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FORESIGHT CAPABILITY AND MATURITY FOR KNOWLEDGE-INTENSIVE ORGANIZATIONS

Capacidad y madurez en prospectiva para organizaciones intensivas en conocimiento

Capacidade e maturidade em prospectiva para organizações intensivas em conhecimento

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ABSTRACT

The article develops an institutional maturity perspective for foresight capacity building in knowledge-intensive organizations (KIO), as typically embedded in highly demanding dynamics of generation and use of knowledge, which is necessary for constructing comprehensive visions and studying the future. A foresight maturity grid is proposed as structured in five dimensions: people; sophistication of methods, platforms, and infrastructures; the complexity of application areas; organizational structure; and impact on the environment. Described in five maturity levels gradually progressing in organizational capabilities, they constitute an evolutionary logic operatively articulated in processes, projects, and foresight cycles. The resulting grid, conceptually constructed in consideration of other proposals, guides the design and stabilization of foresight systems, forming a basis for the accumulation of organizational learning curves. An application case in a Colombian public KIO provides evidence of its usefulness and applicability in building foresight capabilities.

Keywords: maturity models, capability, foresight, knowledge-intensive organizations, learning curves.

RESUMEN

El artículo desarrolla una perspectiva de madurez para la construcción de capacidades en prospectiva para organizaciones intensivas en conocimiento (OIC), característicamente inmersas en exigentes dinámicas de generación y uso de conocimiento, necesario para elaborar visiones integrales y estudiar el futuro. Se propone una matriz de madurez estructurada en cinco dimensiones: personas; sofisticación de métodos, plataformas e infraestructuras; complejidad de las áreas de aplicación; estructura organizacional; e impacto en el entorno. Descritas en cinco niveles de madurez que dan cuenta de un avance gradual en las capacidades organizacionales, constituyen una lógica evolutiva operativamente articulada en procesos, proyectos y ciclos de trabajo. La matriz resultante, construida conceptualmente en consideración de otras propuestas, orienta el diseño y estabilización de sistemas prospectivos conformando una base para la acumulación de curvas de aprendizaje organizacional. Un caso de aplicación en una OIC pública aporta evidencia de su utilidad y aplicabilidad en la construcción de capacidades prospectivas.

Palabras clave: *modelos de madurez, capacidad, prospectiva, organizaciones intensivas en conocimiento, curvas de aprendizaje.*

RESUMO

O artigo desenvolve uma perspectiva de maturidade institucional para a construção de capacidade prospectiva para Organizações Intensivas em Conhecimento (OIC), caracteristicamente imersas em dinâmicas exigentes de geração e utilização do conhecimento, necessário para desenvolver visões abrangentes e estudar futuros possíveis. Uma matriz de maturidade prospectiva é desenvolvida em cinco dimensões: pessoas; sofisticação de métodos, plataformas e infraestruturas; complexidade das áreas de aplicação; estrutura organizacional; e impacto no meio ambiente. Descritas em cinco níveis de maturidade que respondem por um avanço gradual das capacidades organizacionais, elas constituem uma lógica evolutiva articulada operativamente em processos, projetos e ciclos de trabalho. A matriz resultante, construída conceitualmente a partir de outras propostas, orienta o desenho e a estabilização de sistemas prospectivos, formando uma base para o acúmulo de curvas de aprendizado organizacional. Um caso de aplicação em uma OIC pública fornece evidências de sua utilidade e aplicabilidade na construção de capacidades prospectivas.

Palavras-chave: *modelos de maturidade, capacidade, prospectiva, organizações intensivas em conhecimento, curvas de aprendizagem.*

INTRODUCTION

Globalization accelerated changes force organizations to have new methodologies and related tools for decision-making, planning, innovation, process management, knowledge, and information management (Davenport & Harris, 2017). In this context, futures studies seek to introduce the rigor of an academic discipline to conduct systematic and organized interrogations about possible futures to sustain and/or enhance current and future human and sustainable well-being and development (Jouvenel, 1967). This requires the design and implementation of various methods, processes, and systems, depending on specific contexts, combining different qualitative, semi-quantitative, and quantitative methods that seek to reduce uncertainty, rather than pretending to find absolute certainty about the future (Medina, 2020; Popper, 2008).

Accordingly, it is pivotal to consider foresight applied to the management of knowledge-intensive organizations (KIO). As construed by Jaso, Ségal, Fernández, and Sanpedro (2009), "those organizations whose intensive processes of assimilation and generation of new knowledge are essential for their economic survival and social legitimacy, responding to both public and private interests" (pp. 5-6), these could be research institutes, technology-based companies, R&D departments, among others (Medina, Mosquera, Jaramillo, Mosquera, & Valderrutén, 2018). Currently, KIO set the tone in the knowledge society and economy, characterized by constant change and increased uncertainty. These organizations have variable geometries in their structure and their capabilities can be easily lost, requiring management of the volatility and fluidity of networking and the integration of knowledge generators, which in many cases may be outside the organization (Medina et al., 2018). Like other prospective maturity models (Grim, 2009; Rohrbeck, 2011), this tool strengthens the managerial capacity and institutional development of KIO, achieving their sustainability over time. However, the implementation of maturity models expresses in different dimensions, involving profound changes in the mindset and organizational culture of KIO, as well as the adaptation of their structures and operating guidelines. In light of the growing interest of various KIO (e.g., ECLAC in Latin America) in promoting the design of foresight systems, the article's contribution lies in the proposal of a maturity grid that works as a conceptual reference orienting not only the gradual planning of level-by-level improvement actions but also the concentration of efforts to ensure that institutional capacities and learning curves do not disappear over time.

The article comprises five sections. First, it presents a conceptual framework drawing on corporate foresight, the growing interest in building foresight capabilities in organizations, as well as the nature and characteristics of KIO, followed by the specific concepts of the organizational maturity approach. The second section reviews the literature around foresight maturity models/grids that serve as a subsequent reference point for this proposal. The third section develops the article's proposal, detailing the five dimensions of the grid in its different maturity levels and the articulation of processes, projects, and foresight cycles. The fourth section presents a Case Study illustrating how the grid suggests an improvement path for the gradual and focused institutionalization of a foresight system. Finally, the conclusions highlight the value of the proposal for the Latin American context.

CONCEPTUAL FRAMEWORK

Corporate foresight and capacity building

After its emergence in the 1950s, with a French and an Anglo-Saxon-based school, corporate foresight has had a long conceptualization journey. In their literature review, Rohrbeck, Battistella, and Huizingh (2015) state as one of the basic assumptions of the French school that foresight can influence the future based on decisions made in the present (Berger, Bourbon-Busset, & Massé, 2007). The levels of analysis have been varied, for example, at the sectoral level, Hamel and Prahalad (1994) consider that "Industry foresight is based on deep insights into trends in technology, demographics, regulations, and lifestyles, which can be harnessed to rewrite industry rules and create new competitive space" (p. 128). And at the organizational level, there are complementary positions between "the organizational ability to read the environment" (Tsoukas & Shepherd, 2004, p. 140) and "how managers' actions can create a competitive advantage" (Ahuja, Coff, & Lee, 2005, p. 792).

Another approach has observed the contribution to business decision-making by considering the possibility of providing adequate organizational responses, involving multiple stakeholders and "providing rapid access to critical resources" (Rohrbeck et al., 2015, p. 2), from the recognition of future-bearing facts, driving forces of change and emerging trends that lead to innovative decisions (Ruff, 2007; Neef, 2005; cited in Medina, 2020, p. 255). For the purposes of this article, it is necessary to emphasize the organized nature of foresight practice and the need for its systematic application to inform strategic decision-making at the corporate, sectorial, and industrial levels. Hence, it is necessary to advance in the skills and capacities for the use of methods, and the conformation of specialized processes and systems, especially in KIO.

Futurists have made evident the need to build foresight capacity, recognizing in the literature two orientations operating at different scales: individual and organizational (Hines, Gary, Daheim, & Lann, 2017). At the individual level, there has been a focus on refining managerial foresight or foresight style instruments; and more recently, the Association of Professional Futurists has proposed its Foresight Competency Model with core competencies for the professional futurist (Hines et al., 2017). In turn, at the organizational level, with an emphasis on process capabilities and organizational maturity (Grim, 2009; Rohrbeck, 2011), capabilities account for a marked historical evolution where practices have moved from a "dominant logic" focused on extrapolation and calculation in the 1980s, towards an open and contextual model that seeks to understand and anticipate or shape change rather than to extrapolate it (Daheim & Uerz, 2008, as cited in Hines et al., 2017).

While identifying and promoting best practices of the discipline is at the root of everything, it must be recognized that the ways in which foresight is adopted and used involve considering cultural variations (e. g., Keenan & Popper, 2008). For example, in developing countries in the Americas, beyond the incorporation of foreign, mainly European, practices, "the region has also managed to achieve its own foresight "style" on account of the creative use of limited

resources, which has sometimes resulted in effective innovations in practices and tools" (Keenan & Popper, 2008, p. 19). Acknowledging these types of organizational and geographical realities, new approaches to maturity are needed that not only articulate general theoretical concerns but also allow for the recognition of endogenous dynamics and potentialities of creation and adaptation for capacity building, recognizing that culture still requires significant development.

Foresight in Knowledge Intensive Organizations (KIO)

The framework presented here is aimed at organizations whose raison d'être involves significant knowledge generation and management processes, and which may be of public, private, or mixed capital. Referred to by authors such as Alvesson (2000, 2001) as knowledge-intensive firms or companies, KIO perform work with a strong intellectual load, where most of their members, products or services are highly qualified. Multiple types of organizations in the development field respond to these features. In the case of governmental organizations, strategic foresight at the country level can contribute to the formulation of public policies at various levels, such as in intelligence tasks on potential changes and risks, "enhancing reflexive mutual social learning processes among policy-makers, and cutting across the traditional boundaries of policy areas and government departments" (Kuosa, 2011, p. 27), and in the contribution to the formulation of visions of the future and policies based on better information and preparation. In this sphere of action, it is worth highlighting the role of think tanks (e.g., ECLAC-ILPES), observatories (e.g., the OECD Observatory of Public Sector Innovation), and research and innovation centers (e.g., the UNDP Global Center for Public Service Excellence), the Global Center for Public Service Excellence), as knowledge and recommendations drivers for the design of policies at regional and global level with a long-term strategic perspective (strategic foresight units have been consolidated, for example, in the OECD in 2013 as the successor to the International Futures Program; and in USAID during 2020) (United Nations Committee of Experts on Public Administration, 2021).

The Organizational Maturity Approach

Maturity models (MM) have been used for some decades to refer to the ability of a given organization, process, or unit to recognize its current point of development compared to a standard and to develop progressively over time towards higher stages of performance (Solarte & Sanchez, 2014, p. 6).

Maturity models popularized in 1991 with the launch of the Capability Maturity Model (CMM) by the Software Engineering Institute (SEI) of Carnegie Mellon University, a robust and complex type of model, which proposes process areas at various levels of maturity that must be fully implemented for each level to be considered fulfilled. However, it is possible to develop simpler and lighter tools, such as maturity grids (Maier, Moultrie, & Clarkson, 2012) that, instead

of defining best practices for specific processes (e. g., software, product development) that are measurable by Likert scales or binary yes/no questionnaires, they do not define any type of industry or what a specific process should look like. Rather, they serve as simple diagnostic and improvement tools, through characteristic descriptions of particular performances (Maier et al., 2012). The purpose of maturity grids is "to measure and encode capabilities or typical behaviors that reflect on best practices to effectively accomplish specific tasks and goals." (Reis, Mathias, & Oliveira, 2017, p. 647). In this regard, it is possible to recognize various underlying rationales, such as adherence to a structured process, alteration of organizational structures, emphasis on people, or learning (Maier et al., 2012). Regardless of the approach, it is possible to understand that any effort to implement practices and to build capacities in foresight will depend on the effective modification of organizational routines that, although they may provide "the stability needed to understand and explore external signals (Becker and Knudsen, 2005), they may as well become “traps” (Levitt and March, 1988) for others who get overly comfortable with previous and usually proven ways of acting to the extent that they become blind to the need for change." (Appiah & Sarpong, 2015, p. 513).

LITERATURE REVIEW

Over a decade ago, the field of foresight witnessed the emergence of two proposals for maturity models with different approaches and uses. To establish these models as a point of reference for our proposal (described in the following section), we will provide a brief description of their structural characteristics and conceptual orientations, drawing on their main differences. Thus, in the next section, it will be possible to articulate specific aspects concerning the similarities and specificities of our proposal.

Foresight Maturity Model (FMM)

The first model in the field of foresight, published in 2009, stems from Terry Grim's experience in IBM's NASA Space team and his ensuing contribution to the Strategy Maturity Model. The Foresight Maturity Model (FMM) is structured in a generic foresight process, based on practice areas defined as disciplines: *Leadership* (action), *Framing* (solving appropriate problems), *Scanning* (understanding the environment), *Forecasting* (considering possibilities), *Visioning* (deciding), and *Planning* (plans, people, processes). These derive from the practice areas and best practices set out in *Thinking about the future*, co-edited by Hines and Bishop in 2006 (as cited in Grim, 2009). The FMM comprises 25 practices that are distributed in groups of 3 to 5 per discipline. Operationalized in grids and maturity indicators by level, the FMM is inspired by the SEI's CMM, referring to a broader model on a website, currently disabled.

Maturity Model of Corporate Foresight (MMCF)

René Rohrbeck published the Maturity Model of Corporate Foresight (MMCF) in 2011, the outcome of a thesis that articulates perspectives from strategic management, innovation management, and futures management to focus on "their ability to identify, prepare for, and respond to discontinuous change" or corporate foresight (Rohrbeck, 2011, p. 1). MMCF consists of three parts: Context (6 criteria), capabilities (5 dimensions –information usage; method sophistication; people and networks; organization; and culture– and 21 criteria/aspects) and impact (4 categories –reduction of uncertainty; triggering actions; influencing others to act; and secondary benefits– and 12 criteria).

To conclude, based on the above characteristics, it is possible to point out the following differences between the two models. In contrast to the process approach of Grim's FMM, the MMCF constructs categories with a broader organizational horizon (addressing, for example, culture and impact) supported even by research questions of organizational theoretical interest. They also differ in their conceptual bases and improvement perspectives, in that the MMCF draws its maturity scale from a new product development model within "a four-maturity level logic" (Kahn et al., 2006, as cited in Rohrbeck, 2011, p. 93), moving closer to the maturity grid type orientation, while the FMM takes up the SEI CMM scale, bringing it closer to its structure. Based on these elements, the following section, under the subtitle of specificities and complements, will analyze their similarities and differences in light of our proposal.

A FORESIGHT MATURITY APPROACH

Our proposal stems from two independent efforts at Universidad del Valle, Cali, Colombia. On the one hand, the Institute for Foresight, Innovation and Knowledge Management (IPIGC) was created in 2007, within the framework of the follow-up of the Colombian Program for Technological and Industrial Foresight of Colciencias (2002-2007). More than 100 projects were carried out by 2019 that included foresight, technology watch, and strategic planning for Colombian public organizations and trade associations, as well as organizational capacity building and design of planning and impact evaluation systems. Furthermore, it managed to launch in 2021 the Master's degree in Foresight and Innovation of the Universidad del Valle. Between 2010 and 2017, the IPIGC carried out two projects that culminated in the design and implementation of the PREVIOS System of Foresight, Surveillance and Organizational Intelligence of SENA (see the last section) (IPIGC, 2010, 2017), involving the challenge of designing a maturity tool that would allow guiding step-by-step its institutionalization in 117 Training Centers nationwide. On the other hand, the second initiative involved the experience of the Research Group on Management and Evaluation of Programs and Projects of the same university, which between 2003 and 2010 had ventured into the design of the CP3M© Project Management Maturity Model (Solarte & Sánchez, 2014).

Features and components

The proposal is developed as a maturity matrix or grid (Maier et al., 2012), putting forward an improvement path within the framework of which concrete organizational practices and capacities can be developed leading to the consolidation of a foresight system in KIO. To understand the proposed logic, it should be made explicit that, given the greater interest of both countries and organizations in developing stable foresight processes and systems beyond casual explorations, it is imperative to build greater capacities to carry out foresight cycles or multi-round exercises. They would allow the consolidation of capacities over time (Medina & Ortegón, 2006, p. 100) as well as greater knowledge accumulation and updating, avoiding the obsolescence and fuzziness of the results over time.

Specificities and complementarities with previous maturity models

Concerning scope, comparatively, it is possible to identify a distancing of our perspective with respect to Grim's FMM, by not focusing merely on a generic foresight process but on the organization itself from several dimensions, as does Rohrbeck's MMCF. Likewise, it addresses the interaction with the environment, as is the case of the aforementioned CP3M® model (Solarte & Sanchez, 2014) and of the MMCF itself (the impact of "influencing others to act").

However, although in the face of the MMCF there are overlapping concerns, in the fundamentals there are important differences in approach, analytical perspective, and organizational improvement (beyond the origin of the maturity scale). On the one hand, in organizational matters, while our "Organizational Structure" dimension is based on the documentation of learning, the articulation with project management and the roles of a foresight unit, the "Organization" dimension in the MMCF articulates other strategic and innovation management processes, dealing with aspects of dissemination of foresight results or findings, accountability and incentives, and compensation. Likewise, the impact of foresight projects, which is a common theme, is organized in the MMCF under predetermined categories, including internal ones, while our perspective develops the theme from the geographic and multidisciplinary scale of impact.

Differences also arise even around more important issues such as the scope of foresight and the breadth of topics covered. In our perspective, they are represented as forms of complexity associated with the very use of foresight in the "Complexity of application areas" dimension, whereas in the MMCF they constitute two mere aspects of the use of information ("Information usage" dimension). Such complexification also implies a "sophistication of methods, platforms, and infrastructures", depending on the knowledge objectives within the framework of which five basic prospective processes are proposed (applied in the National Learning Service [SENA, 2017]).

Another group of elements is even more telling of the differences in the application contexts. Given the common lack of foresight qualification and formation in the Latin American context, foresight is incorporated in the "People" dimension starting from the basic level of "beginners" (cf.

Flores, 1994, as cited in Medina & Aranzazú, 2013); while the MMCF in its "People and networks" dimension assumes foresight practitioners with a "deep knowledge of their field" from level 1. This shows the abysmal differences in contextual matters where, even in its "Culture" dimension, the MMCF acknowledges that certain future-oriented behaviors would already be disseminated throughout the organization and would make it possible to mature foresight without an approach that gives guidelines from the structure (which can give rise to a foresight unit). However, this vision reflects the context of large European companies, which is why we stress the imperative need for a structural approach according to the five dimensions proposed, to foster a culture of foresight in organizations.

Processes, projects, cycles, and the foresight system

The core evolutionary logic of the maturity grid for KIO is presented in the progression from methods to processes and, finally, to systems, which are based on three fundamental units: Foresight projects, processes, and cycles (see Figure 1). The foresight project is "a one-time or isolated activity that produces a study or analysis of a given reality." Whereas a foresight process is a methodology or a specific combination of foresight methods, designed for a specific knowledge purpose, setting in motion several foresight projects simultaneously (cf. Medina, 2020, p. 250). Beyond the pretended methodological universality of the traditional perspective, these processes are conceived in the holistic perspective of context-based foresight. Methodologies are designed according to variables such as the political and cultural context, the availability of information, and working teams, making it possible to develop specialization according to fields of action such as economic foresight, political foresight, human and social foresight, among others. (Daheim, 2007).

In the present model, a group of five processes were designed in collaboration with Ian Miles and Rafael Popper from the University of Manchester and applied in an organizational case (SENA, 2017), namely: the processes of territorial, sectoral, technological, and occupational foresight and the process of surveillance and organizational intelligence. Far from being able to give a univocal response to the contextual specificities of other organizations, these processes can illustrate to novice organizations what a foresight process might look like, from which adaptations can be elaborated. It is necessary, however, for every organization to select its methods (Popper, 2008), adopt complementary process-oriented maturity tools (e.g., Grim, 2009), and learn from its own experience.

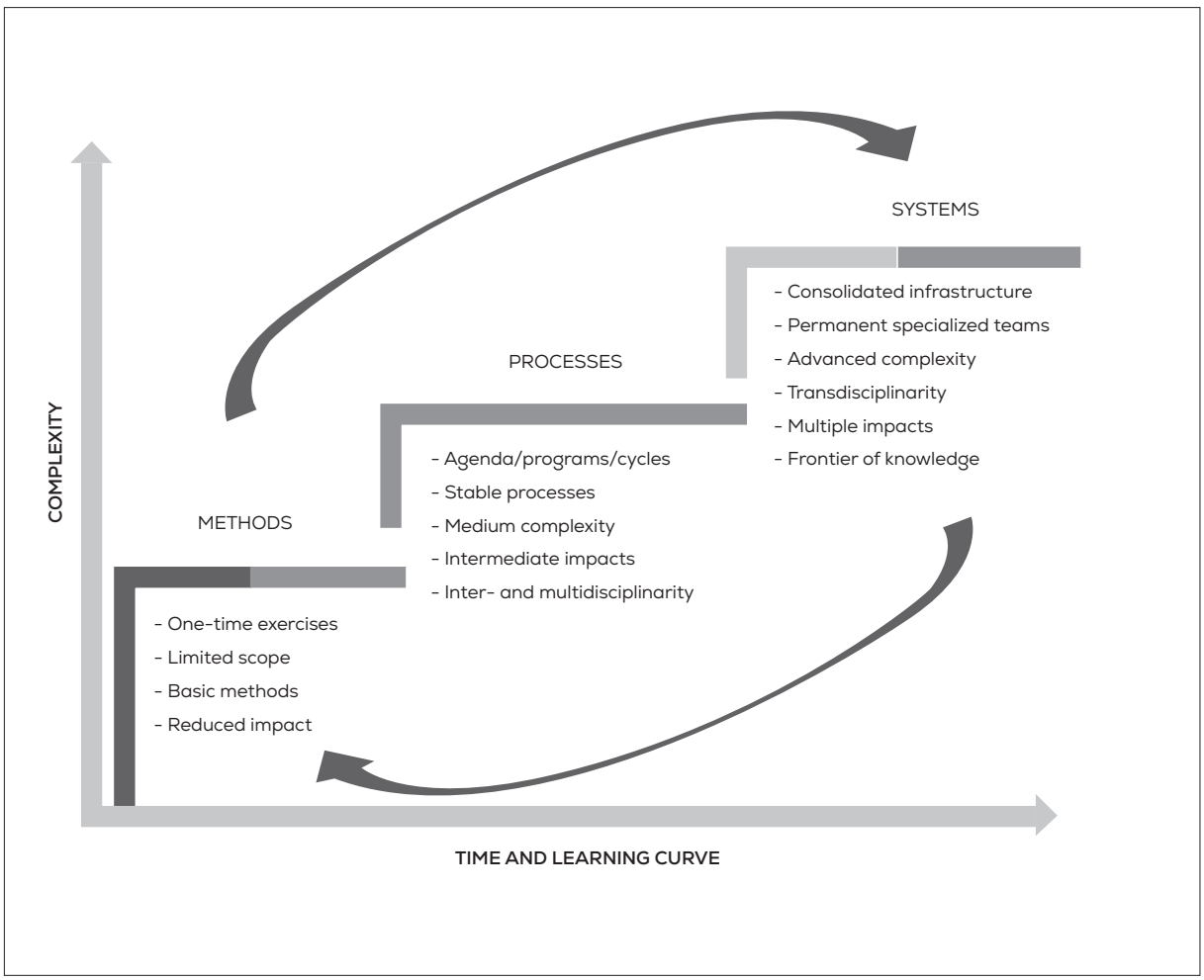
On the other hand, in terms of capacity building, foresight projects, which are one-time one-off exercises, entail a low level of institutional development. Although they can become complex projects, they work in a short-term horizon in the institutions (Medina, 2021).

Recently, the CYTED Open Network of Foresight and Innovation has identified a paradoxical situation in the region where a reappraisal of foresight in the last fifteen years has, in turn, seen a continuous dismantling of foresight capacities. This situation has inhibited the consolidation of authentic foresight systems (Medina et al., 2021), where short-term political cycles, far from promoting

maturation, have ended up destroying the current cycle, permanently restarting (Medina, 2021). This is contrary to the learning curves and sustained cumulative processes observed for decades not only in Europe but also in Japan and South Korea (Windle-Wehrle, 2018).

Therein lies the relevance of appropriately utilizing the potential of foresight processes from which it is possible to create sustained cycles of activity known as foresight programs, agendas, or cycles, in which foresight projects are systematically repeated over several years, progressively accumulating capacities through spirals of knowledge (Medina, 2020, p. 250). Accordingly, we can move towards the consolidation of foresight systems in specialized organizations, which requires the consolidation of permanent teams with advanced competencies that generate learning curves (Medina, 2020, p. 250). Figure 1 outlines the basic rationale for establishing a frame of reference to guide the construction of foresight capabilities.

Figure 1. An evolutionary perspective for foresight capacity building



Source: Authors' elaboration based on Medina (2020).

Maturity levels

Our perspective progresses through five maturity levels that do not reflect a specific maturity logic but rather underpin multiple logics. It highlights both adherence to a structured process (sophistication of methods, platforms, and infrastructures), alteration of organizational structure, and emphasis on people and their competencies (Maier et al., 2012), among others. The levels are:

- Level 1: Inconsistency: personal motivation guides the implementation of any practice, without awareness or expertise.
- Level 2: Acknowledgement: the organization is aware and recognizes the importance of selecting and using foresight methods in specific exercises, generating a reduced impact.
- Level 3: Integration: foresight teams are formed to carry out foresight projects of greater scope and complexity, based on integration with the organization's project management system.
- Level 4: Institutionalization: foresight is embedded in the organizational culture and structure, where high-performance teams carry out high-impact foresight programs.
- Level 5: Transformation: the organization has a foresight system with a consolidated infrastructure and expert teams with the capacity to develop several highly complex foresight programs. It contributes to the development of the foresight discipline and other areas of knowledge.

Maturity dimensions

The grid proposed in Exhibit 1 1 develops the maturity levels into five dimensions within which KIO can strengthen their foresight practices in an orderly fashion. Compendia of foresight practices and guidelines can be found, for example, in Thinking about the future (Hines & Bishop, 2015) and the current Foresight competency model (Hines et al., 2017). Exhibit 1 presents the evolutionary progression of each dimension, drawing from other works, its definition is detailed below (Medina, 2020; Medina & Aranzazú, 2013):

1. People. It is related to the conformation and consolidation of a human team that implements the foresight processes in the organization, referring directly to the improvement of the capacity to do foresight, in terms of knowledge levels, competencies, and experience of individuals and teams.
2. Sophistication of methods, platforms, and infrastructures. It refers to the institution of a consolidated and coherent set of tools, information systems, and working methods defining a basic infrastructure that the organization uses to build its foresight projects and processes, according to its needs and operating contexts. The processes become more complex through methodological refinement and the incorporation of basic infrastructures such as software and databases, even going as far as the design or

adaptation of technical applications that allow for richer and complex foresight; while maintaining the systematicity of its foresight cycles.

3. Complexity of the areas of application. It addresses the themes towards which the use of foresight is directed, its inter/multi/transdisciplinary nature, and its fields of action (territorial, corporate, educational, environmental, cultural). These areas of application can be intra-organizational, related to aspects of logistics, supply chains, and production; or extra-organizational, concerning technological, social, political... fields of action, up to the study of current and potential sectors where new ventures can be explored.
4. Organizational structure. It refers to the capacity, in terms of mechanisms and organic aspects, that include rules, policies, roles, and other guidelines concerning the flow of information, as well as the responsibilities that allow the foresight system to function in an orderly and predictable manner. It supports the consolidation of the foresight system, including the systematization of lessons learned and success stories, to consolidate the functions of a foresight unit. Such units can constitute a knowledge reservoir and become training and advisory agents, providing information and analysis to update the reports and conclusions of foresight activities (Miles, 2002, p. 25). Usually, this type of function includes continuous scanning and consequence analysis; as well as considering alternative courses of action and linking foresight products to decisions (Fuerth & Faber, 2012). In our perspective, the articulation of the foresight system with the project management system, from which change initiatives are operated and tracked, is characteristic. A unit can be located at different levels of the organizational structure according to its specificity (e. g., R&D, customer service management, general management, etc.) (Ortega-San Martín, 2017).
5. Impact on the environment. This addresses both immediate and long-term effects, anticipated or not, that foresight projects and programs bring about in the environment. These are contributions in fields as varied as social problems, development visions, science and technology, public policies, among others.

The grid is presented in Exhibit 1.

Exhibit 1. Maturity grid for organizational foresight capabilities

Dimension	Level 1 Inconsistency	Level 2 Acknowledgement	Level 3 Integration	Level 4 Institutionalization	Level 5 Transformation
People	Foresight activities are carried out at the request of the organization's members, based on their personal experience and motivation.	Basic individual competencies are developed for simple foresight exercises of low complexity.	Competencies are developed and working teams are formed for the development of foresight projects with greater scope and complexity.	Competencies are developed at a specialized level with high-performance teams for the development of foresight programs.	Advanced competencies are consolidated for the development of simultaneous programs of high complexity and novelty. Theoretical knowledge is discussed.

Exhibit 1. Maturity grid for organizational foresight capabilities

Dimension	Level 1 Inconsistency	Level 2 Acknowledgement	Level 3 Integration	Level 4 Institutionalization	Level 5 Transformation
Sophistication of methods, platforms and infrastructures	Tools and methods are selected and used based on the personal interest and experiences of the organization's members.	Basic foresight tools and methods and databases are used, according to themes defined by the organization.	Stable foresight processes are defined/adapted with methods of intermediate complexity, using the basic functionalities of specialized software.	Stable foresight processes are defined/adapted, using advanced foresight methods and advanced functionalities of specialized software.	New processes are created and proprietary applications, techniques, tools, and/or methods are designed to improve the foresight system.
Complexity of application areas	The application of foresight methods is aimed at specific issues on a particular topic. The scope is defined by the members according to immediate needs.	Foresight exercises are developed on a single topic, with a monodisciplinary approach.	Foresight projects are developed on two or three topics simultaneously, of medium complexity, with an interdisciplinary approach.	Foresight programs are developed on several topics or focus at the same time, of greater complexity, using a multidisciplinary approach.	Foresight programs are developed in multiple fields of high complexity, from a multidisciplinary approach.
Organizational structure	Roles and responsibilities are proposed by the members of the organization according to their experience and perception. Some roles may not be considered.	Basic roles and responsibilities are ensured according to the experience of the organization's members, including leadership and support roles.	Organizational mechanisms are defined to articulate some foresight processes and standards with elements of the organization's project management system.	The functions of a foresight unit are created, with a defined structure and roles that allow programming, managing, and monitoring the organization's foresight activities.	Requirements for the adjustment of processes and standards of other systems, such as the project management and innovation systems, are transmitted.
Impact on the environment	The impact of foresight may or may not be accounted for at the time it is applied. There is not necessarily an awareness of it.	The results of foresight exercises have an impact on the environment but limited.	The results of foresight projects have a regional or national impact in some knowledge areas.	The results of foresight programs have an important impact on some knowledge areas.	Frontier knowledge of global impact is generated in multiple knowledge areas.

Source: Own formulation

A CASE STUDY

The maturity perspective developed was empirically validated during the design and implementation project of the Foresight, Surveillance, and Organizational Intelligence System (PREVIOS) at SENA, a public entity ascribed to the Colombian Ministry of Labor. The most relevant aspects of the experience are described below to show how the grid suggests a road map for planning the efforts required for capacity building in foresight. In this way, the practical implications of each dimension for maturity level 2 are illustrated.

SENA, created in 1957, currently offers free formation in more than 520 technical, technological, and specialized work programs. With an overall yearly budget of around USD 1,1 billion, under its Research, Technological Development and Innovation System SENNOVA, with 2,264 projects approved for USD 88,9 million between 2016 and 2018 (SENA, 2019), it sought to generate capacities for applied research and experimental development, implementing the PREVIOS system (designed by the IPIGC of the Universidad del Valle, with the participation of the University of Manchester).

The implementation was carried out between August and November 2017, through 6 pilot formation centers in different regions of the country. The high number of centers (117 distributed in 33 regional offices) led to centralizing the coordination of activities in a Foresight, Surveillance, and Organizational Intelligence Unit (PVeIO, in Spanish), as recommended in the literature (Miles, 2002).

The implementation was supported by a follow-up of the centers' action plans during on-site visits, identifying lessons learned, the collective identification of constraints to their institutionalization, virtual follow-up, and a self-assessment survey. How each dimension takes shape in practice is described below (IPIGC, 2017, and progress report via personal communication from SENA on March 15, 2021):

- "People" dimension: After defining teams in 6 pilot centers, theoretical-practical foundations in Foresight and Technology Watch were developed and the roles of leader, professional, and watchers were specified (Medina & Aranzazú, 2013), who applied one of the 5 foresight processes. Although there were 556 participants by 2021, their non-exclusive dedication implied an extension of the schedules from 6 to 18 months.
- "Sophistication of methods, platforms and infrastructures" dimension: Guidelines were defined in methodological instructions for each process. The pilot reports included developments in scientific-technological and competitive surveillance, and strategic analysis, documenting search logs and databases of Delphi rounds. By December 2020, 80% of the 117 centers had formulated their technology plans.
- "Complexity of application areas" dimension: The foresight exercises have addressed specific topics in monodisciplinary perspectives such as formation in Industrial Automation, Industrial Production Management, and Sustainable and Intelligent Mobility, among others; some of which have been published on the website http://revistas.sena.edu.co

- "Organizational Structure" dimension: The structure and functions of a PVeIO Unit were designed, centralizing the coordination of PREVIOS and data management from Bogotá. Between 2018 and 2020, the Unit strengthened formation, consultancy, and knowledge transfer, advancing a bill for its institutionalization and reviewing the requirements of the Integrated Planning and Management Model (MIPG, in Spanish) on foresight studies.
- "Impact on the environment" dimension: In addition to internal organizational benefits, technology foresight studies will generate impacts on the environment, which will involve future assessments in various fields (Poteralska & Sacio-Szymańska, 2014), considering SENA's extensive participation in 31 knowledge networks ranging from culture and hospitality to hydrocarbons and aerospace (SENA, 2020).

After evidencing how the grid allows an orderly approach to improvement work, it is worth mentioning that, as a conclusion of this application, not only was the practical relevance of the grid validated but subsequent adjustments were made, such as the creation of the "Impact on the environment" dimension, the subsumption of some capabilities, and the modification of the names of the dimensions for the sake of greater inclusiveness.

CONCLUSIONS

This study gathers the fundamental reflections of the authors' experience in the intersection of fields that began to take shape a little over a decade ago between strategic foresight and maturity models/grids. A wide variety of projects, as well as collaborations with entities that have invested in the consolidation of foresight capacities, as is the case of SENA, have provided valuable inputs to move forward, making it possible to land a proposal that deduces, from experience, the relevant foresight dimensions in a KIO such as this one.

The ongoing observation of this special type of organization has been decisive in advancing this maturity perspective, whose novelty lies precisely in the focus on KIO and their particular needs in knowledge management. The five dimensions proposed are considered essential to initiate a process of building foresight organizational capabilities. The relevance of this contribution resides in the fact that, through the establishment of a roadmap that allows planning improvement actions and the desired level of capacity, it specifies the new capacities and practices that must be progressively maintained so that institutional performance in foresight does not decrease. This is a relevant solution to the persistent discontinuities of the region's KIO, which, although they build capacities, later allow them to be destroyed, reproducing to a large extent the problems of long-term planning.

The grid has scientific value to the extent that, while responding to real organizational problems, it also articulates the state of the art. Derived from experience in foresight and institutional maturity, it was conceived, applied, and validated between 2010 and 2017 on a real problem of capacity loss in a KIO such as SENA which, after efforts carried out in 2010

(foresight and technology watch model for institutional training response) and 2015 (foresight capacity assessment in 117 centers), had not been able to consolidate a foresight system. The results, four years after the applied maturity grid, account for the stability of the PREVIOS system and its greater anchoring in routines both because of the increase in foresight studies, as well as the progress in its institutionalization and the continuity of its PVeIO Unit. On the other hand, in its articulation to the state of the art, the grid complements previous models such as the FMM (Grim, 2009), whose procedural approach complements our dimension of "Sophistication of methods, platforms, and infrastructures." Hence its relevance, since the grid paves the way for organizations with foresight planning needs in Latin America, which, given their interdisciplinary and highly specialized nature, require a clear conceptual structure to guide sustained progress.

The perspective advocated is thus original for it stimulates debate on practices and capacity building in Latin American KIO, setting out a starting point for future interactions, as well as theoretical and methodological debates of its own. Indeed, in Latin America, there are no tools that, based on the recognition of endogenous needs and characteristics - which even outline regional "styles" (Keenan & Popper, 2008) - make it possible to identify appropriate routes for gradual improvement. The maturity grid is thus a tool for closing the consolidation gaps in the region, which have been pointed out by Medina (2021) at various levels. At the cultural, institutional, and business levels, it has not been possible to connect foresight with the productive apparatus; but very especially, those gaps are pointed out at the level of the development of foresight systems and foresight knowledge itself. The perspective developed seeks to reverse this structural tendency and to ensure that decisions are not seen as a matter restricted to individual technicians and experts (Medina, 2021), but as spaces open to collective learning and sustained capacity building.

REFERENCES

Ahuja, G., Coff, R. W., & Lee, P. (2005). Managerial foresight and attempted rent appropriation: Insider trading on knowledge of imminent breakthroughs. *Strategic Management Journal*, *26*(9), 791-808. doi: 10.1002/smj.474

Alvesson, M. (2000). Social identity and the problem of loyalty in knowledge-intensive companies. *Journal of Management Studies*, *37*(8), 1101-1123. doi: 10.1111/1467-6486.00218

Alvesson, M. (2001). Knowledge work: Ambiguity, image and identity. *Human Relations*, *54*(7), 863-886. doi: 10.1177/0018726701547004

Appiah, G., & Sarpong, D. (2015). On the influence of organisational routines on strategic foresight. *Foresight*, *17*(5), 512-527. doi : 10.1108/FS-11-2014-0067

Berger, G., Bourbon-Busset, J., & Massé, P. (2007). *De la prospective: Textes fondamentaux de la prospective française, 1955-1966*. Paris, France: L'Harmattan.

Daheim, C. (2007). *Corporate foresight in Europe: Experiences, examples, evidence*. Z_punkt The Foresight Company. Cologne, Germany.

Davenport, T., & Harris, J. (2017). *Competing on analytics: The new science of winning*. Cambridge, USA: Harvard Business Press.

Fuerth, L., & Faber, E. (2012). *Anticipatory governance. Practical upgrades: Equipping the executive branch to cope with increasing speed and complexity of major challenges*. National Defense University, Institute for National Strategic Studies. Retrieved from https://apps.dtic.mil/dtic/tr/fulltext/u2/a585519.pdf

Grim, T. (2009). Foresight Maturity Model (FMM): Achieving best practices in the foresight field. *Journal of Futures Studies*, *13*(4), 69-80. Retrieved from https://jfsdigital.org/articles-and-essays/2009-2/vol-13-no-4-may/articles-essays/foresight-maturity-model-fmm-achieving-best-practices-in-the-foresight-field/

Hamel, G., & Prahalad, C. (1994). Competing for the future. *Harvard Business Review*, 72(4), 122-128. Retrieved from https://hbr.org/1994/07/competing-for-the-future

Hines, A., & Bishop, P. (Eds.). (2015). *Thinking about the future: Guidelines for strategic foresight* (2da. ed.). Washington, USA: Social Technologies.

Hines, A., Gary, J., Daheim, C., & Lann, L. van der. (2017). Building foresight capacity: Toward a foresight competency model. *World Futures Review*, *9*(3), 123-141. doi: 10.1177/1946756717715637

Instituto de Prospectiva, Innovación y Gestión del Conocimiento. (2010). *Modelo de Prospectiva y Vigilancia Tecnológica del SENA para la respuesta institucional de formación*. SENA. Retrieved from http://sigp.sena.edu.co/soporte/Plan/01_Modelo%20PVT

Instituto de Prospectiva, Innovación y Gestión del Conocimiento. (2017). *Implementar e institucionalizar el Sistema de Prospectiva, Vigilancia e Inteligencia Organizacional del SENA*. Universidad del Valle, Cali, Colombia.

Jaso, M., Ségal, E., Fernández, M., & Sanpedro, J. (2009). *Organizaciones basadas en el conocimiento*. UAM-Cuajimalpa, México. Retrieved from http://laisumedu.org/DESIN_Ibarra/desin/pdf-seminario2009/Caobc2009.pdf

Jouvenel, B. De. (1967). *L'arte della congettura*. Firenze, Italia: Vallecchi Editore.

Keenan, M., & Popper, R. (2008). Comparing foresight 'style' in six world regions. *Foresight*, *10*(6), 16-38. doi: 10.1108/14636680810918568

Kuosa, T. (2011). Practicing strategic foresight in government: Cases of Finland, Singapore and European Union. *RSIS Monograph N° 19*. Booksmith. S. Rajaratnam School of International Studies of Nanyang Technological University. Retrieved from https://www.files.ethz.ch/isn/145831/Monograph19.pdf

Maier, A., Moultrie, J., & Clarkson, P. (2012). Assessing organizational capabilities: Reviewing and guiding the development of maturity grids. *IEEE Transactions on Engineering Management*, 59(1), 138-159. doi: 10.1109/TEM.2010.2077289

Medina, J. (2020). *Abriendo caminos en la prospectiva de América Latina y el Caribe*. Cali, Santiago de Chile: Programa Editorial Universidad del Valle – Editorial USACH, Centro de Estudios del Futuro de la Universidad de Santiago de Chile.

Medina, J. (2021). Métodos, procesos y sistemas prospectivos para la construcción de futuros. In L. Solarte (Ed.), *Organizaciones, territorios y desarrollo: Una perspectiva desde los métodos y las prácticas*. Cali, Colombia: Editorial ECOE (en evaluación).

Medina, J., & Aranzazú, C. (2013). *Aprendizaje colectivo y desarrollo de capacidades en prospectiva: Un aporte para América Latina y el Caribe* (Serie Cuadernos de Pensamiento Prospectivo Iberoamericano, 6). México D.C., México: Universidad Nacional Autónoma de México.

Medina, J., Mosquera, H., Jaramillo, A., Mosquera, A., & Valderrutén, A. (2018). *Modelo de un sistema de gestión de calidad para organizaciones intensivas en conocimiento: Caso del Instituto de Prospectiva, Innovación y Gestión del Conocimiento*. Cali, Colombia: Programa Editorial Universidad del Valle.

Medina J., & Ortegón, E. (2006). *Manual de prospectiva y decisión estratégica: Bases teóricas e instrumentos para América Latina y el Caribe* (Serie Manuales, 51). CEPAL. Santiago,Chile: Instituto Latinoamericano y del Caribe de Planificación Económica y Social (ILPES). Retrieved from https://www.cepal.org/es/publicaciones/5490-manual-prospectiva-decision-estrategica-bases-teoricas-instrumentos-america

Medina, J., Vitale, J., & Patroulleau, R. (2021). *Avances y retrocesos en la construcción de capacidades prospectivas en América Latina*. Documento técnico. Red Abierta de Prospectiva e Innovación, Programa Iberoamericano de Ciencia y Tecnología para el Desarrollo (CYTED). Cali, Colombia: Programa Editorial Universidad del Valle (en impresión).

Miles, I. (2002). *Appraisal of alternative methods and procedures for producing regional foresight*. Conference: European Commission's DG Research funded STRATA – ETAN Expert Group Action. Retrived from https://www.researchgate.net/publication/235407634_Appraisal_of_Alternative_Methods_and_Procedures_for_Producing_Regional_Foresight

Ortega-San Martín, F. (2017). *Prospectiva empresarial: Manual de corporate foresight para América Latina*. Lima, Perú: Fondo Editorial Universidad de Lima.

Popper, R. (2008). How are foresight methods selected? *Foresight*, *10*(6), 62-89. doi: 10.1108/14636680810918586

Poteralska, B., & Sacio-Szymańska, A. (2014). Evaluation of technology foresight projects. *European Journal of Futures Research*, *2*(1), 15-26. doi: 10.1007/s40309-013-0026-1

Reis, T., Mathias, M., & Oliveira, O. de. (2017). Maturity models: identifying the state-of-the-art and the scientific gaps from a bibliometric study. *Scientometrics*, *110*(2), 643-672. doi: 10.1007/s11192-016-2182-0

Rohrbeck, R. (2011). *Corporate foresight: Towards a maturity model for the future orientation of a firm*. Berlin, Germany: Physica-Verlag.

Rohrbeck, R., Battistella, C., & Huizingh, E. (2015). Corporate foresight: An emerging field with a rich tradition. *Technological Forecasting and Social Change*, *101*(1), 1-9. doi: 10.1016/j.techfore.2015.11.002

Servicio Nacional de Aprendizaje. (2017). *Panorama tecnológico del emprendimiento digital al 2030*. Centro de la Industria, la Empresa y los Servicios de Neiva, Huila. SENA. Retrieved from https://repositorio.sena.edu.co/bitstream/handle/11404/4606/panorama_tecnologico_emprendimiento_digital_20302.pdf?sequence=5&isAllowed=y

Servicio Nacional de Aprendizaje. (2019). *SENNOVA en cifras*. Dirección de Formación Profesional, Grupo SENNOVA. SENA. Retrieved from http://sennova.senaedu.edu.co/SENNOVA2019.php

Servicio Nacional de Aprendizaje. (2020). *Redes de conocimiento SENA*. Retrieved from https://www.sena.edu.co/es-co/formacion/Paginas/redesConocimiento.aspx

Solarte, L., & Sánchez, L. (2014). Gerencia de proyectos y estrategia organizacional: El modelo de madurez en Gestión de Proyectos CP3M© V5.0. *Innovar*, *24*(52), 5-18. doi: 10.15446/innovar.v24n52.42502

Tsoukas, H., & Shepherd, J. (2004). Coping with the future: Developing organizational foresightfulness – Introduction. *Futures*, *36*(2), 137-144. doi: 10.1016/S0016-3287(03)00146-0

United Nations Committee of Experts on Public Administration. (2021). *CEPA strategy guidance note on strategic planning and foresight*. Retrieved from https://unpan.un.org/sites/unpan.un.org/files/Strategy%20note%20%20strategic%20foresight%20Mar%202021_1.pdf

Windle-Wehrle, F. (2018, octubre 22-23). *Shaping the future: Strategic foresight in the European Parliament*. Seminario 70 años de la CEPAL: Planificación para el desarrollo con visión de futuro. ESPAS, Parlamento Europeo. Santiago de Chile.

AUTHOR'S CONTRIBUTION

Javier Enrique Medina Vásquez, Leonardo Solarte Pazos and Luis Felipe Sánchez Arias worked on the conceptualization and theoretical-methodological approach, so as the theoretical review, data collection and analysis. Javier Enrique Medina Vásquez, Leonardo Solarte Pazos and Luis Felipe Sánchez Arias worked together in the writing and final revision of the manuscript.

