

ARTICLE

Reference modeling of the central elements of
Thomas H. Davenport's "Information Ecology"Amanda Franzão Rodrigues da Silva¹  <https://orcid.org/0000-0003-1017-7398>Leonardo Guimarães Garcia²  <https://orcid.org/0000-0002-9195-0567>¹Federal University of Triângulo Mineiro, Uberaba, MG, Brazil / e-mail: amandafragues@gmail.com²University of São Paulo, Ribeirão Preto, SP, Brazil / e-mail: leonardogarcia@usp.br

ABSTRACT

Introduction: Due to the considerable increase of volume and importance of information for companies, an efficient management of their informational environments has become a necessity. To do so, a correct understanding of the nature and dynamics of these environments is essential. Thomas H. Davenport's model of Information Ecology was created to play this role, though neither the author nor the later literature have gone deep enough into the practical aspects of its implementation. **Objective:** In order to overcome this gap, the present work proposes and applies a modeling approach that converts the elements of "Information Ecology" into reference elements aimed at the implantation in the organizational context. **Methodology:** In methodological terms, this is a bibliographic and exploratory research, carried out through the following steps: bibliographic survey, analysis of the collected material and development of the reference elements. **Results:** As indicated, the main result of the work is the reference elements: a) six reference processes; b) a management architecture of reference that allows to articulate and operationalize the reference processes. The inspiration for the creation of this structure comes from the Management Excellence Model (MEG), a managerial systemic reference model endowed with the most modern and recognized administrative contributions of the present time. **Conclusion:** By indicating a management architecture and management practices based on the Davenport model and appropriate to the informational environment of organizations, the reference elements can provide important contribution to organizational performance and success. Overthrow the small literature focused on implementation, Davenport's main contributions were represented to enable the understanding and implementation of the model by organizations that care about systemic thinking and valuing people

KEYWORDS

Informational environment. Information management. Information Ecology. Reference model.

Modelagem de referência dos elementos centrais da
"Ecologia da Informação" de Thomas H. Davenport

RESUMO

Introdução: Devido ao aumento considerável tanto do volume quanto da importância das informações para as organizações, a gestão eficiente dos ambientes informacionais organizacionais tornou-se uma necessidade. Para que essa eficiência seja alcançada, é essencial que haja uma correta compreensão da natureza e da dinâmica desses ambientes. O modelo da Ecologia da Informação de Thomas H. Davenport foi criado com esse fim, embora nem o livro original nem a literatura que o sucedeu tenham se aprofundado suficientemente nos aspectos práticos da sua implantação. **Objetivo:** Para superar essa lacuna, o presente trabalho propõe e aplica uma abordagem de

modelagem que converte os elementos da “Ecologia da Informação” em elementos de referência direcionados à implantação no contexto organizacional. **Metodologia:** Em termos metodológicos, trata-se de uma pesquisa bibliográfica de cunho exploratório, realizada por meio das seguintes etapas: levantamento bibliográfico, análise do material coletado e desenvolvimento dos elementos de referência. **Resultados:** Como indicado, o resultado principal do trabalho são os elementos de referência: um conjunto de seis processos referenciais e uma arquitetura de referência para a gestão de ambientes informacionais. A inspiração para a criação dessa estrutura vem do Modelo de Excelência da Gestão (MEG), um modelo de referência gerencial e sistêmico, dotado dos aportes administrativos mais modernos e reconhecidos da atualidade. **Conclusão:** Ao indicarem uma arquitetura gerencial e práticas de gestão baseadas no modelo de Davenport, os elementos de referência poderão fornecer importante contribuição ao desempenho e ao sucesso organizacional. Superando a exígua literatura voltada para a implantação, as principais contribuições de Davenport foram representadas para viabilizar a compreensão e implantação do modelo por organizações que preconizam o pensamento sistêmico e a valorização de pessoas.

PALAVRAS-CHAVE

Ambiente informacional. Gestão da informação. Ecologia da informação. Modelo de referência.



JITA: IJ. Reference work.

1 INTRODUCTION

In the last decades, the importance of information for organizations has increased. Globalization, regulatory changes, competition, among others, have made organizational environments increasingly uncertain. Since the reduction of uncertainty depends on the adequate use of information, its importance is great and growing.

Added to this context is the rapid development of Information and Communication Technologies (ICTs) and their large-scale use, which vigorously increases the volume of information circulating in organizations. To deal with this reality, more and more organizations have taken on the challenge of managing their information environments.

For the management of these environments to be effective, it is necessary to understand their nature and dynamics. The literature brings several contributions in this direction, and one of the most influential was proposed by Thomas H. Davenport (1998) in his book "Information Ecology: why technology alone is not enough for success in the information age".

However, despite being widely cited as a reference for understanding informational environments, Davenport's model does not provide clear instructions on its implementation. The literature also does not satisfactorily cover this aspect, and there is little production on this topic.

Thus, this paper aims to contribute to the implementation of Davenport's model by proposing reference elements that represent the essence of the model, but that, due to the way they were constituted and described, can be more easily inserted in the organizational context. These elements are: a) a set of six reference processes (one for each dimension of the model); b) a reference architecture for the management of information environments.

To create these reference elements, we were inspired by the Management Excellence Model (MEG). Created under the coordination of the National Quality Foundation (FNQ), based on the most modern and recognized administrative models, the MEG itself is a reference model originated with the intention of being imitated by organizations of all sizes and types for the generation of their own management systems. By developing the reference elements according to the MEG, we aim to add to them the property of being referential, facilitating their use and making them applicable to any context.

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2 INFORMATIONAL ENVIRONMENTS AND DAVENPORT'S MODEL

To understand the informational environment in the context of Information Ecology, it is essential to present definitions and models found in the literature that seek to explain the functioning of informational environments in different contexts. Additionally, the term "Information Ecology" also requires the rescue of existing definitions so that Davenport's model can be understood in its entirety.

2.1 What are informational environments?

In the literature, the expression "informational environment" is used in several ways. Gomes (2000) defines it as the environment inherent to the learning context of individuals, being an integral part of the signification process that leads to the construction of knowledge. For Macedo (2005), informational environment is a component of information architecture, a space that integrates context, content, and user. Gerolimos and Konsta (2008) follow the same

direction, by stating that the informational environment is the environment in which information circulates, and that it is constantly changing due to technological advances.

Many studies in the area are focused on understanding the informational environment in the digital context. For Camargo (2010), these informational environments are similar to traditional ones, but with digital developments (websites, information systems, etc.). There is, therefore, a hybridism between the physical/analog and digital dimensions of information, which results in increased complexity (BRANDT; VECHIATO; VIDOTTI, 2018). In this context, we highlight works such as those by Camboim, Targino and Sousa (2016) and Poncio and Vidotti (2016), who discuss pervasive information architecture and the use of the concept of "information findability" as ways to extend interoperability between the traditional and digital dimensions of information environments.

For organizations, Loureiro and Albagli (2008, p. 6) argue that:

The characterization of an information environment involves identifying the main actors, their attributions and relationships, as well as other elements that define the conditions of access, needs, and uses of information. This informational environment, eventually, may also include other players that, although not directly involved in the application of the rules, collaborate to the generation of knowledge in this process and act as external sources of knowledge generation for the companies.

In work also related to the organizational context, Nadler et al. (1993) argue that the informational environment is an environment in which messages circulate according to the beliefs and commitments of their holders, expressing accumulative experiences and generating solutions to the organization's problems.

Similarly, to the definition of the term, the literature brings different models of informational environments, some of them focused on the organizational context, such as those in Table 1.

Table 1. Models of informational environment with focus on organizations

AUTHORS	BRIEF DESCRIPTION
Taylor (1991)	It defines the information use environment as the set of those components that: a) affect the flow and use of information within and outside any definable entity; b) determine the criteria for judging the value of information. It emphasizes the importance of the context in which the organization operates and describes how such context affects the way people live and work, and how they seek and use information.
Katzer e Fletcher (1992)	They formulate a model based on the characteristics of Taylor's model. This model would comprise people (i.e., managers), their organizational choices, their typical problems, and their acceptable ranges of resolution. The main notion of the model is that managers, while observing their informational environments, confront problem situations.
Rosenbaum (1993)	One of the best known approaches, introduces structuration theory to clarify the interaction between Taylor's information use environment and information behaviors. It posits that the information use environment is structural in nature and comprises rules, resources, problems, and problem solving.

Source: Adapted from Moresi (2011)

As shown in Table 1, the models of informational environments aimed at the organizational environment encompass not only issues of information use and flow, but also issues related to the behavior of individuals in relation to information.

2.2 Information Ecology and Thomas Davenport's model

The term "Information Ecology", which characterizes Davenport's model, was not created by the author as many believe. It was already used in the late 1950s by economist Charles Lindblom, who sought to explain how public administrators made most decisions without much thought (DAVENPORT, 1998, p. 21). However, for Maia and Viana (2018), Davenport was the author who best transported to organizations the "ecological" way in which ecosystems effectively function.

For Saracevic (1996), informational ecology represents the coming together of producers, institutions, funders, publishers, and communication channels from the perspective of a social-ecological system. The author explains that information ecology, despite having technology as the key to its evolution, "is a social ecology, where the social, including economic, political, cultural, and educational factors, play a predominant role" (SARACEVIC, 1996, p. 58).

Lazarte (2000, p. 48) points out that:

In the context of identifying contributions to the construction of the "information ecology", the so-called holistic movement stands out, probably the most undifferentiated, but which, on the other hand, characterizes an alternative vision to that of fragmentation.

More recently, Siqueira (2016, p. 43) clarifies that information ecology "is how individuals create, distribute, and use information," and Silva and Vitorino (2016, p. 246) emphasize that:

The ecological or holistic approach to information has been countering the view that remains in organizational spaces and behaviors, in which the advancement of technology has privileged the aspects of technological mastery to the detriment of the main goals of information, which are to inform, transfer knowledge, and build history.

Davenport considers information ecology as "holistic information management" or "human-centered information management" (DAVENPORT, 1998, p. 21). In this sense, the author defines informational environment as a context that brings together strategy, team, policy, culture/behavior, process, and information architecture. These dimensions of the environment are presented in Table 2.

Table 2. Dimensions of Davenport's model

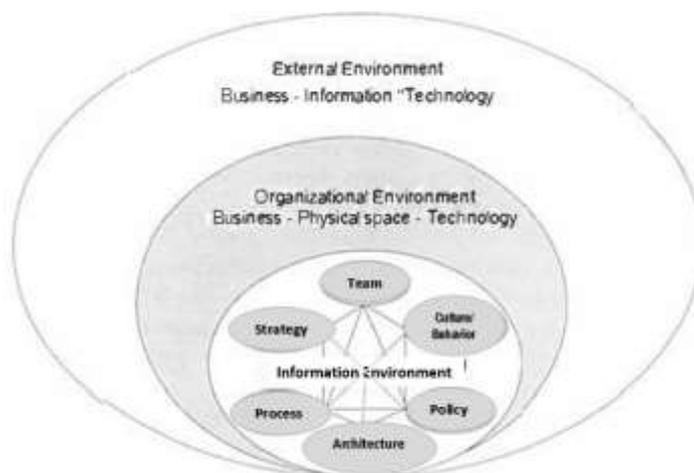
DIMENSIONS	BRIEF EXPLANATION OF THE DIMENSION
Information Strategy	Focused on promoting the strategic use of information, this dimension of the model corresponds to the organization's "informational intent," its course of action for success in the information realm, given that organizations have information from numerous sources and need to apply it intelligently. It reveals how information should help the organization realize its strategic objectives, and promotes increased awareness of the relevance of information.
Information Policy	It corresponds to a set of guidelines for informational programs, decisions, or actions. They are principles for informational conduct, disciplining the way in which the power

	provided by information is (or is not) shared. This control, more or less centralized, of information flows already occurs in all organizations, so that the challenge of information policy is to make this reality explicit and indoctrinate it.
Culture and information behavior	Essential to success, these are perhaps the strongholds of greatest resistance to change. However, as "changing the way people use information [...] is the crux of information ecology" (DAVENPORT, 1998, p. 109), actions on informational culture and behavior become essential.
Specialized information team	Adding value to information requires a specialized team. This team has the role of giving meaning and context to information and offering it in the best way for the organization, qualifying its decisions and processes. Davenport suggests that the team should have technical professionals (programmers, systems analysts, etc.) and non-technical professionals (management and business analysts, etc.).
Information Management Processes	Dimension that indicates how to manage information in an interfunctional and systemic manner, from the perspective of management by processes. It involves determining the demands/needs for information, obtaining and processing them, distributing/circulating them, and using them, which is the essential purpose of the process and, indeed, of the entire model.
Information Architecture	For Davenport, information architecture represents the IT structure responsible for supporting the informational processes of the organization. This dimension is essential, but it is not the most important one in the scope of the model (something different from what we see in the day-to-day of most organizations, which still tend to overvalue technology to the detriment of people).

Source: Adapted from Davenport (1998)

Davenport points out that the information environment is a component of the organizational environment, the latter having the power to direct the former according to its specificities, just as the former is able to stimulate or restrict the organization in its development (figure 1).

Figure 1. The informational, organizational, and external environments, according to Davenport



Source: Davenport (1998, p. 51)

Figure 1 shows that, in addition to being influenced by the external environment and the organizational environment, the six elements that constitute the informational environment assume interdependent relationships for the functioning of the dynamics of the informational environment.

3 THE MANAGEMENT EXCELLENCE MODEL (MEG)

Davenport's model was not described with an emphasis on implementation. To address this problem, we adopted the strategy of using a management reference model (the MEG) as inspiration for the creation of reference elements based on Davenport's model. To facilitate understanding of the results of this process, we describe in this section the essential features of the MEG.

3.1 The National Quality Foundation (FNQ) and the MEG

The FNQ was created in 1999 to support the pursuit of organizational excellence. A private non-profit organization, the FNQ is the Brazilian representative in a global movement for management improvement that brings together more than 100 countries (National Quality Foundation, 2016, 2017).

One of the Foundation's responsibilities is to disseminate the MEG, a management reference model that "reflects the experience, knowledge and research work of several organizations, public and private, universities and experts from Brazil and abroad [...]" (FUNDAÇÃO NACIONAL DA QUALIDADE, 2017, p. 11).

According to Pagliuso, Cardoso, and Spiegel (2010, p. 47), reference models are "standardized and generic models that play a reference role for decision makers regarding practices to be employed in organizational operations and processes." Smarçaro (2009) reminds us that these models have existed for decades and have wide acceptance, as is the case of the ISO 9000 series. They may have different purposes, but they all have the same function: to serve as a reference for the construction of some organizational solution.

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3.2 The MEG structure: from the fundamentals to the management cycle

The MEG is based on eight fundamentals of excellence (chart 3), considered to be responsible for the success of organizations around the world. Therefore, taking ownership of the MEG corresponds to interjecting these fundamentals into the organization's day-to-day operations.

Table 3. Fundamentals of excellence of the Management Excellence Model (MEG)

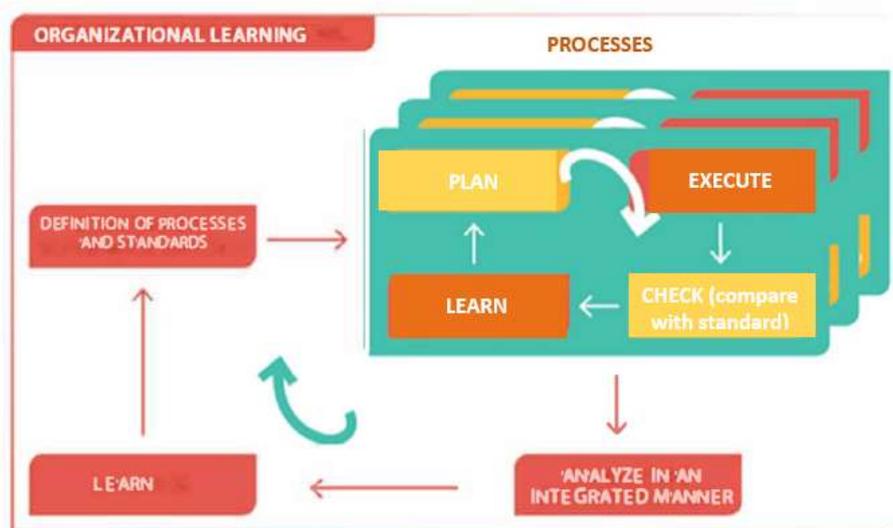
FOUNDATION	DEFINITION
Systemic Thinking	Understanding and dealing with the interdependency relationships and their effects among the various components that make up the organization, as well as between these and the environment with which they interact.
Organizational learning and innovation	Search and achievement of new levels of competence for the organization and its workforce, through perception, reflection, evaluation, and sharing of knowledge, promoting a favorable environment for creativity, experimentation, and implementation of new ideas capable of generating sustainable gains for the stakeholders.
Adaptability	Flexibility and ability to change in a timely manner in the face of new stakeholder demands and changes in context.
transforming leadership	Leaders act in an ethical, inspiring, exemplary way, committed to excellence, understanding the likely scenarios and trends of the environment and the possible effects on the organization and its stakeholders, in the short and long term; mobilizing people around the organization's values, principles, and objectives;

	exploring the potential of the cultures present; preparing leaders and people, and interacting with stakeholders.
Sustainable Development	Commitment of the organization to account for the impacts of its decisions and activities, on society and the environment, and to contribute to the improvement of living conditions, both now and for future generations, through ethical and transparent behavior.
Commitment to stakeholders	Establishing pacts with stakeholders and their interrelationships with strategies and processes in a short- and long-term perspective.
Process orientation	Recognition that the organization is a set of processes that need to be understood from end to end and considered in the definition of the organizational, work and management structures. The processes must be managed aiming at the search for efficiency and effectiveness of activities in order to add value to the organization and stakeholders.
Value Generation	Achievement of economic, social, and environmental results, as well as the results of the processes that enhance them, at levels of excellence that meet the needs and expectations of stakeholders.

Source: National Quality Foundation (2016, p. 14)

Since the fundamentals represent principles, their direct application by organizations would be difficult. As such, the MEG proposes a set of management processes, designed to be a tangible expression of the fundamentals. Organizations using this model should therefore (re)define their management practices (*i.e.*, the way management is carried out in practice) based on the MEG's referential processes. Moreover, their execution should occur through the management cycle (figure 2), so as to ensure that the practices are used and improved systematically, generating continuous improvement.

Figure 2. Management cycle diagram



Source: National Quality Foundation (2017, p. 15)

3.3 Organizational results and the MEG

Results represent the desired effects of organizational activities. Measuring them allows us to understand whether the organization is actually fulfilling its objectives and how

this is occurring. Linked to the foundation "Value Generation", organizational results occupy a prominent position in MEG and are divided into two types (NATIONAL QUALITY FONDATION, 2016):

- a) **Operational results:** quantitative and/or qualitative measurements of the degree of fulfillment of the organization's operational objectives (i.e., objectives linked to the performance of daily tasks, the operation of production processes, etc.).
- b) **Strategic results:** quantitative and/or qualitative measurements of the degree of fulfillment of the organization's strategic objectives (i.e., its global objectives, linked to the achievement of its strategy, mission and vision).

In the MEG framework, organizational results need to be expressed in the form of performance indicators¹ and fit into one of the model's seven groups of results: economic-financial, environmental, social, customer-related, workforce-related, supplier-related, and product and process-related.

4 METHODOLOGY

The exploratory research is used for little explored subjects and for the understanding of concepts and ideas (ANDRADE, 2017; GIL, 2019), in this way, regarding the objective, the work has exploratory nature, since it represents the first attempt in the sense of identifying and developing the elements of reference to the implementation of Davenport's model. As to the approach, there is bibliographic research, since the reference elements were developed from the literature analysis (MARCONI; LAKATOS, 2006).

As for the procedure, the research contemplated three main phases, the first being the analysis of Davenport's book. This activity was complemented by the search, acquisition and analysis of literature directly related to the author's model and, more broadly, to the ecological approach of informational environments. For this survey, we used the CAPES journals portal and Google Scholar. The journals in the area of Information Science classified as Qualis A1 or A2 were listed and searched individually, in order to reduce the loss of articles due to failures of the search engines of the databases.

Next, the official documentation of the MEG was obtained and analyzed, allowing its use as inspiration for the creation of the reference elements as the last phase of the procedure.

5 ANALYSIS AND DISCUSSION OF THE RESULTS

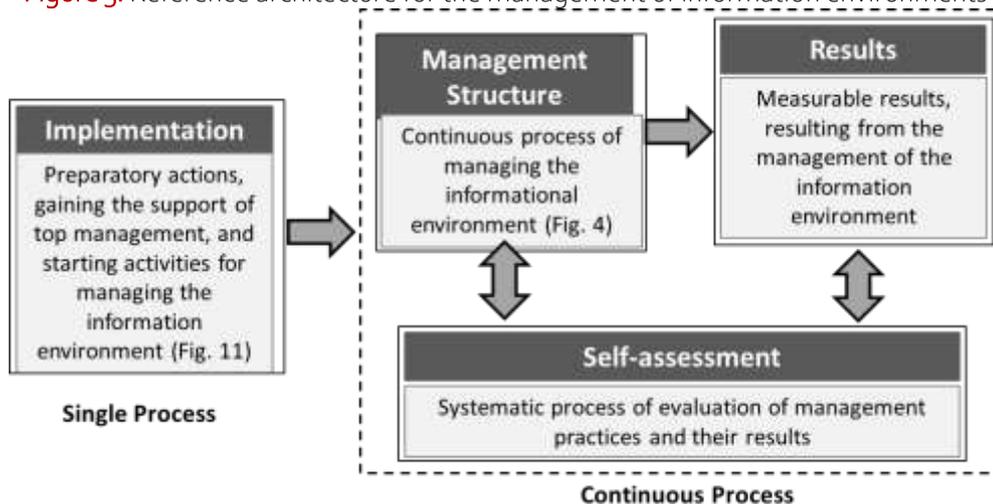
This section presents the results of the work: a set of reference elements for the management of informational environments, extracted from Davenport's model with the help of MEG. Its description is divided into two parts: in the first, the reference architecture for the management of informational environments is presented; in the second, the referential processes extracted from the six dimensions of Davenport's model.

¹According to the National Quality Foundation (2014, p. 4), an indicator is "quantitative or qualitative information that expresses the performance of a process, in terms of efficiency, effectiveness or level of satisfaction and that, in general, allows to track its evolution over time and compare it with other organizations."

5.1 Reference architecture for the management of information environments

The proposed reference architecture is represented by figure 3. Its logic was inspired by MEG and is based on the management structure-results-self-evaluation tripod: the management structure corresponds to the continuous management process of the information environment; the results come from the functioning of the management practices; and the self-assessment evaluates the whole, aiming at its improvement.

Figure 3. Reference architecture for the management of information environments



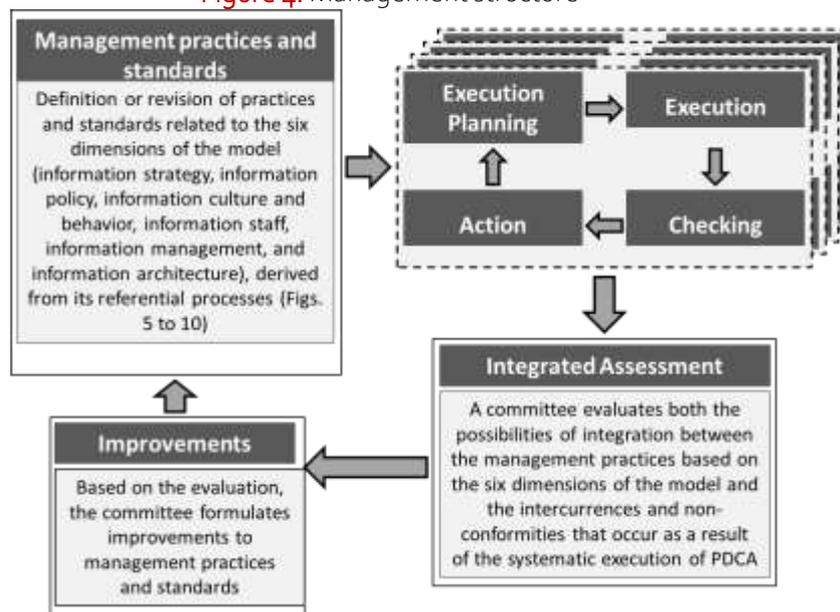
Source: Prepared by the authors.

The first component of the architecture (management structure - figure 4) fully corresponds to the MEG management cycle (figure 2) and, although figure 4 fully represents the management cycle, it is not identical to figure 2 (which also represents the cycle). The differences between them are not conceptual, they are merely explanatory. The use of the cycle as the basis of the architecture allows us to inherit all its advantages (i.e., effective definition of managerial practices and standards, their planned and systematic use, and their continuous and integrative improvement in relation to all the dimensions of the model), also demanded by Davenport's model, which is systemic by nature. In this way, the management cycle ensures such properties.

The second component of the architecture (results) is also inspired by the MEG. The classification of informational results into strategic and operational contributes both to the monitoring of information management practices and to the verification of the achievement of its objectives. Ideally, these results should be represented in the form of indicators, making up a continuous and uninterrupted performance measurement system.

It is important to remember that many organizations already manage their results in a systematic way, even using performance measurement systems. In these cases, the informational results and their indicators should be inserted into the existing structure. However, if the organization does not perform this activity, the informational team should make the top management aware of its importance and, if necessary, institute its own system (for which the MEG is a good reference).

Figure 4. Management structure



Source: Adapted from National Quality Foundation (2016)

Finally, the third component (self-assessment) can also follow the system adopted by MEG, since this is generic and applies to any organization, process or result. As with the results, many organizations already evaluate themselves systematically. Therefore, adhering to an existing program is usually the best way to go. But if there is no such activity, the information team can intervene and even create its own system. If this is the case, the following content - based on National Quality Foundation (2017) - may serve as guidance.

The self-assessment should cover both management practices, inspired by the six referential processes (figures 5 to 10), and informational results. Starting with the benchmark processes, a maximum score should initially be established for each of them. The MEG allocates 550 points for all processes, so if it is decided to adopt this score, it should be divided among the six benchmark processes. It should be emphasized that this division should not be, a priori, identical: each process will have a unique score, representative of the organization's view of its relative importance. This decision, to be made by top management, must consider the profile and particularities of the organization, its strategy, and its operating context.

After the distribution of the points, they will constitute the reference score for the process. This means that, when evaluating the set of management practices arising from a particular process, the maximum score that can be achieved will be the reference score.

The self-assessment will proceed by separately addressing each of the six sets of management practices, which can be evaluated through four factors of the MEG management process assessment: **Plan** (assesses the design of management practices), **Execute** (assesses the implementation of practices), **Check** (assesses the monitoring of efficiency and effectiveness of practices), and **Learn** (assesses whether practices are incorporating innovations and/or improvements). Through procedures detailed in National Quality Foundation (2017), this assessment returns how much of the benchmark score the set of practices has managed to achieve. The closer to the maximum value, the better the management practices concerning the referential process.

The assessment of informational outcomes follows a similar logic. One should establish the groupings of results - both strategic and operational - that are most relevant to the organization, and then assign a score to each group. If one adopts the same 450 points assigned

by MEG to the results, they should be distributed among the clusters according to the organization's view on the relative importance of each of them.

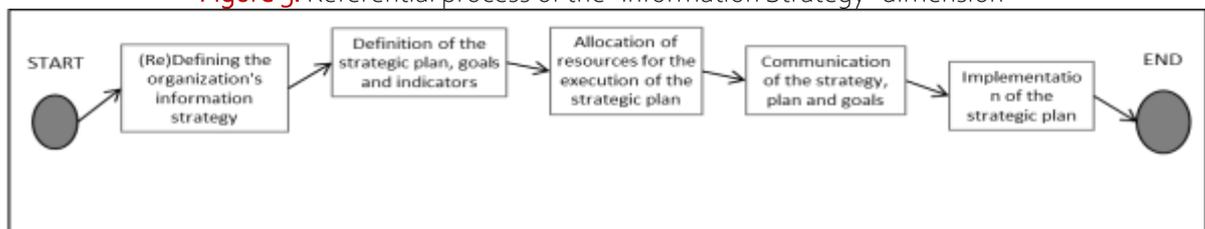
Working each group separately, the self-assessment can use the four MEG factors focused on organizational results: **Relevance** (assesses whether the set of results - strategic and operational - of each group of results is represented by necessary and sufficient indicators), **Improvement** (assesses whether there is improvement or stabilization of results at an acceptable level), **Competitiveness** (assesses whether the results present values equal to or higher than external comparative benchmarks), and **Commitment** (assesses whether the results present values equal to or higher than the commitments made to stakeholders - customers, employees, shareholders, etc.) (NATIONAL QUALITY FOUNDATION, 2017). Similarly, to the management processes, the closer to 450 points the organization is, the better.

5.2 Referential processes extracted from the six dimensions of Davenport's model

After analyzing Davenport's work, each of the six dimensions of the model was represented schematically as a referential process ² (this even allows informational environments to be managed by processes, as advocated by Davenport himself). These processes are generic and non-prescriptive as to tools or techniques, so that organizations of any type or size may adapt them to their circumstances, generating their practices and management standards as shown in figure 4.

Figures 5, 6, 7, 8, 9, and 10 represent these processes, described by means of a flowchart containing phases, each with a textual explanation indicating the activities that comprise them, their order of execution, and the main related decision-making. The explanations also indicate the main partnerships between the team responsible for the process and other teams/sectors in the organization, as well as the main relationships among the six processes.

Figure 5. Referential process of the "Information Strategy" dimension



Source: Adapted from Davenport (1998)

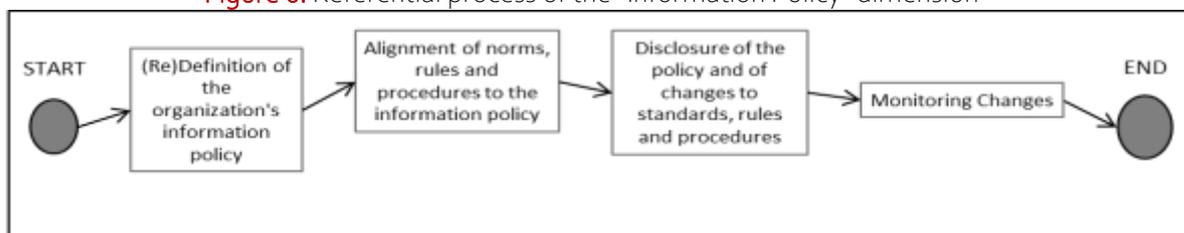
(Re)Defining the organization's information strategy: Davenport indicates four possible focuses for the information strategy (focus on a certain type of content, on information and knowledge sharing, on information processes, or on new information markets). But these indications should be considered within a strategic formulation process whose priority is the creation (or improvement) of an information strategy that supports the existing organizational strategy. In addition to Davenport's indications, the profile of the organization and the characteristics/demands of its environment should be considered in this process, as well as the role of technology in the informational environment of the organization. This set of information, obtained through diagnostic actions, should be analyzed using appropriate techniques (such as SWOT, for example), generating alternative informational strategies. These alternatives should be presented to the top management, who will choose one of them.

² Each process includes the main activities indicated by Davenport in his book, as well as others introduced with the intention of filling gaps and making practical realization possible.

Definition of the strategic plan, goals and indicators: For a strategy to be properly implemented, it is necessary to create an action plan that clearly establishes the actions to be performed, who will do them, how, when and where they will be done, and the necessary resources for their realization. This strategic plan must be accompanied by the definition of goals to be achieved and indicators for monitoring the process. We suggest the structuring of a planning process that, in possession of the selected information strategy, generates the action plan, the targets, and the indicators for the effective implementation of the proposed strategy. Resource allocation for strategic plan execution: One of the most common failures in strategic formulation processes is their disconnection from the organization's budget process. We suggest creating awareness actions directed to those responsible for the annual budget, communicating resource needs for strategic plan execution, and clarifying the importance of the informational strategy for the entire organization.

Communication of the strategy, the plan and the goals: For the strategy to be realized, it must be presented to the whole organization. The same goes for the plan and its goals: if they are not properly communicated, the chance of success diminishes considerably. We suggest a communication activity that identifies the target audiences (i.e., which stakeholders should receive the content about the strategy), the means of disclosure for each audience (meetings, bulletin board, social networks, minutes, handouts, etc.), the appropriate message, and the frequency of disclosure. Implementation of the strategic plan: This corresponds to the effective implementation of the planning carried out in the second stage. The challenge is to create a process for monitoring and supporting the execution of the plan, which can make use of any techniques and managerial control and monitoring tools already used by the organization or considered appropriate by the information team.

Figure 6. Referential process of the "Information Policy" dimension



Source: Adapted from Davenport (1998)

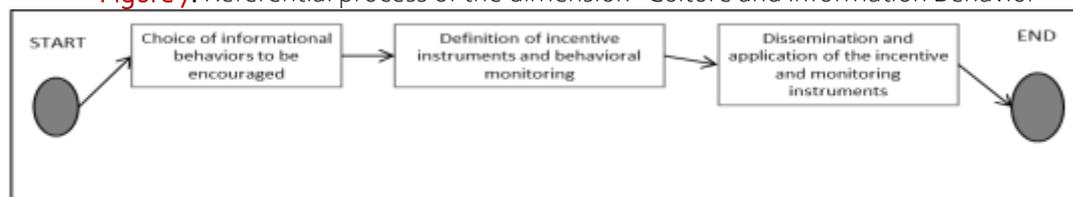
(Re)Definition of the organization's information policy: As we have seen, Davenport describes four referential models for information policy (Federalism, Feudalism, Monarchy and Anarchy). These models, despite not covering all possibilities (DAVENPORT, 1998, p. 102), are important references to be considered during the (re)definition of the information policy, which according to the author should indicate the adequate level of information centralization (and, consequently, of the power provided by it). We suggest the performance of diagnostic actions for the mapping of the main sources and informational flows (as well as their controllers), and the analysis of the advantages and disadvantages of the diagnosed situation in relation to the informational strategy and the level of centralization arising from the strategy itself and also from the profile, size and diversification of the organizational performance. The presentation of these results - which include recommendations for change and a set of guidelines for the organization's informational programs, decisions and actions (i.e., the content of the policy) - should be presented to top management, who will redefine the map of informational power and establish which changes should be made and which guidelines should be assimilated by the organization.

Alignment of norms, rules and procedures to the information policy: This step consists of the creation and/or revision of the organization's permanent plans - norms, rules, procedures, etc. - whose indications influence the flow, management or behavior of information. To do so, a survey (or project) of the organization's permanent plans related to the control, flow and use of information (including their connection with the appropriate interested parties) is necessary, as well as the actions for their creation/revision aiming at their adequacy to the information policy. With the consent of the top management, the creation/revision actions must be carried out in partnership with the other sectors of the organization, respecting the authority and the needs of the different stakeholders related to the plans. The process ends with the validation of the new/revised plans by top management.

Dissemination of the policy and of changes in standards, rules and procedures: In order to be effectively implemented, both the informational policy and changes to the standing plans need to be communicated to the stakeholders. The policy should be disseminated to everyone, widely and indiscriminately, using various means. Changes to the permanent plans can be communicated through a process that identifies, for each plan created/changed, the affected stakeholders (target audiences for communication), the means for the disclosure of what was created/changed (e.g., meetings, bulletin board, social networks, minutes, handouts, etc.), the content to be communicated and the frequency of disclosure (whether daily, weekly, monthly, etc.) depending on the content, means and audience.

Monitoring the changes: The organization's processes and actions must be adjusted to the new policy and the new permanent plans. To increase the effectiveness of these adjustments, a change follow-up process should be instituted. The top management should set a deadline for each department to indicate which processes and actions they will modify, under what conditions and with what timeline. This information will be passed to the information team that will analyze it and, in partnership with the departments, establish intermediate goals and indicators for the progress of the changes. These indicators and targets will be monitored by the information team, which will report regularly to top management on the departments' progress and setbacks.

Figure 7. Referential process of the dimension "Culture and Information Behavior"



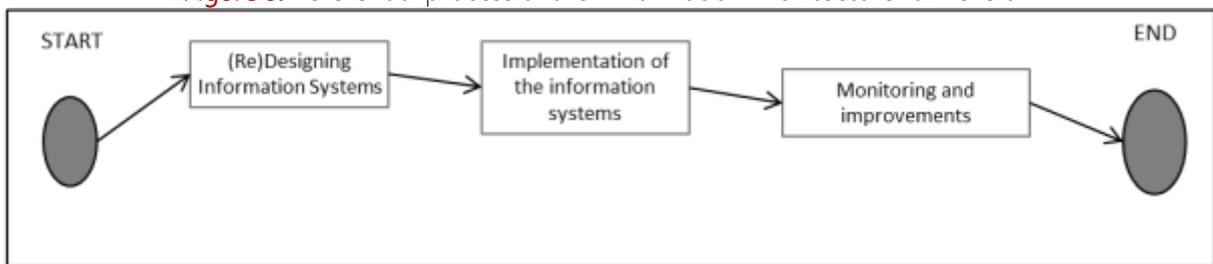
Source: Adapted from (1998)

Choice of information behaviors to be encouraged: These behaviors include those related to the proper functioning of the information policy and those listed by Davenport (sharing, managing information overload, and reducing multiple meanings). Thus, the choice should be based on a preliminary list, consisting of the behaviors listed by Davenport and others drawn from the information policy through an analytical process. To facilitate the choice, a compatibility analysis should be performed between the behaviors on the list and the dominant features of the organization's information culture, in order to establish the extent of the challenge of implementing the desired behaviors. In addition, the list should be checked against the informational strategy to establish priorities and possible conflicts. Finally, the conclusions of these analyses and the list itself should be presented to the top management, who will make the choice.

Definition of incentive instruments and monitoring of behaviors: From the list of behaviors elected by top management, the information team can rescue the analyses of the previous phase and design, with the support of Human Resources professionals, the incentives to adopt the behaviors (benefits, recognition, etc.). Mechanisms to monitor behavioral changes should also be created. These ideas should be validated by top management before implementation.

Dissemination and application of the incentive and monitoring tools: The information team, in partnership with Human Resources professionals, should develop initiatives for dissemination and clarification of the behaviors, as well as design and implement a process for monitoring behavioral changes, based on the mechanisms defined in the previous phase. Special attention should be given to support and feedback activities, essential when dealing with behaviors. These actions and their results should be reported regularly to top management.

Figure 8. Referential process of the "Information Architecture" dimension



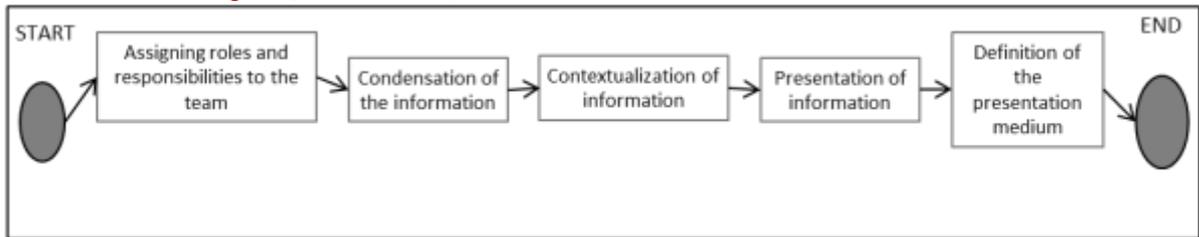
Source: Adapted from Davenport (1998)

(Re) Information Systems Design: For Davenport, architecture corresponds to the IT layer of the information environment. For the author, the traditional approach to designing these systems is inadequate, reductionist, and excessively ambitious in terms of scope. He advocates a lean architecture, focused on a particular class of information or part of the organization. Its design process should consider the information strategy and follow the guidelines of the information policy, since the latter conditions the use of information. In addition, the architecture must be designed to subsidize the information management process, providing tools and solutions that are consistent with the informational behaviors desired by the organization. This project should be built by the organization's information team (with or without the participation of external consultants), and later validated by the top management.

Deployment of the information systems: Once in possession of the systems design/reproject, the IT team must apply the approach and techniques pertinent to the execution of the determined activities. The implementation must be based on the description of the actions, responsible people, deadlines, and necessary resources. Techniques such as 5W2H can help this description.

Follow-up and improvements: A follow-up process must be instituted, focusing on the establishment, based on the implementation plan, of intermediate goals and indicators for evaluating the progress of the implementation. After being established, the indicators and targets should be communicated to those responsible and managed, allowing the identification of mishaps and their rapid resolution.

Figure 9. Referential process of the "Information Team" dimension



Source: Adapted from Davenport (1998)

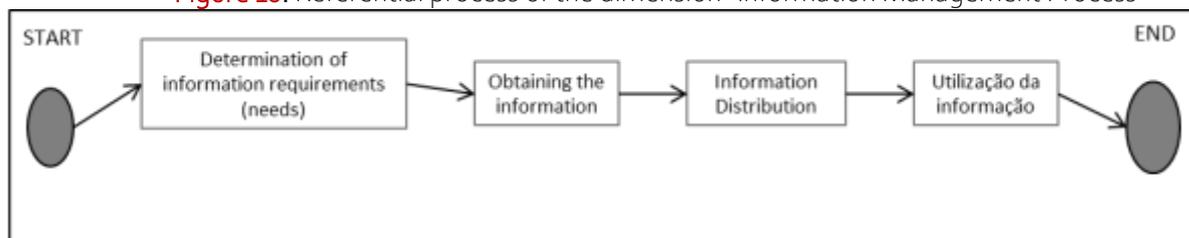
Assigning roles and responsibilities to the team: Davenport indicates the need for an information technical team, formed by IT professionals and the other information professionals, aimed at performing collection and analysis work not satisfied by information systems. The objective of this phase is to evaluate if all the necessary positions have been created and if the number of employees to fill them is compatible with the workload established by the processes of this and the other dimensions of Information Ecology. If there is a need to expand the team, this demand must be presented to the top management, who will decide on its attendance.

Condensation of information: Condensation represents an editing activity: "[...] information managers must relentlessly cut the obsolete, the irrelevant, the imprecise from the main media and sources. (DAVENPORT, 1998, p. 157). This is an important attribution of the information team, since it decisively influences several characteristics that, according to Davenport (1998, p. 151), determine the value of information (these are: accuracy, opportunity, accessibility, involvement, applicability and scarcity). Thus, the information team should map the priority informational content of the organization and provide support for its development or revision. This decision will depend on the circumstances and on the convenience of the producers and clients of the information produced.

Contextualization of information: For Davenport (1998, p. 158), "contextualizing information is the most powerful way to increase both the public's interest and propensity to interact with information in a certain way". Like condensation, contextualization influences the characteristics that determine the value of information. In this sense, the contextualization activity is in addition to the condensation activity, and may occur in sequence or at the same time. **Presentation of information:** The presentation represents the style of language and its resources (vocabulary, figures of speech, etc.). Like condensation and contextualization, presentation is crucial to the value of the information, encouraging its involvement with the client. The presentation activity can also be carried out sequentially or simultaneously with the two previous ones.

Definition of the medium of presentation: Medium and message are intrinsically associated, so that the selection of the means of presentation of information should be associated with the previous activities, indicating the most appropriate communication channels for each of the organization's priority contents, considering its strengths and weaknesses and the different contexts of information use by clients.

Figure 10. Referential process of the dimension "Information Management Process"



Source: Adapted from Davenport (1998)

Determination of information requirements (needs): This is a particularly difficult phase because, according to Davenport, people are not aware of their real information needs, nor of the way in which they satisfy them. Thus, the author advocates a process of identifying needs that is less analytical and more descriptive, resulting from the observation of individuals' informational behaviors, their preferences, and what really works for them (including unstructured, informal, and non-computerized information).

Information Retrieval: Davenport indicates that information needs are satisfied not by a few, but by several sources of information, and that their information needs to be extracted and processed before it becomes useful. Thus, information retrieval should contemplate the identification of sources via information mapping (Davenport, 1998, p. 216-217), the collection of information, its classification according to the needs previously raised, its formatting and structuring, to facilitate retrieval and effective use.

Information distribution: Here, the focus is to connect people to the information they need. Davenport indicates that information distribution must combine dissemination actions (individuals automatically receive the information produced by the information team and/or by the information systems) with search actions (individuals are trained and encouraged to search for their information by themselves).

Information use: Davenport describes this phase as being highly complex, dependent not only on the intricacies of the human mind, but also on the informational context and organizational challenges, both of which are continuously changing. To address this challenge, the author suggests that information utilization should incorporate actions to assess the use of information sources (with measurement of indicators of access to bases and repositories and other measures of information circulation), to encourage use (including awards and praise), to incorporate use in employee performance evaluations, and to create an institutional context conducive to use.

5.3 Implementing the model using the reference elements

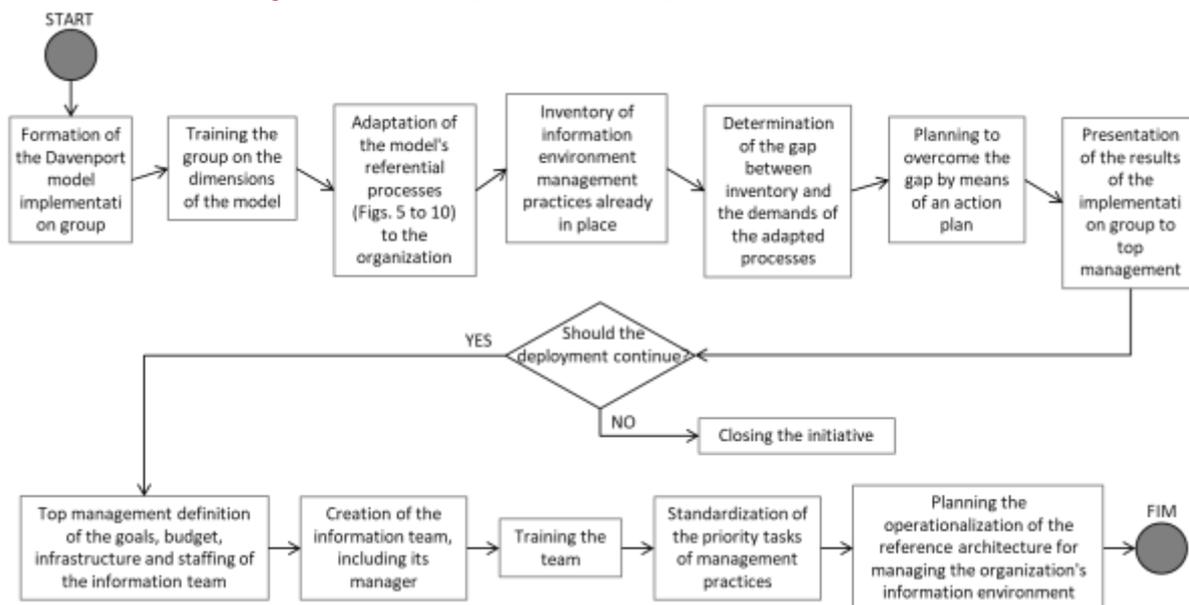
As indicated in figure 3, we need a process to implement the reference elements (figure 11) and an implementation group that should initially conduct an inventory of information management practices already existing in the organization (e.g., ICT management, information and knowledge management initiatives, etc.). The referential processes themselves (figures 5 to 10) should be used to create the inventory, so that every management practice in execution in the organization that meets some aspect of the referential processes should be listed.

On another front, this group should propose, based on the referential processes, the ideal management practices for the reality of their organization. Finally, it should indicate the gaps between the idealized practices and those mapped out via the inventory, as well as plan how to eliminate the priority gaps through an interdepartmental action plan.

The group's results must be presented to top management, who will decide whether the action plan will be implemented. After this, a permanent team should be formed, which

should be trained and already plan the operationalization of the reference architecture (figure 3).

Figure 11. Deploying the model using the reference elements



Source: Prepared by the authors (2020)

As from the elements presented, it is inferred that, for the satisfactory implementation of Davenport's model through reference elements, the receptiveness of the initiative by top management and teamwork become indispensable for the functioning of all stages. It is also emphasized that the implementation takes time and therefore requires dedication and the ability to adapt to the possible challenges that the organization may encounter during the process.

6 FINAL CONSIDERATIONS

This work presented a representation of the essential components of Thomas H. Davenport's Information Ecology model, with the major objective of facilitating its implementation and use by organizations. We were motivated by the perception of an important gap: that this model, despite being widely cited, has little literature related to its implementation (the author himself, in his book, did not clearly describe such actions).

In this sense, we proposed the following reference elements based on the model: a) a set of six referential processes; b) a reference architecture for the management of information environments. Given the objective of the work, these elements were planned to serve as implementation references. In other words, our intention was to re-present Davenport's main contributions in a comprehensible form, directed to implementation and appropriation by imitation. We believe we have given such characteristics to the benchmarks as a result of the application of the MEG guidelines, since the MEG itself is a reference model.

The reference elements may enable the implementation of Davenport's model when they are: 1) converted into management practices and standards appropriate to the context and profile of the organization; 2) managed in a systemic way and that values the human being. It is worth highlighting the fact that the MEG advocates both systemic thinking and valuing

people, a fact that makes it naturally convergent with Davenport's model and justifies its use as an inspiration for the creation of the referential elements.

Because it is generic and adaptable to any context, MEG has the ability to support the use of any theoretical model. However, if there is an intrinsic compatibility between them, this subsidy becomes more natural and effective. Thus, it is possible to infer that organizations that use the MEG will find it particularly easy to implement the reference elements presented in this article.

CRediT

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REFERENCES

ANDRADE, Maria Margarida de. **Introdução à metodologia do trabalho científico: trabalhos na graduação**. 10. ed. São Paulo: Atlas, 2017.

BRANDT, Mariana Baptista; VECHIATO, Fernando Luiz; VIDOTTI, Silvana Aparecida Borsetti Gregorio. Encontrabilidade da informação na câmara dos deputados. **Em Questão**, Porto Alegre, v. 24, n. 1, p. 41-64, 2018. Available at: <https://seer.ufrgs.br/EmQuestao/article/view/71734/0>. Access on: 21 dez. 2020.

CAMARGO, Liriane Soares de Araújo. **Metodologia de desenvolvimento de ambientes informacionais digitais a partir dos princípios da arquitetura da informação**. 2010. 289 f. Tese (Doutorado em Ciência da Informação) -- Faculdade de Filosofia e Ciências, Universidade Estadual Paulista, Marília, SP, 2010. Available at: <http://hdl.handle.net/11449/103357>. Access on: 21 dez. 2019.

CAMBOIM, Luzia Goés; TARGINO, Maria das Graças; SOUSA, Marckson Roberto Ferreira de. Gestão da informação em ambientes híbridos: condições de apoio da arquitetura da informação. **Informação & Sociedade: estudos**, João Pessoa, v. 26, n. 3, p. 21-30, 2016. Available at: <http://www.periodicos.ufpb.br/ojs/index.php/ies/article/view/29852>. Access on: 18 abr. 2020.

DAVENPORT, Thomas H. **Ecologia da Informação: por que só a tecnologia não basta para o sucesso na era da informação**. São Paulo: Futura, 1998.

FUNDAÇÃO NACIONAL DA QUALIDADE. **Modelo de excelência da gestão (MEG): guia de referência da gestão para excelência**. 21. ed. São Paulo: FNQ, 2016.

FUNDAÇÃO NACIONAL DA QUALIDADE. **Modelo de excelência da gestão (MEG):** instrumento de avaliação da maturidade da gestão. 21. ed. São Paulo: FNQ, 2017.

FUNDAÇÃO NACIONAL DA QUALIDADE. **Sistema de indicadores.** São Paulo: FNQ, 2014. *E-Book*. Available at: <https://fnq.org.br/comunidade/e-book-3-sistema-de-indicadores/>. Access on: 25 maio 2021.

GEROLIMOS, Michalis; KONSTA, Rania. Librarians' skills and qualifications in a modern informational environment. **Library Management**, Bradford, v. 29, n. 8/9, p. 691-69, 2008. Available at: <http://www.emeraldinsight.com/doi/pdfplus/10.1108/01435120810917305>. Access on: 15 set. 2019.

GIL, Antônio Carlos. **Métodos e técnicas de pesquisa social.** 7. ed. São Paulo: Atlas, 2019.

GOMES, Henriette Ferreira. O ambiente informacional e suas tecnologias na construção dos sentidos e significados. **Ciência da Informação**, Brasília, DF, v. 29, n. 1, p. 61-70, jan./abr. 2000. Available at: <http://www.scielo.br/pdf/ci/v29n1/v29n1a7.pdf>. Access on: 03 out. 2019.

LAZARTE, Leonardo. Ecologia cognitiva na sociedade da Informação. **Ciência da Informação**, Brasília, DF, v. 29, n. 2, p. 43-51, maio./ago., 2000. Available at: <https://brapci.inf.br/index.php/res/download/53374>. Access on: 19 dez. 2020.

LOUREIRO, Isabel Moniz Aragão; ALBAGLI, Sarita. O papel do ambiente informacional na geração do conhecimento e inovação. In: ENCONTRO NACIONAL DE PESQUISA EM CIÊNCIA DA INFORMAÇÃO, 9., 2008, São Paulo. **Anais [...]**. São Paulo: Universidade de São Paulo, 2008. Available at: <https://bit.ly/3fMqMdq>. Access on: 18 dez. 2019.

MACEDO, Flávia Lacerda Oliveira de. **Arquitetura da informação: aspectos epistemológicos, científicos e práticos.** 2005. 190 f. Dissertação (Mestrado em Ciência da Informação) -- Universidade de Brasília, Brasília, DF, 2005. Available at: <https://repositorio.unb.br/handle/10482/35858>. Access on: 10 dez. 2020.

MAIA, Marcos Felipe Gonçalves; VIANA, Rodney Haulien Oliveira. Coleções biológicas e bibliotecas universitárias: uma proposta para além do desenvolvimento sustentável. **Informação & Informação**, Londrina, PR, v. 23, n. 1, p. 58-76, 2018. Available at: <http://www.uel.br/revistas/uel/index.php/informacao/article/view/25862/23230>. Access on: 29 abr. 2020.

MARCONI, Marina de Andrade; LAKATOS, Eva Maria. **Técnicas de pesquisa: planejamento e execução de pesquisas, amostragens e técnicas de pesquisa, elaboração, análise e interpretação dos dados.** 6. ed. São Paulo: Atlas, 2006.

MORESI, Eduardo Amadeu Dutra. **Monitoração ambiental e complexidade.** 2001. 191 f. Tese (Doutorado em Ciência da informação) -- Universidade de Brasília, Brasília, DF, 2001. Available at: <https://repositorio.unb.br/handle/10482/4920>. Access on: 21 dez. 2020.

NADLER, David A. *et al.* **Arquitetura organizacional: a chave para a mudança empresarial.** 8. ed. Rio de Janeiro: Campus, 1993.

PAGLIUSO, Antônio Tadeu; CARDOSO, Rodolfo; SPIEGEL, Thais. **Gestão organizacional: o desafio da construção do modelo de gestão**. São Paulo: Saraiva, 2010.

PONCIO, Henry; VIDOTTI, Silvana Aparecida Borsetti Gregorio. Dos ambientes informacionais às ecologias informacionais complexas. **Informação & Sociedade: estudos**, Londrina, PR, v. 26, n. 1, p. 91-101, 2016. Available at: <http://www.periodicos.ufpb.br/ojs/index.php/ies/article/view/29438>. Access on: 18 abr. 2020.

SARACEVIC, Tefko. Ciência da informação: origem, evolução e relações. **Perspectivas em Ciência da Informação**, Belo Horizonte, v. 1, n. 1, p. 41-62, jan./jun. 1996. Available at: <http://ppggoc.eci.ufmg.br/downloads/bibliografia/Saracevic1996.pdf>. Access on: 31 out. 2019.

SILVA, Elizabeth Coelho Rosa e; VITORINO, Elizete Vieira. A gestão da informação sob a abordagem da Ecologia: possibilidades à competência em informação. **Em Questão**, Porto Alegre, v. 22, n. 1, p. 242-66, 2016. Available at: <http://seer.ufrgs.br/index.php/EmQuestao/article/viewFile/55547/37101>. Access on: 12 abr. 2020.

SIQUEIRA, Jéssica Câmara. **Glossário de neologismo da ciência da informação**. São Paulo: Agbook, 2016.

SMARÇARO, Joana. **A construção de um modelo de referência baseado em boas práticas para um setor de estocagem, preparação e movimentação de produtos petroquímicos**. 209. 202 f. Dissertação (Mestrado em Engenharia de Produção) -- Universidade Federal do Rio de Janeiro, Rio de Janeiro, 2009.



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