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PROPOSED METHODOLOGY FOR IDENTIFYING STRATEGIC INFORMATION IN INFORMATION-INTENSIVE ORGANIZATIONS

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ABSTRACT

It presents a methodology for identifying the organization's strategic information, called information assets. The methodology is robust and based on studies of the organization, regulations, and interviews with managers. The methodology introduces two modeling elements called metamodel and operation cycle.

Keywords: Information Management; Knowledge Management; Information Goods; Information Assets; Operation Cycle; Metamodel; Regulatory Agency; Organizational Efficiency.

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1. INTRODUCTION

The importance of information management for organizations

Within the scope of strategic management and in the context of organizations, the relevance of information handling is defended by Mintzberg (1994). According to this author, information management stems from a permanent activity related to processing, filtering, and disseminating information so that the organization evolves. And, observing the management scenario of many organizations, an important gap is noted in the informational treatment in their management tools. It is not uncommon for organizational diagnoses performed in light of information management to point out situations such as: lack of knowledge of strategic information, non-integrated information systems in use; absence of automated support for organizational processes; absence of a structured repository that contains all the strategic information and services provided by the organization; absence of systematic activities for validation, sharing and dissemination of strategic information; and inexistence of systematic activities for the dissemination of the organizational knowledge, as well as mechanisms for documenting the acquired experiences and, furthermore, the procedures and controls are often not formalized in manuals, tutorials, or didactic material that can be easily accessed by people (Source: MGIC Integrated Report - Deliverable E9 - Item 21 of the Work Plan).

Peter Drucker (1988) introduced the notion of information-based organizations as an advanced stage of development of companies that use information efficiently. Also according to Drucker (1989 apud Mueller, 2006), since the performers in information-based organizations are experts, it is not necessary to tell them what should be done, but only to discuss common strategies for the execution of the work. In this sense, the author suggests that this type of organization should be structured around clear goals and objectives and that the performance expectations of each specialist should be precisely established in the general concert of the task or service to be performed, in which each task is organized from a feedback that compares results and expectations so that each specialist can exercise self-control or self-criticism.

Thus, one can understand that regulatory agencies are information-intensive organizations in the sense that one of the main results of their processes is the issuance of regulations for the provision of services in their area of competence. These are concessions, authorizations, and permits for the manufacture and/or use of substances, drugs, or certain equipment. Regulatory agencies need the entire life cycle of information to be controlled, ensuring the quality and timeliness of information.

The current pandemic - resulting from COVID-19 - has put the regulatory agencies and the importance of their function for the Brazilian market in the spotlight. The approval of vaccines, medications, regulations, and other outcomes resulting from the regulatory process are not procedures comparable to dispatchers, in which it is only necessary to make a "pile of documents" in order for the approval to be effective. These are information and knowledge intensive processes, in which it is necessary that the participating actors can generate and trust information to support a decision-making process. It is necessary to identify what the strategic information is and ensure that it is correct, reliable, and available for decision making at the right time. This practice reinforces the need for techniques to identify strategic information and for good information management.

On the other hand, the players involved must be properly prepared for decision making, or the process will be compromised. Another relevant aspect is that the process must provide a learning cycle that will promote the continuous improvement of the organization.

Therefore, organizations in general, and information intensive ones in particular, have a set of information assets that are part of or directly influence their business processes and that must be available at the right time. Otherwise, the organization's entire process will be compromised. For example, a land transportation regulatory agency should have a repository that contains all proposals for regulations that have been made in perhaps the last five years, so as to avoid rework when formulating its annual regulatory agenda. There should be another repository with the results of the enforcement plans executed in a given year, so that these results can serve as inputs for actions in later years.

These repositories must have their content very well defined and the entire organizational process affecting their "life cycle. In other words, you need to analyze how the information related to this repository flows in the organization and what transformations will take place in this process.

These repositories are, in this research, called "information assets".

In this context, a project called Information and Knowledge Management Model (MGIC) was developed with a national regulatory agency, aiming to develop an integrated model for information and knowledge mana-

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gement, which would mitigate problems related to the theme. In this project, a structured and innovative methodology was developed to identify the organization's strategic information and, from these, derive the information and knowledge management models. The objective of this article is to present, specifically, the structured methodology developed to identify the organization's strategic information, called information assets.

The article is structured as follows: the first section discusses the importance of information management for organizations and information assets in the literature. The second presents the methodological procedures used to develop this research. The third section briefly discusses the context of the MGIC project and how it was executed in a Brazilian federal regulatory agency. The fourth section brings the theoretical foundation about information assets, as considered in the MGIC project. The fifth section describes the journey of identification of information assets that was followed within the MGIC project to identify the strategic information of the organization and organize it in a structured manner from the perspective of how its operation cycle should be. It also addresses two important elements in the modeling: the metamodel and the operation cycle. The sixth section discusses the results obtained from the modeling of information assets for the organization studied and highlights the importance of knowing strategic information and their respective life cycles. The seventh section reveals the conclusions of the study and points out directions for future work, as well as indicating enhancements for the improvement of the information asset identification strategy presented.

Information Assets in Literature

The expression Information Asset or IA, for the scope of this research, comes from the English language. Some authors use the expression "information goods", but as the terminology adopted in the project that gave rise to the methodology presented used Information Asset, we chose to keep this terminology.

According to Detlor (2010) *apud* Moreira (2014), many organizations recognize the potential value of information and the need to identify what their resources are and what costs are associated with acquiring, storing, processing, and using that information. The author points to the importance of information management, as well as any other critical resources of the organization (people, equipment, and capital, for example) as a way to transform it into a strategic asset that can bring competitive advantages to the organization.

To understand information and how to manage and protect it, it is important to understand the concept of Information Asset.

Several authors agree that Information Asset is a set of data and information that has value or potential value to the Organization (Caralli *et al.*, 2010; Higgins *et al.*, 2006; Oppenheim *et al.*, 1998).

For Oppenheim et al. (2003), Information Assets comprise resources that are or should be documented and that promise future economic benefits. For this reason, Information Assets must be identified and classified according to their value and importance, and the resources required to manage them and get the most out of them must be identified.

An Information Asset is the information that is organized and has value; therefore, it must be easily accessible to those who need it. Developing an Information Asset requires defining the issues to be solved, identifying the information needed, capturing the information through documented processes, and building a structure to allow easy access to the groups that benefit from the information. Information Assets form an umbrella category that includes data, information, and explicit knowledge that can be structured, communicated, and transferred (Davenport and Prusak, 1998).

Information Assets are recognized as having value to the organization and cannot be easily replaced without cost, skill, time, resources, or a combination of these factors. Information Assets form a part of the organization's corporate identity, without which the organization may be threatened.

For Higgins et al., (2006), of the Queensland Government, Australia, Information Assets are defined as an identifiable set of data, stored in some form, and recognized as having value to the organization, enabling the execution of its business functions, and known to satisfy one or more of its business requirements. For Oppenheim et al. (2003), tacit knowledge cannot be formally communicated; and explicit knowledge is actually information. Thus, knowledge assets should also be considered as information assets. For Carlucci and Schiuma (2006), successful companies tend to be those that are continuously able to develop their knowledge assets, such as: employees' skills and knowledge, organizational culture, and the organization's image, which reinforces the authors' position that knowledge resources are a fundamental source of corporate growth, and that organizations must provide structured approaches to the management of their knowledge resources.

The UK Government is also concerned with the identification of Information Assets and their business requirements (The National Archives, 2010; 2011a; 2011b). For the UK, an Information Asset is a set of information defined and managed as a unit so that it can be effectively understood, shared, protected, and exploited.

Information Assets have recognized value and manageable risk, content, and life cycle. They are not just a list of systems to be managed, but the identification of what information needs to be managed in these systems, which includes sensitive personal data of employees or contractors, for example, and non-personal business--critical information handled in paper or electronic form. The risks to be managed are to ensure against inappropriate access to personal data, information security, loss of information during transfer or movement of data, loss of access, and poor quality of information, among others (The National Archives, 2010).

The issue of identification and management of Information Assets is still the subject of discussion and research, showing the relevance of the theme. Some authors state that it is more common to manage systems than information. According to Evansa (2020), who studied ways to identify important domains for the management of Information Assets, with the advent of digital transformation, the topic is increasingly relevant, and many organizations do not realize that, in order to accomplish it, it takes much more than technology. Digital transformation will only be successful if data, information, and knowledge are treated as a true Information Asset, showing the importance of techniques capable of identifying them.

Eroglu (2020) studied the importance of public institutions accessing the value of their Information Assets for aspects such as competitive advantage and improving management processes. The study addressed the effects of valuing information assets.

Lateef (2019) considers Information Assets to be strategic and discusses how they assist organizations in achieving their organizational goals. Batini (2018) argues that while both researchers and marketers agree on the importance of information as a fundamental asset, there is no consensus on what the determinants of information value are, particularly in light of the ever-increasing amount of data available through digitization processes. The studies by these authors show how current the theme is and the importance of developing techniques to identify, record, and manage the strategic information of an organization, as Information Assets.

More and more information is being produced. The great ease of access to the Internet and other factors such as reduced storage costs, data compression, and many other technologies currently available have exponentially raised the amount of information available for consultation. This process has increased the importance of methods to reduce the information overload and to control its quality and importance in a defined context. Despite the fact that the several analyzed works address in detail various aspects related to Information Assets, none of them presents a structured methodology for identifying and treating the strategic information of an organization, which is the object of this work.

2. METHODOLOGICAL PROCEDURES

The research methodology used to conduct the project in the organization studied is based on two scientific research methods: action research and grounded theory.

Action research, according to Baldissera (1998), requires a structure of relationship between researchers and people involved in the study of reality of the participatory/collective type. The participation of researchers is made explicit within the process of "knowing" with the necessary "caution" so that there is reciprocity/complementarity on the part of the people and groups involved, who have something to "say and do". It is not, therefore, a simple data collection.

Grounded theory, as recommended by Prigol et al. (2019), has an exploratory nature and allows the researcher to become familiar with the problem, since it works directly with the phenomenon to be studied, with a view to making it more explicit, refining ideas, and obtaining information for a more complete investigation. This requires the researcher to be receptive to information and data, and to have a flexible attitude. The method is categorized as qualitative research, which adds, as in a jigsaw puzzle, new pieces, that is, new data, which can be collected according to the needs of the investigation - marked by identifying phenomena by observing real world situations - so that they can be understood in the context in which they occur. Thus, data is collected from the angle of those involved, rescuing the voice of the interviewees. This aspect is amplified in grounded theory, which has flexible guidelines according to which the researcher can move between the broadest and the narrowest focus of the data collected, and vice versa, enabling its refinement.

The data and information used for the analysis, discussion and conclusion of this research come from the models produced by the MGIC project, which are col-

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lected directly from the managers of the organization studied and are coupled with a literature research. This study addresses issues related to the object of this work and supports the construction of arguments that justify the relevance of implementing an operation cycle model for regulatory agencies and present meaning to a management model oriented to Information Assets, which is aligned to the precepts of action research.

From the grounded theory perspective, the strategy adopted to execute the project is based on the combination of some methodologies for the development of ANTT's information and knowledge architecture, supported by the elaboration of the following models: Information Assets and Information Flows Model; Business Requirements and Usage Case Model; Information Model and Knowledge Model; Information and Knowledge Architecture Model; Ontology Model; and ANTT's Information and Knowledge Management Model. The work of identifying the Information Assets, object of this research, originates the architecture of the organization's Information Assets. In this sense, it acts as the basis for the development of the other models, which are briefly presented in the next section.

It is important to emphasize that all the work is performed iteratively and incrementally, generating partial products by Organizational Unit (OU) for each work step proposed, which are gradually consolidated until the consolidation of the complete model throughout the Agency. An OU, in the scope of this research, can be understood as a department or a management within the organization, which was the object of one of the interactions in the IA identification process.

3. O PROJETO MGIC

This section briefly introduces the MGIC project. The reader interested in more details should look for the references presented throughout the section.

The MGIC Project - Information and Knowledge Management Model aimed to develop an integrated model for information and knowledge management. To understand how this model should be proposed, the methodology used integrates contributions from five distinct areas of science: the final area of the organization studied, information management, business requirements, knowledge management, and the ontology of the domain of knowledge and action in question (Bastos *et al.*, 2011).

A premise adopted in MGIC is that knowledge can be generated from structured information, and for this reason it presents a modeling approach based on the organization's information assets. However, it only makes sense to store and manage information if it is, at some point, at least consulted. Therefore, an Information Asset, and its use by the organization, is in turn materialized by the information flows associated with it. These flows describe how information flows through the various organizational units and what are the transformations performed on it in light of the information life cycle. In this sense, the information flow models for each Information Asset reveal the organization's work routine, its workflow, and then, it is possible to identify the knowledge and skills required to handle these information assets.

From these models, it is also possible to identify the business requirements of the organization through which the system requirements for developing the information systems embodied in the use case models can be derived. A conceptual ontology model is also developed, containing the glossary of terms inherent to the field of activity of the research studied, which defines terms and concepts and helps maintain consistency between the models and eventual systems to be developed.

The differential of the MGIC/ANTT Project was to use, in an innovative way, a specific methodology that congregates several theories, tools, and methods consecrated in Information and Knowledge Management (Benevides, 2010; Zamborlini, 2010; Kroll; kruchten, 2003; Kruchten, 1999; Larman, 2005; Rezende; 2007; Lévy; Authier, 1995; Nonaka; Takeuchi, 1997; Guizzardi, 2005; Jackson, 2004).

In the project, the Information Assets are those collected from the analysis of the objectives, the regulatory attributions and the main activities performed by the Organization, reflecting its current situation. The Information Assets bring together collected data (inputs), which must be treated by business functions, generating results and must be stored for later retrieval and dissemination to interested parties, internal or external to the organization, and form one of the integrating elements of the methodology.

Other integrating elements of the Information Management (IM) and Knowledge Management (KM) models are proposed. One of them is the ontology model, since it formally defines the manipulated information and the semantics of processes, domains, and functions, ensuring information reliability and facilitating knowledge integration (Guizzardi, 2005; Jackson, 2004). The information needed by the organization to perform its activities in the domain of operation is modeled. The modeling of each domain is relevant because it formalizes the information and treats it semantically to ensure consistency, correctness, and completeness. This modeling enables the effective exchange of information between different users, be they people, workgroups, or computer systems.

A third integrating element lies in the improvement model. The evaluation of the current situation (as is) and the projection of what should be the desired situation (to be), that is, the one in which the information life cycle, the knowledge flow, and the knowledge conversion processes take place in a complete way for all the identified and suggested information assets, leads to the proposition of improvement recommendations that will be reflected in the models of the desired situation (to be). The improvement model contemplates the recommendations to be prioritized and implemented as projects, with emphasis on those that deal with: a) revision, completeness, standardization, and restructuring of the IAs; b) implementation of tools and techniques related to the information life cycle, knowledge flow, and knowledge conversion processes; c) development of applications, tools, and systems for IM and KM; d) capacity building and organizational learning activities.

In addition to the models listed above, the methodology makes use of other models. For the construction of the IM model, the following formal models are produced:

An information flow map that establishes at a high level how information is handled, considering the information life cycle, that is, for each IA, the fulfillment of the seven phases that information goes through is analyzed: collection, validation, processing, storage and retrieval, distribution, and dissemination (Zack, 1999), identifying gaps to be filled;

A business requirements model that describes the services provided by the organization and the logical information model (structural view of information) needed to execute these services. The use case model defines the business requirements in an appropriate pattern to be met by information systems development. The information model establishes the relevant business objects (information) to be managed by the information systems and specifies the need for sharing these objects between systems (Benevides, 2010; Martins, 2010; Zamborlini, 2010; Larman, 2005; Kroll; Kruchten, 2003; Kruchten, 1999);

To build the KM model, the following formal models are produced:

- A Knowledge Model based on the mapping of competencies, knowledge, and professionals related to IA processing. The knowledge models identify the ways in which knowledge is built and competencies are mobilized by professionals, pertinent to business processes and the flow of information. The relevance of these models lies in the fact that, while mapping and representing the knowledge/competencies/professionals (Fleury; Fleury, 2004; Zarifian, 2005; Rezende; 2007; Rezende et al., 2011), they analyze the knowledge flow, i.e., the steps of collecting and mobilizing knowledge to generate innovation (Sabbag, 2007) and the processes of knowledge conversion (Nonaka; Takeuchi, 1997), grounding the construction of an architecture and the proposition of tools and practices that can support KM in the organization;

- The construction of the workflow of the current situation, detailing the procedures adopted by employees to perform the activities in the IAs processing, enables a better understanding of the organization's operation and the identification of those who perform a set of procedures related to a specific activity of the Information Flow of an IA. The inputs provided by the Workflow As Is and the knowledge topography allow associating the knowledge that is mobilized to the procedures of the Information Flow activities. With the analysis of this model, one can identify the existing gaps in the knowledge flow, associated with the stages of capture, mobilization, and innovation, and in the processes of knowledge conversion (Rezende, 2007; Rezende *et al*., 2011; Rezende *et al*., 2012), leading then to the Workflow To Be proposal.

A Knowledge Tree that allows visualizing the collected knowledge in a hierarchical way, showing all specialized knowledge that can be shared (Lévy and Authier, 1995).

For additional information regarding the methodology, concepts adopted in the project and models produced, the reader can consult Bastos (2015), Bastos *et al.*, (2011) and Rezende *et al*., (2012).

4. INFORMATION ASSETS IN THE CONTEXT OF THE MGIC PROJECT

In the context of the MGIC project, Information Assets are defined as an identifiable set of data, stored somewhere, recognized as valuable to the organization, enabling the execution of its business functions, satisfying one or more business requirements (Higgins, Hebblethwaite and Chapman, 2006).

For this set of data and information to have value to the organization and, in fact, be considered and have Information Asset treatment, it must be built from the combined efforts between people, processes, and technologies required to:

S&G Journal
Volume 16, Number 3, 2021, pp. 320-334
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- Identify the organization's information needs and requirements;
- Capture unstructured data and information and convert it into information and knowledge that is aligned with the purposes of the organization;
- Transform this information and knowledge into quality products and services;
- Make intelligent use of the products and services generated, in order to support the execution of organizational strategies;

Underpin the decision-making processes in all spheres of the organization. According to Moreira (2016), each Information Asset has a specific purpose and is strategically positioned in the organizational structure, so that the organization's Information Asset architecture forms an umbrella that includes data, information, and explicit knowledge that can be structured, communicated, and transferred according to the needs of each hierarchical level of the organization. Therefore, according to the author, specific knowledge and skills are required for its manipulation throughout its life cycle, considering the aspects of information quality, according to its use and appropriation by the stakeholders. The development of Information Assets requires, in addition to identifying the information needed, that the capture of the information is accomplished through a documented process and the construction of a structure that allows easy access to those who will benefit from the information and use it. This represents the logic of the Information Life Cycle.

Information Assets are materialized by their information flows, which represent how information flows in the organization. The flows are mapped considering each stage of the information life cycle. This means that the process of collection, validation, processing, storage and retrieval, distribution, dissemination, and use of information should be properly formalized as steps in the information life cycle, properly represented in their respective flow and linkage of each Information Asset. This point is aligned with the thinking of Mintzberg (2014) on the relevance of the informational treatment by organizations in their management models. It should be noted that the approach to information flows and the information life cycle are not within the scope of this work.

An IA must have a unique name, representative of the information resulting from the execution of the service associated with it, which, in turn, must be related to a stage of the learning cycle of the organization, called, in the case of the MGIC project, the regulation cycle. This information can be created, collected, or processed during the service procedure, generating results that are not possible to be obtained from a simple derivation. This means that it is possible to relate the organization's Information Assets to the steps of the model in order to show how strategic information should flow in the organizational context and, above all, how information should be handled on a daily basis. This information may also come from and/or be disclosed to external entities.

Its purpose should be related to the strategic questions, related to the high-level goals of the organization, that IA should help answer.

Section 5 presents the steps of the Information Asset identification process used in n project.

A reliable architecture of Information Assets represents the starting point for an organization to reach a new level: that of an intelligent organization that "is one that has the ability to know and understand, easily adapting to situations" (Fachinelli *et al.*, 2006).

Figure 1. Schematically presents the concept of Information Asset

Information and knowledge management processes use assets, which are the union of professionals, systems, forms, relationships, knowledge, methods, and skills, and supports services. These services generate the Information Assets that are accessed by various types of users.

In the intelligent organization, business processes are executed in an agile, reliable, and transparent manner. Thus, the organization starts to have unique information, consistent and recoverable, making the environment conducive to the production of knowledge and that the information is enabled for use in decision support.

5. METHODOLOGY FOR THE IDENTIFICATION OF INFORMATION ASSETS

The information assets identification journey for an information-intensive organization

The journey of identifying information assets begins with the study of the "Macrovision" and the "Vision of the Future" of the organization. This information will support the entire IA identification strategy.

The Macrovision is a document that is produced internally by the MGIC project team by analyzing the organization's institutional information, such as internal regulations, service charter, and other instruments that

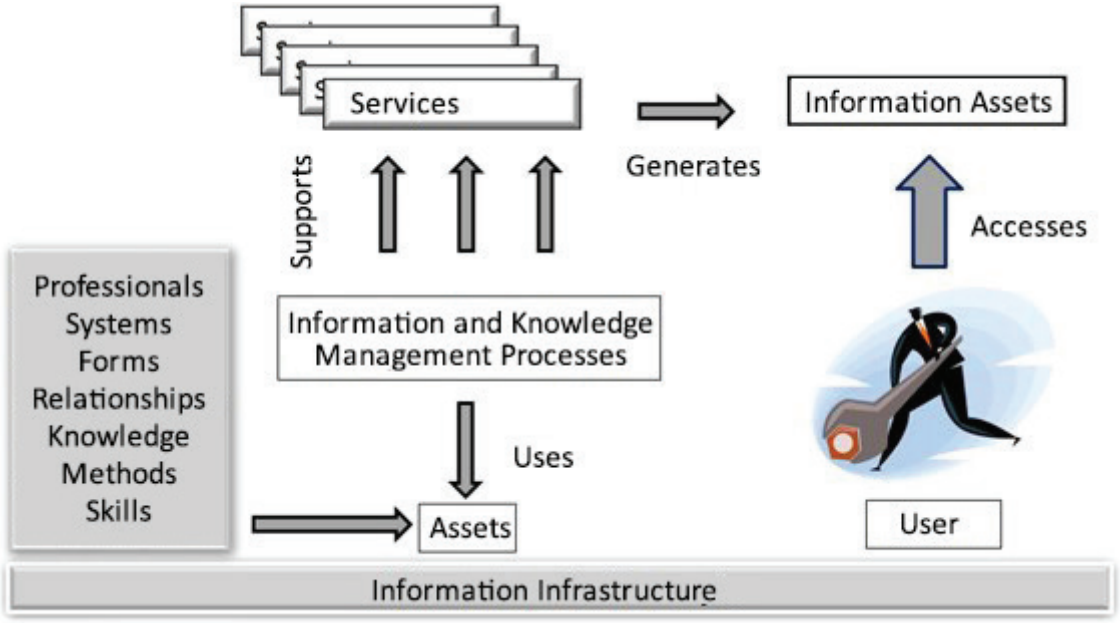

Figure 1. Information Asset

regulate its operation. Its purpose is to present a functional vision of the organization under study and demonstrate which the organization's macro objectives are, as well as to point out the "macro functions" necessary to achieve them. An additional purpose of the macrovision is to provide the modeling teams with an overview of the organization, equalizing knowledge about it, since it would not be feasible for all teams to participate in interviews with the organization's management.

The "Future Vision" is the representation of a future scenario of the organization, collected from the organization's top management. This is the first interaction of the project team with the organization's management. The "Future Vision" materializes the desires of these managers in relation to what they expect from the organization in the medium and long term future. The intention is to outline a path to be followed by the organization in light of the current situation, that is, to support the construction of an improvement plan with prioritized actions. Thus, it is important to mention that in order to build the "Future Vision", it is necessary to study the attributions of each organizational unit and understand its relationship with the organization's Operation Cycle as a whole.

Figure 2 illustrates the stages of the journey from Information Assets to information and knowledge intensive organizations.

The next step in the journey of identifying Information Assets consists, then, in studying a set of national and international references related to the performance of the organization under study, as well as references from other similar organizations. The goal is to benchmark and identify possible good practices and performance models that could be referenced for the identification of opportunities for improvement, and especially to indicate relevant information assets for the proper functioning of the organization.

From the vision of the future, the macro vision, and the set of references, the next step is to make explicit the organization's "Operation Cycle". The Operation Cycle materializes a proposal on how information and knowledge should flow in the organization, so that it can fulfill its attributions and establish a learning cycle in the organization. From this, it is possible to identify whether the learning process is occurring or is interrupted at some point. This cycle, called the regulation cycle in the MGIC project, plays an important role in the IA identification process, since the process of data collection, interviews, analysis, and model building requires an approach divided by organizational units. The regulation cycle thus allows a global vision on how information and knowledge flow in the organization, so that the vision of the whole is not lost, nor the vision of the objective to be reached during the modeling process. The regulation cycle helps to maintain the logical unity in this modeling process. The operation cycle also helps in the evaluation of which should be the next OU to be visited, which should occur in the sense of the operation cycle because the operation cycle, as already shown, indicates the way of occurrence of the flow of information and knowledge in the organization.

S&G Journal
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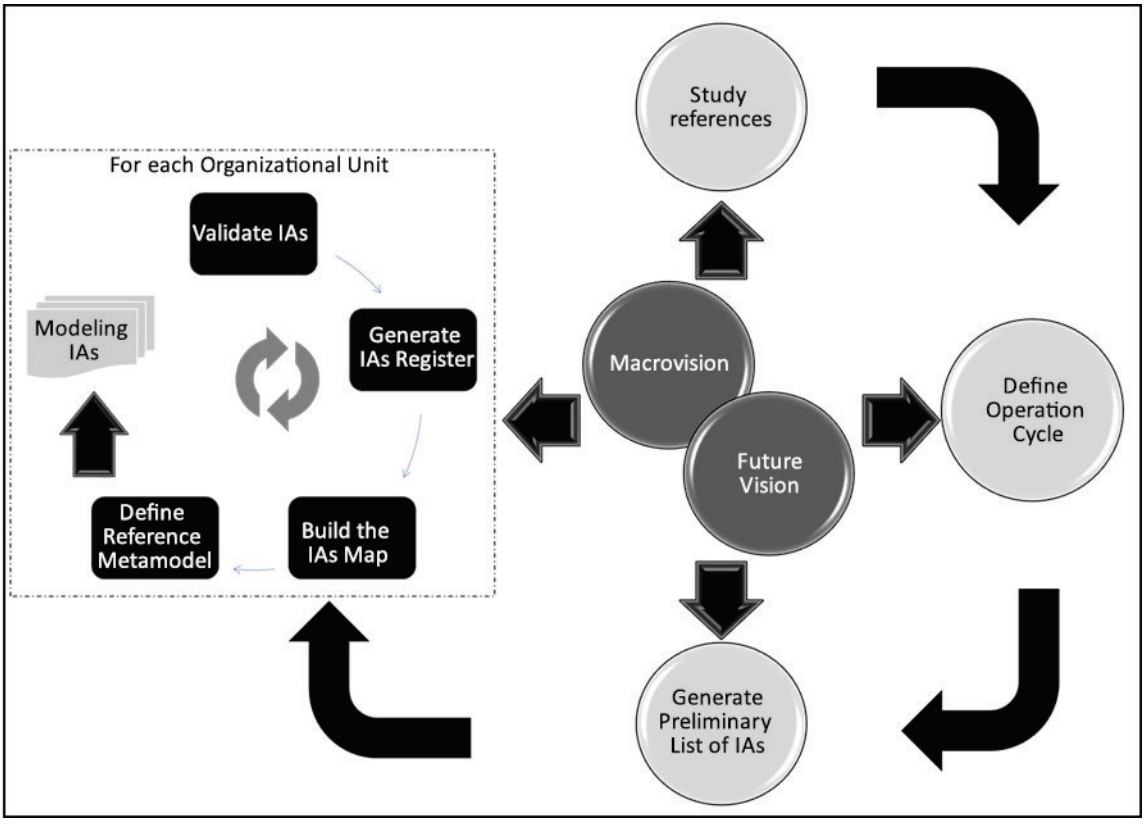

Figure 2. "A" Identification Day

The next step consists of generating the preliminary list of Information Assets of the organization studied. It is an activity of the project's internal teams. The main input for the generation of the preliminary list of Information Assets is the set of references studied. After the generation of the initial list of Information Assets, there is a second interaction with the organization for the presentation of the Preliminary List of Information Assets, which is called Exploratory Meeting. The main objective of this stage is to validate the set of information assets identified, as well as the list of references studied within the organization, while internally the first version of the improvement plan that will later support the modeling of the information assets is prepared for each organizational unit.

The steps of the IA identification journey described so far are carried out with the organization as a whole, because it proposes to portray its functioning in a holistic manner. From this point on, the interactions between the researchers and the organization begin to occur by organizational unit.

With the validation of the information assets by the organization studied, the next step is to validate the set of IAs linked to each OU with their respective managers and generate the record of these information assets, that is, define their attributes, such as: name, description, owner, users, objectives, and associated services, and if the IA must be discarded and when. This is the characterization of the Information Asset to support the identification of the IA architecture of the Organizational Unit being visited, that is, a set of national and international references related to the OU's area of activity is studied, as well as references from other similar organizations. The aim is similar to the one carried out in the study of the organization as a whole: to identify possible good practices and performance models that could be referenced for the identification of opportunities for improvement and, mainly, to indicate relevant information assets for a good functioning of the OU.

From the study of the references, a Reference Metamodel is developed. The metamodel is a conceptual model that proposes to indicate how each OU should function in an ideal or desired perspective, highlighting the expected gains for the organization if the actions indicated by the project were implemented. According to Pagliuso *et al.* (2010), a Metamodel is configured as a conceptual reference that articulates a set of relevant references for a given organization. Thus, the Metamodel produced is able to perform the integration between references, the coherence with ecosystems and strategies, the compatibility with the organizational culture, and the use of cognitive artifacts.

Following these studies with an eye to a specific organizational unit, adjustments to the preliminary list of IAs may occur, such as the identification of new IAs, the separation of an IA into two or more IAs, or even the aggregation of IAs that were originally identified separately. These adjustments may be necessary to better portray the functions and processing of each Information Asset for each organizational unit. After validation and registration of the OU Information Assets, it is possible to place each information asset in a step of the operation cycle previously built. Thus, a map of the organization's information assets is being generated and completed with each interaction.

After identifying the information assets, it is recommended that organizations move on to modeling each IA in order to map its life cycle and therefore know its information flow, corroborating with Krovi, Chandra, and Rayagopalan (2003), who state that organizations need to make systematic and conscious efforts to influence and control their information flow in order to promote efficient business processes in the organizational environment.

In order to complement the understanding of the operating logic of the MGIC project throughout the trajectory of identification of Information Assets, the ontology team performs the consistency of data and information that are generated by the teams in their mappings. This is grounded in G Guizzardi, RA Falbo (2008), who reveal evidence of the successful use of ontology to improve the quality of modeling languages and conceptual models. The purpose of ontology modeling in the MGIC project is, therefore, to ensure that everyone in the organization studied makes use of a single, well-defined vocabulary. To ensure this goal, ontology techniques are used in order to mitigate doubts regarding the most common terms in the organization's daily life, thus ensuring consistency, absence of ambiguities, reduction of semantic distance and other deficiencies, allowing the interoperability by different user entities, whether they are people, work groups, or computer systems. Conceptual models are developed by the ontology team in extended class diagrams based on foundation ontology of the organizational units and the entire organization (called domain), with ontological concepts that ensure that the knowledge represented in the domain is structured in a consistent and unambiguous way. The Ontology Model should be used to define the structuring, classification, association, and retrieval of knowledge from the definition of structures, relationships, and distinctions related to the information model defined in the ontology.

The use of ontology modeling is indispensable for the construction of a corporate database, with valid and validated data, free of inconsistencies, and allowing the complete exchange of information and agency interoperability, in addition to the possibility of automated reasoning based on the information contained in this database derived and mapped from the Ontology Model.

The sections below present in more detail two important elements of the information asset identification methodology: the metamodel and the operating cycle.

6. METAMODEL

To develop the Metamodel, four steps are necessary: 1. survey of reference models; 2. identification of points of interest and building a requirements base; 3. grouping of requirements into similar subjects; and 4. validation of the metamodel.

The first step in building a Metamodel is to survey the reference models related to the topic under study (for example: inspection). These models can be general, specific or internal. General models are those that can be treated generically, such as some frameworks known in the market: MEG, COSO, Cobit, and ISO 31000. The specific models are those used specifically for the subject under study, such as the inspection manuals of control bodies, for example. Internal models are the specific references of the organization where the modeling is being conducted, such as internal regulations and ordinances that impact the operation of the subject under study.

The second step in the development of the metamodel is the identification of the requirements, or points of interest, related to the theme under study, such as: object of the inspection, precision of the inspection instruments, inspector's competence, agreements needed for the inspection action, results of the inspection actions, infraction reports, and inspection planning.

The third step is to group the identified requirements into similar subjects in order to obtain an integrating requirement. In this example, we used the requirements inspection object, inspector competence, and inspection planning, which would be grouped in a subject called inspection plan.

The fourth step aims to validate the metamodel generated by the previous steps. The purpose of this validation is to verify the clarity of the requirements grouped into subjects and their suitability to the particularities of the organization and, more specifically, to the topic under study. In practice, the metamodel is used to test the organization under the perspectives: meets, does not meet, and partially meets, against the requirements

S&G Journal
Volume 16, Number 3, 2021, pp. 320-334
DOI: 10.20985/1980-5160.2021.v16n3.1749

grouped by observing the reference models studied in step 1. For example, for the subject inspection plan, the organization would be tested (it meets, does not meet, or partially meets) what the models studied, such as the MEG and the inspection manuals of the control agencies, recommend.

The result of metamodel use is to guide the construction of models of the desired situation.

7. THE OPERATION CYCLE OF THE ORGANIZATION STUDIED

As already discussed, the operation cycle materializes a proposal of how information and knowledge should flow in the regulatory agency, so that its attributions are fulfilled and a learning cycle is established in the organization. It is organized in stages, and the organization's Information Assets must be distributed through these stages. The figure represents the stages of the operation cycle proposed for the organization studied and their logical order.

Figure 3. Cycle of Operation of a Regulatory Agency
Source: MGIC

Each stage presents a specific function and the Information Assets should be located in each of the stages. Each stage should have at least one Information Asset associated to it that will register the contribution of that stage in the operation and knowledge cycle of the organization.

The first stage is called "Analysis of the Regulated Environment". In this stage studies, investigations, and surveys are carried out to map and identify the existing relations in the environment and in the regulatory segment that is the focus of the agency, aiming at the construction of scenarios and the identification of competitive forces and strategic issues that determine the restrictions and boundaries of the market. An information asset positioned in this stage is what has been called the "regulated environment issue". This IA contains information that allows adopting actions for regulatory measures to maintain a competitive regulated environment and to propose measures to improve service delivery to the user.

The second stage is called "Planning", stage of high-level prioritization of major regulatory issues aiming at improvement actions and planning of the set of grants. An Information Asset positioned in this stage is called "regulatory agenda", which is the planning instrument in which the several demands identified for regulation are related and prioritized.

The third stage is called "Treatment of Regulatory Demand". According to the guidelines and demands prioritized in the planning stage, initiatives are defined for the treatment of regulatory demand, including the analysis of the regulatory impact of the respective demands. An Information Asset positioned in this stage is the "analysis of the regulatory impact". This IA is an important decision mechanism in the normative process, as it corresponds to the record of results of the analysis of possible solutions for a demand, providing support for the mapping of possible scenarios, implementation strategies, and objectives for the stakeholders.

The fourth stage is "Regulation". It involves the steps of maintaining the regulatory framework, defining strategies for public participation, and drafting the Regulatory Acts. An information asset positioned in this stage is the "regulatory resolution". This information asset is responsible for disciplining the activities of the concession companies, aiming at quality assurance and, above all, legitimizing the agency's actions. The fifth stage is called "Decision Making Process". It is the stage of approval of the regulation by the collegiate board of directors. In practice, the agency's board of directors was not the scope of the project's intervention. However, it was assumed for this stage an information asset called "minutes of the board".

The sixth stage is that of "Communication and Service". It involves the steps of dissemination of the new normative act, as well as the respective organization to meet any demands from society. One Information Asset in this stage is what has been called "ombudsman results".

The seventh stage, called "Supervision", assesses compliance with the normative acts. It includes the techni-

cal-operational and economic-financial follow-up of the concessionaires or licensees, besides the actions of field inspection/supervision. Most of the services performed by the regulatory agency are located in this stage, and are related to the inspection actions, with the monitoring of the concession contracts and field inspection. The inspection ensures that the regulatory actions are complied with and feeds back the cycle with the behavior of the grants in relation to the signed contracts. This stage concentrates the largest number of Information Assets to be managed. An IA positioned in this stage is called the "Annual Plan of Road Infrastructure Inspection". All inspections are carried out based on a single set of guidelines and requirements. The road infrastructure inspectors carry out the planning of inspection actions and can meet various demands.

The eighth and last stage called "Sanction and Penalties" is the stage of treatment of the nonconformities identified in the inspection stage, in which the agency determines the application of sanctions or penalties. In this stage are the services associated with the treatment given by the agency to the communications of infractions and infraction notices issued, thus ensuring the effectiveness of regulation. An Information Asset positioned in this stage is the one called "Infraction Notice", issued when there is a non-conformity found in the inspection stage.

8. DISCUSSION OF RESULTS

The methodology presented was developed and applied in the context of a project that proposed the development of an information and knowledge management model for an information-intensive organization.

From a quantitative standpoint, for the project at hand, the methodology was applied in eleven organizational units, providing a wide testing ground. A total of 84 Information Assets were identified, from which it was possible to derive 124 information flow models, 106 use case models, 256 mapped knowledge, 42 mapped competencies, and 3,775 modeled concepts within 64 domains in nearly three years of work. 540 recommendations for improvement were suggested, categorized by the five areas of the project (MGIC, 2012). These models are interconnected, developed in successive iterations with the organization, one for each organizational unit, and are based on the Information Assets identified with the methodology described in this work.

The complexity of both the organization studied and the information and knowledge management modeling procedures using the complete modeling, outside the scope of this work, allowed us to evaluate the robustness of the IA identification methodology. Throughout the modeling process of the various project areas in each OU, very few changes were made to the IA architecture identified by the modeling process. The final list of IAs in each OU, after validation by the organization's managers, was identical to the IA list proposed after the identification process. A few modifications appeared when visiting a next OU and the need for some IA appeared to feed back the flow of information.

The process forces the organization to rethink its information and decision making process, leading to an improvement in the decision making process.

An important result obtained from the identification of the organization's IAs was the positioning of these Information Assets in the operation cycle built along the identification journey. **Figure 4** illustrates the extract of the positioning of some of the Information Assets in the organization's operation cycle.

From this map illustrated in **Figure 4**, it is possible to see the relationship between the agency's Information Assets, as well as the behavior of the information flow. The dotted lines in red did not exist originally, showing gaps or breaks in the organizational knowledge cycle, as is the case of the IA Ombudsman's Results Report that was not used to prepare the regulatory agenda for the following year, which compromised the achievement of the organizational mission in terms of meeting the needs of society. Another gap identified was that the Information Assets related to the inspection results were not being used for the preparation of the following year's inspection plans, which may indicate that the organization did not make use of lessons learned from inspection actions already carried out.

Once identified, the Information Assets had their life cycle analyzed, in light of the information flow models. This analysis allowed us to verify aspects such as the adequacy of the data collection methods, the validation of the Information Assets, and whether they achieved their objective of being used to support decision making.

The methodology for identifying the IAs is relatively simple, but the complete modeling process, described in the section that addresses the project, is quite laborious and requires considerable effort from both the modeling teams and the organization's managers. In this sense, if the objective is only to identify the Information Assets, it would be desirable to add a brief information flow analysis to assess the life cycle of the Information Asset, which also allows assessing whether the information quality requirements are being met. For, according

S&G Journal
Volume 16, Number 3, 2021, pp. 320-334
DOI: 10.20985/1980-5160.2021.v16n3.1749

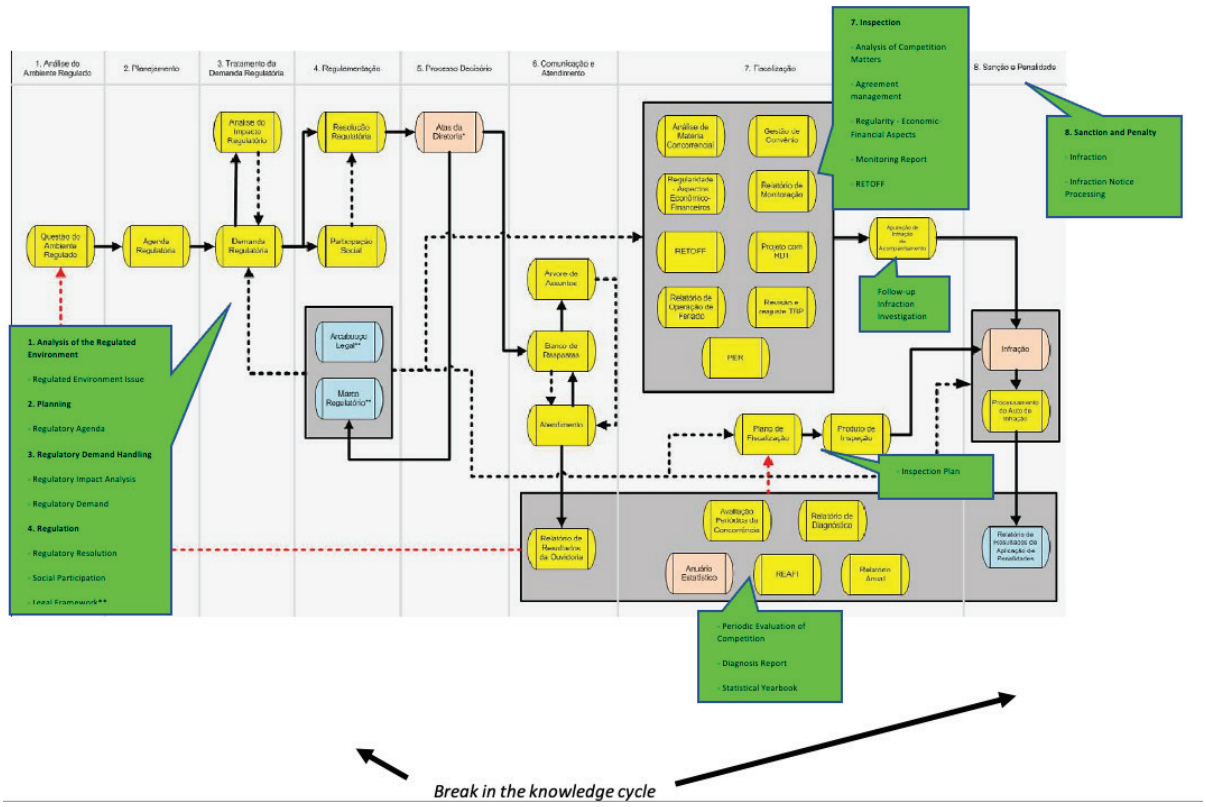

Figure 4. Positioning of information assets in the Operation Cycle

to De Sordi (2008), the value of information in the organizational context needs to be explicit and translated into requirements, such as: relevance, usefulness, clarity, objectivity, and contextualization. And yet, Mattos (2010) warns that deficiencies related to these factors may generate new demands and unnecessary content and communications.

Two important modeling elements, in addition to others, have been developed: the metamodel and the operating cycle, called the regulation cycle, and have proven to be important tools for the modeling process.

The application of the methodology did not depend on any specific characteristic of the organization studied, which allows its use in any information and knowledge intensive organization.

9. CONCLUSION

This study aimed to present a strategy to identify Information Assets for organizations that are considered information-intensive. Section 1.1 highlighted the importance of information management in organizations, especially in organizations whose main asset is information. This is the case of regulatory agencies, whose main mission is the regulation of the market through regulatory resolutions.

According to a publication in a periodical in the field of land transportation, the Agency saw the construction of the information and knowledge management model (MGIC) as a great gain. According to the entity, projects of this nature do not generate gains only by their results. According to the statement made by the Agency's executive manager at the time the project was developed:

"Equally or more important than the model being built is the opportunity to better understand the Agency from the multiple perspectives of the MGIC. This understanding will occur by participating in the day to day of the project, assimilating knowledge related not only to the steps of the work methodology, but also deepening the knowledge about the Institution's business" (REVISTA ANTT, 2012).

Section 1.2, on the IA foundation in the literature, made it clear that the IA theme is still a relevant subject in the academic environment; however, it was not observed in the researched literature a formalized method to identify these assets. This gives this work the characteristic of originality by presenting a structured method to identify an organization's Information Assets.

Sections 3 and 4, showed that the development of the models followed a methodology specific to the MGIC project and all products generated were duly validated by the relevant managers, especially the identified Information Assets, which are the object of study of this current work. This indicates the robustness and density of the methods and methodology used.

Sections 5 and 6 revealed that the positioning of Information Assets in the operation cycle enables deeper critical analysis that could serve as input for the identification of regulatory demands, that is, the operation cycle proved to be a powerful tool for identifying knowledge gaps and breaks in the organizational learning cycle through the finding of the absence of Information Assets that satisfy each of the phases of the organization's operation cycle.

Although the Information Asset identification strategy has proven to be efficient to identify the strategic information of the organization, it has a high cost because it involves five areas of knowledge with highly trained researchers, and also requires many hours of interaction with the organization due to the fact that most of the work is done per organizational unit. In this respect, the challenge for future work is to think about a leaner identification journey, considering agile methods and innovative methodologies for information gathering and interactions with and between people, and for validating the information life cycle.

The ideas of metamodeling and operation or learning cycles are already used in other contexts. Nevertheless, their application in the context of the identification of Information Assets is innovative and we intend to explore their application in other organizations, confirming their generality and usefulness.

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