many examples..." (M3).

Health issues and the death of individuals holding strategic knowledge for NTIO are mentioned by the interviewees as factors associated with knowledge loss due to the unpredictability of these events.

Turnover is emphasized by the interviewees as a magnifying factor of knowledge loss: "We have seen it, professionals come and professionals go, so I believe there is a difficulty in retaining knowledge." (M10). Additionally, the lack of attractiveness of the career leads to the departure of individuals from the company: "Some absences occur due to the little attractiveness, sometimes, of the organization - little attractiveness in the market. If you have a highly qualified professional, the tendency is for them not to stay for long: either they will pass another public exam, or even go to the private sector. This also happens frequently..." (M4)

Additionally, the occurrence of knowledge loss is also associated with failures in the knowledge retention process (Figure 2). The failure to capture knowledge occurs when tacit knowledge is not shared, resulting in the concentration of knowledge and activities in a few individuals or departments within the company, further exposing it to knowledge loss: "I believe that, currently, we still struggle with leaving certain knowledge concentrated in specific individuals or departments" (M9).

The failure to capture knowledge is also evident in limited documentation, inappropriate or incomplete records of situations and decisions within the company, which hinders the retrieval and reuse of previously documented knowledge: "There is truly a lack of documentation, a lack of scripts, processes, and procedures.

So, in each case, we have to sit down, analyze, and discuss with the group...

precisely because of the lack of cataloging or consolidation of this material, these procedures" (M7).

The failure to capture knowledge, due to its various aspects, leads to a failure in storage, as if knowledge is not captured, it cannot be stored, whether in other individuals, technologies, processes, etc. Thus, in NTIO, there are instances of loss of administrative, physical, and digital documents, resulting from failures in continuity and communication between information systems and the dispersion of communicated and uncataloged knowledge in repositories: "Even in the digital aspect, we have gone through various programs over time.

However, what was in one program did not migrate to another, so we have been losing that knowledge" (M5). Additionally, there is the obsolescence of stored knowledge, especially in the form of standards, which, in some cases, need to be verified for their validity: "Every norm must always go through a scrutiny. On NTIO website, there is standardization, there are revoked norms. If it is still in effect, then it undergoes a critical analysis, and we also need to search and conduct research" (M4).

The failure to retrieve knowledge indicates difficulty in retrieving knowledge for reuse, particularly in conducting research and accessing physical and digital documents: “Indeed, there is no internal structure or organization that facilitates access to systematized, organized information" (M3).

The aspect of failure in understanding the stored knowledge and its storage location is revealed in situations where, when the need arises to consult previous decisions and procedures, it is unknown whether these critical knowledge exist or where they are stored: "So, this lack of document organization, I believe it is a limiting factor today. We waste a lot of time searching for a document, and sometimes we don't even know if it still exists or not. There is a lack of document organization" (M7).

The causes of knowledge loss in NTIO resulting from different situations of people leaving the organization and/or failures in the retention process indicate a relationship between knowledge loss and the retention process. Thus, possible aspects influencing the effectiveness of this process in NTIO were analyzed.

4.2 Aspects Influencing Knowledge Retention

The data analysis allowed for the identification of a set of aspects that influence the knowledge retention process in NTIO. These aspects were found to either enhance or limit the development of the organizational knowledge retention process and are related to four main emerging categories: environmental, organizational, individual, and technological (Table 2). Despite the categorized analysis, these aspects are not mutually exclusive and may be interconnected in their meanings.

The identified environmental aspects (Table 2) have a limiting influence on the knowledge retention process. The constant changes in government affect the organizational objectives and the way processes and priorities are managed in the studied company, revealing conflicting strategic decisions.

Table 2. *Aspects influencing knowledge retention: enhancers (+) and/or inhibitors (-)*

Categories (Dimensions)	**Subcategories (Aspects)**
Environmental (-)	Government changes (-)
	Legislation, norms, and guidelines changes (-)
	Pandemic (-)
Organizational (+, -)	Strategic alignment (-)
	Management commitment (+, -)
	Organizational communication (-)
	Organizational culture (-)
	Organizational structure (+, -)
	People management (+, -)
	Process mapping (-)
	Institutional knowledge management program (-)
	Outsourcing (+, -)
Individual (-)	Professional identification and commitment to the organization (-)
	Insecurity about personal knowledge (-)
	Personal interests (-)
	Apprehension about taking on new responsibilities (-)
	Interpersonal relationships (-)
	Individual feelings of vulnerability and loss of power (-)
Technological (+, -)	Access to software (-)
	System customization (-)
	Hardware infrastructure (+, -)

Source: *Own study.*

Despite the need for updates, excessive changes in legislation, norms, and guidelines also hinder the stages of the knowledge retention process, limiting recovery and reuse: “I'm not saying we shouldn't create, we should, but it's no use having a rule and then changing it every now and then …you have a handbook that you can't rely on this week because it will change in 30 days, in 90 days [...] " (M2).

The global Covid-19 pandemic has also been a limiting aspect, influencing the functioning of organizational units and their processes. Unplanned remote routines and the interruption of certain processes have affected knowledge sharing and the development of favourable processes for knowledge retention: "It was something that was progressing before the pandemic in NTIO…Unfortunately, this [process mapping] was lost during the pandemic" (E3).

The revealed organizational aspects (Table 2) influence the knowledge retention

process in NTIO as both enhancers and inhibitors. Deficient strategic alignment, disrupting organizational strategies, processes, and objectives, compromises the very existence of the organization and limits the knowledge retention process: "[...] I see NTIO dismantling itself more and more every day, in terms of fulfilling its institutional objective.

So, today, I don't see any initiatives in terms of organizational aspects of NTIO knowledge retention, for example. [...] So, I see a certain mismatch between the core activity of NTIO, why it exists, and what it is currently performing." (M7). Managerial commitment acts as both an enhancer and a limiter of the critical knowledge retention process since some managers are more committed to it than others: "There is not yet a culture, but I believe there is a... willingness [from management] to share and retain knowledge..." (M10).

Fragmented, inconsistent, and inadequate organizational communication acts as a limiter of the organizational knowledge retention process in NTIO: "Very few people know what is being done internally, what projects, what works, what services are being carried out, and that demotivates, of course, because people don't feel like they're participating..." (M3).

Remote work, driven by the pandemic, revealed that physical distancing and deficiencies in the use of internal communication tools limited the capture and sharing of knowledge. The dispersion of information and knowledge within NTIO and the use of various means of disseminating internal information make it difficult to search for recovery and reuse: "There is a lot of dispersion, actually, a lot of isolated effort without integration between departments and without systems that communicate with each other. There is a lot of dispersed information..." (M3).

A lack of organizational culture promoting knowledge sharing, interaction, and integration, as well as the absence of incentives and rewards for knowledge retention, proved to be a limiting aspect, creating challenges for the maintenance, creation of opportunities, and the very sharing of knowledge: "… knowledge sharing, but I believe this is still not a strong culture within NTIO, so I think it is not a strong culture on the part of the companies that provide services to NTIO and NTIO does not have this culture deeply rooted..." (M10).

The organizational culture of NTIO is not capable of mitigating the loss of this strategic resource because: "…this sharing of know-how within NTIO, it does not exist." (M2).

The research and development-focused organizational structure has been diminishing in importance due to decisions made by the company itself: "It was a very productive seminar, very good, but it happened one year, two years, and then it didn't happen anymore"(M2). This situation hinders the creation, sharing, and retention of critical knowledge. Additionally, the large number of hierarchical levels

limits knowledge sharing and retention within the company: "person from another department, and to talk to her, you have to go through her superior..." (M10).

Furthermore, organizational restructuring within NTIO, by relocating professionals from existing areas to new areas, creates a situation where knowledge is lost for the departments that provided the experts, limiting knowledge retention: "… there is already a small team that was moved from places where it was already lacking, to fill this new area. So, for sure, knowledge will always be lost in this process..." (M5).

Employee training acts as an enhancer of knowledge retention by facilitating the sharing of strategic knowledge within the organization: "[...] this knowledge ends up being shared through these courses." (M9). However, the scarcity of technical and strategic training opportunities, coupled with the lack of training for new employees, limits knowledge retention: "[...] there is limited training. [...] the fact that there is little, that this type of training is not abundant, I think it can contribute to the loss of knowledge." (M4).

The stability of employees enhances the knowledge retention process by maintaining and continuing the expertise and critical knowledge of experienced individuals: "What is important is to keep people for a longer time. The importance of civil servants with stability during the years they remain in the organization ends up retaining this history…The issue of knowledge continuity of these civil servants, the stability" (M5).

However, due to workload overload and concentration of activities on a few individuals, task management limits the knowledge retention process: "Due to the excessive demand we have in NTIO there is no time for information sharing between these individuals responsible for specific matters…due to this rush,… you end up not having time." (M9).

The number of professionals in NTIO is insufficient compared to the assignments and demands, thus limiting the knowledge retention process: "In reality, there is more work than there are really thinking minds." (M5). Additionally, the unplanned replacement of individuals indicates a failure in succession planning, limiting the capture, storage, and retrieval of critical organizational knowledge: "In NTIO, everything is very immediate, they only think about replacing someone who is leaving or retiring when the person has already left the organization." (M7).

The organizational aspect of process mapping has been identified as a limiting factor in the retention of critical organizational knowledge. Its absence or presence solely for the purpose of justifying other organizational actions, rather than knowledge retention, hinders the process: "There are sporadic initiatives to create routines, mapping the processes of NTIO…activities mapping, but it is not for the purpose of retention; it is to justify remote work" (M10).

Furthermore, the absence of an institutional knowledge management program manifested in the lack of policies, guidelines, planning, and procedures for the sharing and retention of critical knowledge within NTIO: "Knowledge retention is currently relegated to a secondary role in NTIO…I really don't see it in the structure of NTIO today" (E7).

The organizational aspect of outsourcing is perceived from an enhancing perspective, where the knowledge sharing from outsourced companies with NTIO can occur, and NTIO may also come to possess this critical resource. However, the majority of the interviewees indicated that the outsourced companies possess critical knowledge for NTIO but they do not transfer it effectively as a means to maintain their importance, power, and competitiveness for future contracts.

This presents a limiting perspective: "This is the strategy of the companies themselves; it's what sets them apart from others. So, what they have in terms of knowledge, they keep to themselves to maintain the importance of the company. Many times, NTIO becomes hostage…They hold onto the knowledge to remain important during contract renewals" (M1).

Individual aspects (Table 2) also indicated limitations in the retention of critical knowledge in NTIO. The weak identification and commitment of professionals with the organization, especially in strategic areas, affect the psychological contract of individuals with the organization and limit the retention of critical knowledge: "There are many people who do not identify themselves, who work within NTIO, but do not identify with NTIO…there's a lack of working as a unit"(M10).

Additionally, the insecurity of some professionals in the strategic areas of NTIO was revealed regarding the completeness and validity of the knowledge they apply in their activities and decision-making: "Sometimes, people may feel insecure about procedures, external audits, which can be somewhat exaggerated, or people may be afraid to perform certain procedures when they are not sure about what they are doing, whether it is allowed or not - that's the question about your knowledge…sometimes, this insecurity" (M4).

The lack of personal interest from some professionals with critical knowledge in NTIO indicates a lack of willingness to share and retain new knowledge to avoid taking on additional responsibilities: "The employee doesn't seek this knowledge, sometimes what I notice is that for some people, once you have knowledge, you become responsible for performing a certain task" (M2).

Interpersonal relationships within the organization are hindered by barriers existing between teams and among individuals within teams, creating obstacles to the retention of critical knowledge: " If an individual lacks confidence or finds it challenging to socialize with others, they won't share anything—not even a smile, let alone knowledge." (M4).

Additionally, there are individual feelings of vulnerability and loss of power associated with sharing critical knowledge in NTIO, represented by negative emotions related to the loss of individual resources and a decrease in importance: "There are situations where the person who possesses this knowledge wants to hold onto it, not share it with others, in order to be important..." (M1).

Technological aspects (Table 2) are also revealed to enhance and limit the process of retaining critical knowledge in NTIO. The difficulty, and even the impossibility, of accessing software due to obstacles or hindrances from company limit the development of strategic processes and hinder the stages of the knowledge retention process:"…things are very specific, precarious, there are certain software licenses that are shared, and there is a limited number of people who can access it, and even the [name of the software] software has a limit because NTIO is also a large organization. So, in that sense, it's not something that is available 100%." (M4).

The customization of systems within NTIO is identified as deficient and not aligned with the organization's reality, limiting the process of retaining critical knowledge. The hardware infrastructure provides good, up-to-date microcomputers: "I think when it comes to hardware, we are well-equipped with good equipment..." (E10).

However, it was also noted that this aspect relates to the unavailability of equipment for scanning large format sheets, such as those used in engineering projects: "[...] For A4-sized formats, it's excellent. But since we couldn't scan all the blueprints, I still think it's lacking. We need to improve, it can be done, and it's not expensive either..." (M8).

The changes in systems and information migrations have presented difficulties and limitations in retaining critical knowledge within these software systems: "We have gone through various types of programs over time. However, what was in one program did not migrate to the other, so we ended up losing that knowledge…So, today, when there's a demand, many times we don't have the historical information from the past" (M5). On the other hand, eletronic processes, applications, and the company's website point to the use of different electronic communication solutions among people and teams, enhancing the retention of critical knowledge.

However, the excessive quantity and lack of integration of systems in use limit the knowledge retention: "Nowadays, I see that NTIO has many systems, and many of them are not even interconnected. So, if the system itself is not interconnected, imagine if it will help retain knowledge in any way. Sometimes they create two, three systems for the same thing…an absurd number of systems..." (M2).

The usability of information systems indicates the existence of some intuitive softwares and others that are difficult to use, which affects the knowledge retrieval stage: "I find the [software] extremely intuitive; it has undergone some improvements over time, possibly mandated by regulatory authorities.

NTIO performed this upgrade, and today, this information is also available. I believe it's quite easy to navigate; yes, it's very user-friendly." (M9) and "…without organization, you can't find anything in [the software] anymore…from this perspective, it's not as user-friendly for research purposes. [...] that's why we're creating a parallel archive..." (E1).

When analysing the aspects that affect the knowledge retention process in NTIO, it can be observed that the majority of them act as limitations to this process.

5. Discussion

The loss of explicit and tacit knowledge has negative consequences for the performance of the organization under study. This relationship between knowledge loss and negative impact on organizational performance has also been highlighted in previous studies (Daghfous *et al.*, 2013; Levy, 2011; P.R. Massingham, 2018; Tseole and Marutha, 2022). Retirement, despite being a predictable event, represents an important form of critical knowledge loss for NTIO.

Studies have indicated that people were taking away their tacit knowledge upon retirement (Levy, 2011; P.R. Massingham, 2018). Therefore, planning is necessary regarding the replacement of professionals who will retire soon. The loss of critical knowledge in the public organization under study is also associated with the termination of outsourcing contracts and the departure of outsourced personnel from the company.

This situation highlights the need for the creation of mechanisms and processes for outsourced companies to share knowledge, which should be retained by the public organization. Such intention could even be already expressed in the contractual terms used. The outsourcing of critical knowledge is an operational support, but equally a situation that generates knowledge loss and encompasses the turnover of professionals in these contexts (Durst and Zieba, 2019; Galan, 2023).

Health issues and death force NTIO to confront the sudden loss of critical knowledge, especially tacit knowledge. In addition to the global COVID-19 pandemic, inherent circumstances of human beings highlight this aspect of personnel departure. Once again, the need for planning and prior retention of critical knowledge is evident.

In general, the loss of knowledge in NTIO due to the departure of individuals, whether from the company itself or its units, indicates failures in the organizational knowledge retention process. The lack of sharing tacit critical knowledge leads to the concentration of knowledge in a few individuals or units, which ultimately results in the loss of unshared knowledge when these expert individuals depart.

Knowledge sharing benefits the organization by transforming individual knowledge

into organizational knowledge (Ali, Selvam, Paris, and Gunasekaran, 2019; Levallet and Chan, 2019).

The misplacement of knowledge storage and the obsolescence of stored knowledge have led to situations where the organizational performance of NTIO has been affected. Mitigating this knowledge loss requires attention to the continuity of information systems and their databases, as well as their appropriate customization. The misplacement of the repository of stored knowledge and the obsolescence of this knowledge result in the loss of this strategic resource (Durst and Zieba, 2019; P.R. Massingham, 2018).

From the evidence, aspects from the environmental, organizational, individual, and technological dimensions emerged that influence the process of retaining critical knowledge. Authors in the fields of management, retention, and knowledge sharing have already addressed the organizational, individual, and technological dimensions to analyze aspects that influence knowledge management (Kukko, 2013; Lin, 2007; Riege, 2005).

Thus, in this study, the environmental dimension (changes in government, changes in legislation, norms, and guidelines, and the pandemic) emerged as a limiting aspect in the retention of critical organizational knowledge. Special attention is given to the pandemic aspect, which limited direct physical contact between individuals and abruptly initiated remote work, creating a contingent dynamic required as a means to combat virus transmission. This challenge interrupted practices of exchanging experiences and sharing critical knowledge.

The organizational dimension is highlighted with both limiting and enhancing influences on the knowledge retention process. The aspect of stability of professionals in their positions enhances the retention of critical knowledge if proper workforce planning is in place.

The literature reinforces that turnover, identified as the rotation of personnel within the unit or organization, limits the retention of critical knowledge, leading to its loss (Daghfous *et al.*, 2013; Tseole and Marutha, 2022; Galan, 2023).

The number of hierarchical levels and bureaucracy within NTIO hinders knowledge sharing in the public organization. The organizational structure directly impacts communication and cooperation among individuals and organizational units, with flat structures demonstrating advantages in organizational knowledge management processes (Al-Dmour *et al.*, 2020).

Furthermore, the organizational restructuring that has occurred in the studied organization reveals area disruptions and rearrangements with a personnel deficit. During organizational restructuring, the way in which organizational processes, positions, and functions are modified can create difficulties for knowledge retention

and affect organizational performance (Borzillo and Kaminska-Labbe, 2011; Stein, 1995).

The absence of a culture of interaction and integration negatively affects the culture of knowledge sharing. Additionally, the absence of incentives and rewards policies for knowledge retention in NTIO contributes to this vicious circle, along with managerial commitment, people management, and institutional knowledge management programs.

Organizational culture affects knowledge management and retention (Al-Dmour *et al.*, 2020; Tseole and Marutha, 2022). Thus, there is a need for an organizational culture that encourages the dissemination of knowledge at all levels and units of the organization (Daghfous *et al.*, 2013).

The organizational culture that enables interaction among different units and teams, whose knowledge is intended to be retained, needs to be supported by an organizational structure that facilitates cooperation between different units, in order to create effective conditions for the management and retention of critical knowledge (Donate and Guadamillas, 2011; Martins and Meyer, 2012; Wikström *et al.*, 2018).

In the Canadian public administration, it has been shown that individuals need recognition, whether financial or non-financial, to feel motivated to retain knowledge within the organization (Levallet and Chan, 2019). Additionally, the goals of a knowledge retention process need to be aligned with the organization's strategic objectives, and this arrangement needs to be communicated to all group members (Levallet and Chan, 2019).

In the individual dimension, limitations in managing individuals' interests, feelings, and bonds add to the lack of identification between strategic professionals and the organization under study. This scenario highlights a weak psychological bond between individuals and the company, limiting the sharing and retention of critical knowledge and maximizing knowledge loss due to retention process failures. The capture and retention of knowledge require a strong bond between the individual and the organization (Levallet and Chan, 2019; P.R. Massingham, 2018).

Some individuals in NTIO demonstrate a lack of motivation to learn, retain, and share critical knowledge. This lack of interest in continuing organizational processes when more experienced individuals leave limits the retention of critical knowledge and maximizes its loss. In the Canadian public sector, it has also been shown that expert individuals did not perceive incentives for retaining their knowledge, leading to demotivation and limitations in retaining critical knowledge (Levallet and Chan, 2019).

The lack of interest among individuals in retaining new critical knowledge in NTIO is also related to the fear of having to take on additional responsibilities within the

organization as a result. This creates a vicious cycle that limits the retention of critical knowledge. On the other hand, the lack of interest in acquiring new knowledge can stem from individuals' demotivation due to heavy workloads (Daghfous *et al.*, 2013), which is an aspect found in NTIO.

Additionally, feelings of vulnerability and loss of power among individuals when sharing any critical knowledge are limiting knowledge retention. It is known that people are reluctant to share their knowledge due to the fear of becoming less valuable within the organization and becoming replaceable (Daghfous *et al.*, 2013).

In the technological dimension, the capabilities of information technology tools and infrastructure, such as electronic processes, applications, websites, and equipment, provide opportunities to enhance the process of retaining critical knowledge. However, the presence of multiple different systems, coupled with a lack of customization and the unavailability of specific information technology software and equipment for strategic areas within NTIO, limits all stages of the knowledge retention process and amplifies its loss.

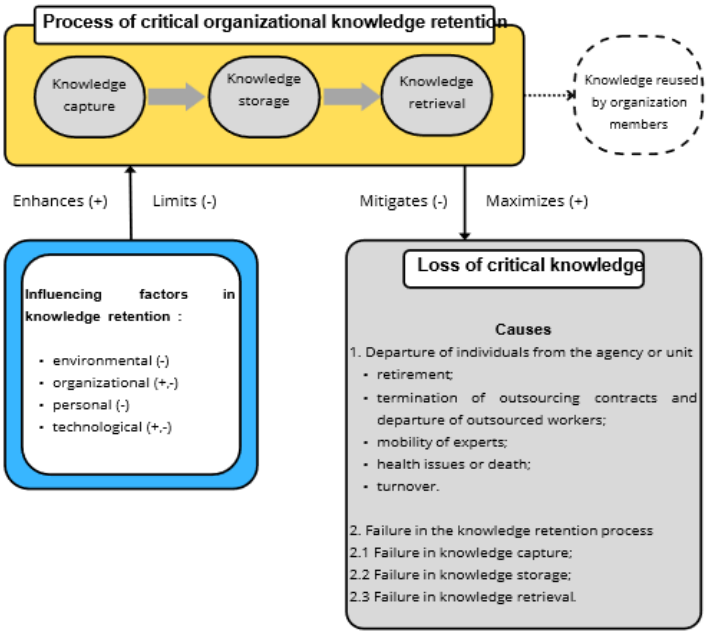
The deployment and use of different and outdated information technology systems that do not communicate with each other and are unsuitable for knowledge retention lead the organization towards knowledge loss (Durst and Zieba, 2019; Levallet and Chan, 2019; P.R. Massingham, 2018). Thus, there is a need for the unification of information systems and their customization to the needs and realities of the company.

Based on these analyses, a framework has been developed to comprehend the dynamics of the knowledge retention process, including the causes of knowledge loss and the aspects influencing the retention of critical knowledge (Figure 3).

According to the research framework (Figure 3), it can be assumed that the way influencing aspects are managed within the organization will determine how they act in the process of retaining critical organizational knowledge. In the studied public organization, environmental, organizational, individual, and technological aspects were observed to act as both enhancers and, for the most part, limiters of the knowledge retention process. Thus, when a aspect is developed and managed appropriately by the company, aligning it with organizational strategy and also focusing on knowledge retention, that aspect will enhance the knowledge retention process.

On the other hand, when the company fails to develop an organizational aspect or does not manage it in alignment with organizational strategy and knowledge retention, that aspect will act as a limiter of the process of retaining critical organizational knowledge. The analysis of the study's results allows for the proposition "a," which states that:

Figure 3. *Dynamics of the process of knowledge retention and loss*



Source: *Own study.*

a) Environmental, organizational, individual, and technological aspects influence the retention of critical knowledge, potentially enhancing or limiting this process.

Further exploring the dynamics of the process of retaining critical organizational knowledge (Figure 3), there is an interaction between the influencing aspects and the consequences on the phenomenon of knowledge loss, aiming to mitigate it. By enhancing this process, each stage that comprises it (i.e., capture, storage, and retrieval for reuse) is strengthened. As a result, the causes are addressed, mitigating the loss of this strategic knowledge in different situations related to the departure of individuals from the organization or unit and due to failures in the retention process.

It can be understood that the arrangement and interaction of the influencing and enhancing aspecs in the process of retaining critical knowledge mitigate the loss of critical organizational knowledge. Therefore, proposition "b" is presented:

b) Environmental, organizational, individual, and technological aspects, by enhancing the knowledge retention process, can mitigate the loss of critical knowledge caused by failures in the retention process and/or the departure of individuals from the organization or the organizational unit in which they operate.

Considering propositions "a" and "b," based on the study results, it is evident that influencing aspects can also limit the process of retaining critical organizational

knowledge. By limiting this strategic process, the loss of knowledge is maximized. Thus, proposition "c" is established:

c) Environmental, organizational, individual, and technological aspects, by limiting the knowledge retention process, can maximize the loss of critical knowledge caused by failures in the retention process and/or the departure of individuals from the organization or the organizational unit in which they operate.

Considering the research propositions, it is understood that the process of retaining critical knowledge can mitigate the loss of this strategic resource. In this regard, it is consistent for the management of the studied public organization to seek ways to create and strengthen aspects and actions, previously planned and aligned with the company's strategic objectives, to enhance the retention of critical knowledge and mitigate the loss of this resource.

To achieve this, the public organization needs to develop an institutional and continuous process of retaining critical knowledge aligned with its strategic plan.

6. Conclusions, Proposals, Recommendations

A qualitative investigation of the loss and retention process of critical knowledge was conducted in a Brazilian national public organization in the transportation infrastructure sector. The loss of critical knowledge in the studied company was evident, even with awareness among managers.

This loss was related to different reasons for the departure of individuals from the organization or its units, as well as failures in the stages that comprise the process of retaining critical organizational knowledge. The loss of critical organizational knowledge due to the departure of individuals underscores the need for planning in managing and replacing expert personnel.

Furthermore, the loss of organizational knowledge related to failures in the stages of the knowledge retention process highlighted the need for intentionality in organizational processes, structure, and infrastructure to ensure the effective retention of critical knowledge. In addition to these organizational aspects, there is a need for the development and management of a culture of knowledge sharing and retention, as well as interaction among individuals, teams, and collaborating companies within the organization under study.

If knowledge cannot be retained, it will be lost. The identified aspects and how they are managed will impact the potential for enhancing or limiting the strategic process of retaining critical knowledge within the organization, which, in turn, will mitigate or maximize the loss of knowledge. Therefore, it is important for the organization to develop an institutional and continuous program for retaining critical knowledge.

This study contributes to the knowledge management literature by qualitatively highlighting the relationships between knowledge retention and loss in a public organizational context concerning critical knowledge loss. Additionally, while reinforcing the dimensions of organizational, individual, and technological aspects from previous literature, it also sheds light on aspects related to the environmental dimension that can influence this process.

Furthermore, it is shown that the absence or ineffectiveness of strategies focused on knowledge retention, coupled with limitations in managing environmental, organizational, individual, and technological aspects, restrict the knowledge retention process and maximize the loss of this strategic resource.

Moreover, in practice, this study contributes to the strategic management of the organizations, with a focus on retaining critical organizational knowledge. Knowledge loss signifies the loss of strategic resources for a public organization with responsibilities that impact national logistics.

Consequently, a decline in organizational performance will have consequences on the movement of people, passengers, raw materials, or finished products, both for domestic consumption and export. Thus, the detrimental effect on the performance of the organization studied extends to the national economy.

In this regard, it is necessary to raise awareness among managers regarding the occurrence and negative consequences of knowledge loss on organizational performance. The organization's strategic planning should support initiatives and processes that enhance knowledge retention within the organization, as well as proper management to mitigate loss. The presented framework and its resulting propositions have the potential to contribute to other organizations beyond the scope of this research.

One limitation identified is that the investigation focused on a specific public organization, and therefore, the results cannot be generalized to other organizations. To further advance the topic, it is suggested that future studies analyze the constructs addressed in this research using a quantitative approach. The aspects affecting the retention process identified in this study can be quantitatively related to the causes of knowledge loss that were identified.

Furthermore, it is recommended that future studies encompass public organizations in Brazil and in other emerging countries to compare the findings with those of this investigation.

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