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Complex problem solving as a source of competitive advantage

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ABSTRACT

This study explores the role of complex problem solving in securing sustainable competitive advantage for organizations. It investigates whether the ability to resolve complex, multidimensional problems contributes to a firm's strategic positioning and operational efficiency. The research employs a qualitative methodology, utilizing interviews with professionals in the consultancy sector to gather insights on the impact of problem-solving skills on organizational performance. Findings indicate that while solving complex problems is valued and contributes to competitive parity, it is not sufficiently rare or inimitable to ensure a sustainable competitive advantage on its own. However, effectively leveraging problem-solving capabilities within organizational strategy and innovation processes can enhance competitiveness. The study contributes to the dynamic capabilities and competitive advantage literature by highlighting the importance of problem-solving skills and suggesting avenues for organizations to harness these capabilities more effectively.

1. Introduction

Solving complex problems is a topic that has been gaining more and more relevance, covering any sector of activity and is an ability to identify and solve problems that are multi-dimensional, ill-defined, and that require considering multiple information and perspectives. Therefore, problem-solving is the method of understanding and working on a challenge so that problems can be resolved as quickly and effectively as possible and is considered one of the most important and necessary skills in the future (Forum, 2020).

The world is increasingly complex and solutions are not linear. Most jobs consist mainly of decision-making and problem-solving work (Xiao and Ke, 2021). Organizations must have the ability to make decisions effectively so that they can deal with the countless problems they encounter over time, whether large or small (Simon et al., 1987) and thus achieve greater success in a rapidly changing and complex world (Gambetti et al., 2022).

Knowledge management and organizational learning are highlighted as crucial components in gaining a competitive edge (Fivaz and Pretorius, 2015; Fiegenbaum and Thomas, 2004). Nonaka (1991) emphasizes that knowledge is a lasting source of competitive advantage, encompassing best practices, problem-solving methods, and creative processes (Fivaz and Pretorius, 2015). Furthermore, organizational learning, which accumulates knowledge over time, can be utilized as a source of competitive advantage (Fiegenbaum and Thomas, 2004). This aligns with the resource-based view, which focuses on costly-to-copy attributes of the firm as sources of economic rents and drivers of performance and competitive advantage (Conner, 1991). Additionally, the development of knowledge through mutually beneficial relationships, such as alliances, is identified as a resource that can provide enduring competitive advantage (Ireland et al., 2002).

In the context of problem-solving, it is noted that heuristic search to highly complex problems can be facilitated by consensus-based hierarchies, which possess distinct advantages over authority-based hierarchies (Nickerson and Zenger, 2004). Moreover, the emphasis on competition and cooperation in learning can motivate individuals to solve problems more efficiently, potentially leading to competitive advantages (Du et al., 2022).

In the realm of technology, metaheuristic techniques are proposed as substitutes for traditional programming methods to solve hard problems, indicating an open research area in utilizing these techniques for complex problem solving (El-Qulity and Mohamed, 2016; El-Quliti et al., 2015). Furthermore, advancements in quantum computing have shown the potential for achieving a quantum advantage in runtime over state-of-the-art heuristic algorithms for solving complex problems (Lykov et al., 2022).

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In an organization, when there is a certain problem, workers must find solutions to problems using analytical, creative, and critical thinking skills. Communication, collaboration, and identifying potential solutions are essential skills for addressing complex problems. These skills are considered highly valued in companies and are crucial for addressing the challenges faced by employees in the organizational world (Pereira et al., 2021).

The complexity of problem-solving poses challenges for companies, leading many to recognize their issues and implement measures to manage them better, as they struggle to follow a clear approach to problem-solving (Harvard Business Review, 2015). It is said that a complex problem occurs when the solution requires a series of operations (Dörner and Kreuzig, 1983). The ability to solve complex problems consists of achieving one's objectives (Fischer et al., 2017). It is measured through dynamic systems that contain several highly interrelated variables that stakeholders need to change (Dörner and Funke, 2017).

This is a very vast topic, that affects most companies worldwide where there is little knowledge from a business point of view and some uncertainty in the literature regarding the benefit that these resolutions provide to organizations thus it is crucial to discover/investigate together with them. Therefore, the main question of this research arises: analyzing whether the resolution of complex problems represents a source of sustainable competitive advantage for companies and whether they should be incorporated into the definition of organizational strategy. In this sense, companies must have the ability to evaluate the benefits and impacts that these resolutions provide to companies for effective management, in a constantly changing environment.

The document offers a detailed investigation into how complex problem solving can foster competitive advantage within organizations. It begins with an introduction that sets the context by emphasizing the importance and challenges of solving complex problems in today's dynamic business environment. The literature review follows, exploring theoretical frameworks and prior research on the topic. The methodology section describes the qualitative approach used, including participant selection and interview processes. Data analysis then delves into how the collected data was examined to draw meaningful insights. The results and discussion section interprets these findings, evaluating complex problem solving's role in achieving a sustainable competitive advantage. The conclusion summarizes the study's key points, acknowledges its limitations, and proposes directions for future research. The document meticulously progresses from establishing the foundational importance of complex problem solving to a nuanced analysis of its implications for competitive strategy, providing a comprehensive narrative throughout.

2. Literature review

2.1. Problems in the organizational context

In general, problems are regularly present, both at an individual (Dostál, 2015) and organizational level (Hackman and Wageman, 1995), and can arise from different sources and manifest themselves in countless ways, having a significant impact on the company's performance. All organizations deal with countless problems and challenges (Iuga and Rosca, 2017). There is a problem when an individual has a certain objective but does not know exactly how it can be achieved (Fischer et al., 2012) since the solution is not immediately obvious (Dunbar, 2017). Still, if the individual realizes the problem, the willingness to deal with it is essential (Dostál, 2015).

Problems are challenges, even the smallest ones with lower complexity. However, complex problems require creativity, cooperation, and commitment for successful resolution. Addressing root causes and analyzing the core problem is crucial, as inadequate analysis can lead to recurring issues and limit problem-solving to short-term solutions. Hence, proper attention to problems is essential for successful resolution (Mohaghegh and Größler, 2022).

For this same reason, it is necessary that when a problem is identified, one can understand its dimensions, so that it can be resolved quickly and efficiently. In this sense, speed is a decisive factor in the growth of a company (Robert Baum and Wally, 2003), as well as effectiveness so that the same or other problems do not reappear due to poor planning or resolution.

2.2. Problem-solving and decision-making

For Simon et al., (1987), the most important thing for society is undoubtedly the ability to solve problems and make decisions effectively to successfully resolve many of the problems that require attention, at different levels. The same is also true in the business context, where most jobs consist mainly of decision-making and problem-solving work and, most of them, of choosing and prioritizing problems that require time management, attention, the definition of objectives (activities called "problem-solving"), and finally, the evaluation and selection of available action strategies (activities that are defined as "decision making") (Simon et al., 1987).

Decision-making consists of making choices between a set of alternatives, being part of the problem-solving process (Pollard, 1987; Treffinger and Isaksen, 2005), from defining the problem to choosing the solution, thus ensuring the proper functioning of organizations at all levels to achieve the intended objectives. Decisions made in organizations are often made in groups, which is important for organizations, as these groups are made up of individuals, which involve individual decisions, as they have different skills, experiences, and knowledge (McFadzean, 1996).

Problem-solving, on the other hand, is the process of searching for an operation or series of operations, so-called acquired knowledge to transfer the problem situation (initial state) to an objective state (Gilhooly, 2012; Newell and Simon, 1972), that is, it is the method of identifying, analyzing and understanding a challenge and working on it so that an effective solution can be found through several stages, being considered as a of the most desired skills in the current market.

Decision-making, as well as problem-solving, are not homogeneous or isolated activities, being influenced by the type of problem to be solved and by individual, group, and organizational characteristics (O'Loughlin and McFadzean, 1999). These are permanent skills that influence the smooth functioning of an organization and through performance make it successful. Therefore, the development of problem-solving capabilities is considered an important competence of companies so that they can respond quickly to changes to achieve continuous improvement (Astor et al., 2016; Choo et al., 2015; Garvin, 1993; MacDuffie, 1997; Tucker et al., 2002; Rahadian et al., 2024) and thus increase the level of competitiveness over time (Helfat and Peteraf, 2015; Teece, 2007).

2.3. Solving complex problems in organizations

An important and extremely transversal competence necessary in an organizational context is the ability to solve complex problems (Mainzer, 2009), and for this to happen there must be an efficient interaction between the solver and the conditions of the situations (Eichmann et al., 2019). The concept of "complex problem solving" was introduced by Dörner (1975), when real problems, such as the 1973 oil crisis, increasingly highlighted the need for other ways in which individuals solve problems and make complex decisions, other than the more traditional ways used until now (Brehmer, 1992; Gonzalez et al., 2005; Klein, 1993).

Complex problem-solving is a sequence of observations and decisions used to discover and implement a solution to a problem. There is no single solution, requiring more steps and considerations (Pollard, 1987), and it is essential to know all the concepts that exist in a problem, to a certain extent, to be able to respond correctly to it (Wang et al., 2021).

Obtaining a satisfactory solution depends on simplification and concentration on the essentials, and it is crucial to communicate a shared vision of the problem (Mumford et al., 2000) and coordinate actions to resolve it.

2.4. Complex problem-solving and dynamic capabilities

Dynamic capabilities allow the company to change (Winter, 2003; Zollo and Winter, 2002), forming part of the organization's global resource base (Banerjee et al., 2018). Dynamic capabilities create business opportunities (Teece, 2007) for new value-creation strategies through the modification of common capabilities (Eisenhardt and Martin, 2000), and an organization that balances these two dimensions will be better prepared to face the challenges market challenges.

Dynamic capabilities are important to an organization's performance and success (Banerjee et al., 2018) and its long-term growth. These also play a fundamental role in solving complex problems, as the ability to solve complex problems requires the ability to move away from standard solutions which requires the flexibility inherent to dynamic capabilities.

Dynamic capabilities are defined as the company's ability to integrate, build, and reconfigure internal and external competencies to face rapidly changing environments (Teece et al., 1997), these being considered as an extension of the resource-based view (RBV) of the company (Barney, 1991) which aims to explain how through RBV, a company can obtain a lasting competitive advantage through the analysis of its sets of resources and internal capabilities (Barreto, 2010). These resources and capabilities provide a competitive advantage (Banerjee et al., 2018) and to provide a sustainable competitive advantage, they must be considered valuable, rare, and difficult to imitate (Newbert, 2008) and the organization must be able to take advantage of these resources (Sheehan and Foss, 2017), considered as the VRIO model, thus allowing the company to achieve exceptional performance.

In turn, the development of dynamic capabilities depends on the organization's knowledge and learning (Easterby-Smith and Prieto, 2008). It is increasingly important for companies to create new knowledge through internal processes (Ahuja and Novelli, 2012), as well as to obtain new external knowledge, as it allows them to be in direct contact with the advanced knowledge of other companies (Lyles, 2014). Knowledge management increases the competitive capabilities of companies (Gray, 2001; Nuruzzaman et al., 2019), helps to achieve the objectives or results established by organizations, and the creation of value, being considered a parameter of organizational performance (Mukherjee et al., 2013).

Knowledge is a valuable tool and the best predictor of complex problem-solving performance (Wittmann and Hattrup, 2004; Wittmann and Süß, 1999). Sharing knowledge is crucial in organizations to obtain quality solutions and to solve existing complex problems effectively (Carmeli et al., 2013).

These two concepts, dynamic capabilities and the resolution of complex problems are strongly interconnected as dynamic capabilities strengthen the resolution of complex problems and the effective resolution of complex problems contributes to the development of dynamic capabilities, which drives an organization's ability to adapt in an agile way, learn from experience, and continually innovate to meet challenges in constantly changing environments. This not only allows organizations to overcome obstacles but also positions them to achieve a sustainable competitive advantage.

2.5. Integrating perspectives on open innovation: insights from TFSC, EPS, STS, KMRP, and the society of open innovation conferences

Open Innovation (OI), as conceptualized by Chesbrough (2003), marks a significant departure from the conventional model where innovation activities were confined within the boundaries of organizations. Traditionally, companies relied heavily on their internal Research and Development (R&D) departments for new ideas and technological advancements. This inward-looking approach limited the scope of innovation to the knowledge and resources available within the organization. Chesbrough (2003) introduction of OI challenged this paradigm by suggesting that companies could greatly benefit from looking beyond their borders, tapping into a vast reservoir of external knowledge, skills, and technologies.

This transformative approach to innovation is predicated on the idea that in a world of widely distributed knowledge, companies cannot afford to rely solely on their internal resources but should instead embrace the porousness of their organizational boundaries to innovation. By doing so, organizations can access diverse and complementary assets that reside outside their immediate sphere, ranging from academic research findings and technologies developed by startups to customer insights and contributions from independent inventors. Chesbrough (2006) further elaborated on this by highlighting the importance of not just acquiring external knowledge, but also effectively integrating it with internal R&D efforts to create new products, services, and processes.

The implementation of OI necessitates a culture of collaboration and openness, where sharing knowledge with external partners becomes a strategic imperative. This shift demands robust mechanisms for managing intellectual property, ensuring that while ideas flow freely, they are also protected to maintain competitive advantage. Moreover, it requires the development of new organizational capabilities to scout, absorb, and integrate external knowledge effectively.

The exploitation of external innovation ecosystems, as noted by Chesbrough (2006), involves engaging with a variety of external entities such as universities, research institutes, other companies, and even competitors, in a manner that is mutually beneficial. This ecosystem approach to innovation not only expands the innovation potential of firms but also accelerates the innovation process, reduces risks associated with R&D activities, and enhances market responsiveness.

Chesbrough's work on OI has catalyzed a broader movement towards more open forms of innovation, influencing a wide range of sectors from pharmaceuticals to information technology, and leading to the emergence of new innovation models such as crowdsourcing, innovation contests, and collaborative R&D alliances. The OI paradigm has fundamentally altered the innovation landscape, underscoring the value of external collaborations in driving sustainable growth and competitive differentiation in the modern, knowledge-intensive economy.

2.5.1. Technological forecasting & social change (TFSC)

The publication in Technology Forecasting & Social Change (TFSC) by Bogers et al., (2017) serves as a comprehensive examination of the profound impact that Open Innovation (OI) practices have on technological progress and societal evolution. This extensive research collaboration delves into the mechanisms through which OI catalyzes industry-wide transformations by effectively incorporating external innovations into internal development processes, thus fostering an environment where shared knowledge propels technological breakthroughs and addresses critical societal challenges.

The study highlights several key areas where OI has been particularly influential. One such area is the acceleration of technological advancements through the integration of external knowledge sources. In industries ranging from pharmaceuticals to information technology, OI practices have enabled companies to shorten development cycles, enhance product innovation, and bring breakthrough technologies to market more rapidly. By tapping into a global network of knowledge and expertise, firms are able to leverage the collective intelligence and capabilities of a wide array of contributors, including academic researchers, independent inventors, and even competitors, to push the boundaries of what is technologically possible.

The research underscores the role of OI in driving societal changes by addressing complex challenges through innovative solutions. Emerging technologies such as Artificial Intelligence (AI) and the Internet of

Things (IoT) exemplify the kinds of advancements that can be achieved through OI frameworks. AI, with its vast potential for data analysis, prediction, and automation, and IoT, with its ability to connect and integrate physical devices into a cohesive and intelligent network, both represent technologies that can be harnessed to tackle societal issues such as healthcare access, environmental sustainability, and urban development.

The work of Bogers et al. (2017) demonstrates that OI not only facilitates technological innovation but also promotes a more collaborative and inclusive approach to addressing societal needs. By breaking down the traditional barriers to knowledge sharing and collaboration, OI encourages a more distributed and participatory form of innovation, where diverse stakeholders can contribute to solving global challenges. This shift towards more open and collaborative innovation practices has the potential to democratize the process of technological advancement, ensuring that the benefits of innovation are more widely distributed and aligned with societal goals.

Through this lens, OI emerges as a powerful catalyst for both technological and societal transformation. The insights provided by this body of research in TFSC illustrate the multifaceted impact of OI, offering a blueprint for harnessing external knowledge and collaborative networks to drive progress and address the pressing challenges of our time.

2.5.2. Ecosystem partnership strategy (EPS)

In his influential work, Adner (2017) elucidates the pivotal role of strategic partnerships in cultivating successful Open Innovation (OI) ecosystems, underscoring the essential nature of collaboration among diverse entities such as academia, industry, and government. This tripartite partnership model serves as the backbone of a vibrant innovation ecosystem, where each participant brings unique strengths and resources to the table, thereby enhancing the collective capacity for innovation beyond what any single entity could achieve independently.

Adner's research, as detailed in Ecosystem Partnership Strategy (EPS), provides a comprehensive framework for understanding how these ecosystems function and thrive. He argues that the synergistic relationships formed between different stakeholders not only accelerate the innovation process but also ensure that the innovations are relevant and responsive to societal needs. For instance, academia contributes cutting-edge research and deep theoretical insights, industry offers practical applications and market insights, and government provides regulatory guidance and public policy support. Together, these collaborations create a conducive environment for the co-creation of value, where shared goals and mutual benefits drive the innovation agenda.

Adner (2017) highlights the importance of effectively managing these ecosystems. The success of OI initiatives often hinges on the ability to navigate the complexities of cross-sector partnerships, including aligning objectives, sharing risks and rewards equitably, and managing intellectual property issues. Effective ecosystem management ensures that collaborations are productive, sustainable, and capable of generating innovative solutions to complex challenges.

One of the key contributions of Adner's work is the emphasis on the sustainability of innovation ecosystems. Through strategic partnerships, ecosystems can continuously evolve and adapt to changing technological landscapes and societal demands. This dynamic capability is essential for addressing complex, multifaceted challenges that require a long-term, collaborative approach. Sustainable ecosystems are characterized by their resilience, flexibility, and ability to leverage diverse resources and expertise for ongoing innovation.

Adner's insights into the formation and management of innovation ecosystems through strategic partnerships provide a valuable roadmap for organizations seeking to harness the power of OI. By fostering robust collaborations across academia, industry, and government, organizations can tap into a wider pool of knowledge, accelerate the development of breakthrough innovations, and more effectively address the pressing challenges of our time.

2.5.3. Science, technology, & society (STS)

Stilgoe, Owen, and Macnaghten (2013) seminal work within the field of Science, Technology, and Society (STS) sheds light on the profound ways in which Open Innovation (OI) intersects with and influences the dynamic relationships between science, technology, and societal development. Their research delves into the critical aspects of ethical considerations, governance models, and public engagement in OI initiatives, underscoring the potential for these projects to enact significant societal change. This trio of scholars advocate for a more reflexive approach to innovation, one that conscientiously integrates societal needs and ethical implications into the development and deployment of new technologies.

One of the core arguments presented by Stilgoe et al. (2013) is the importance of anticipatory governance in OI projects. Anticipatory governance refers to the processes and mechanisms that allow for the early consideration of potential social, ethical, and environmental implications of technological innovations. By adopting such forward-looking governance models, OI projects can proactively address potential challenges and align their outcomes with societal values and needs.

Stilgoe et al. emphasize the critical role of public engagement in the OI process. They argue that involving a diverse range of stakeholders, including end-users, community groups, and civil society organizations, in the innovation process can enrich the development of technologies with a wide array of perspectives and values. This inclusive approach to innovation ensures that the resulting technologies are not only technologically advanced but also socially relevant and ethically sound. It also helps in democratizing the innovation process, making it more accessible and accountable to the broader public.

The framework proposed by Stilgoe et al. for assessing the contributions of OI to societal challenges is particularly relevant in the contexts of sustainability and health. For instance, in sustainability projects, OI can facilitate the co-creation of green technologies and sustainable solutions through collaboration between researchers, industries, and environmental organizations. Similarly, in the health sector, OI can accelerate the development of medical innovations and health technologies by fostering partnerships between biomedical scientists, healthcare providers, and patients.

The Insights provided by Stilgoe, Owen, and Macnaghten (2013) not only underscore the potential of OI to contribute positively to societal challenges but also highlight the necessity of embedding ethical considerations and public engagement at the heart of the innovation process. Their work serves as a crucial reminder that the ultimate goal of innovation, particularly in the context of OI, should be to advance societal well-being, ensuring that technological advancements are aligned with the public interest and contribute to the common good.

2.5.4. Knowledge management & research practices (KMRP)

Bierly et al., (2009) delve deep into the intricate relationship between effective knowledge management and the success of Open Innovation (OI) in their comprehensive analysis. They articulate how the mechanisms of knowledge sharing, the utilization of collaboration tools, and the implementation of knowledge retention strategies serve as the backbone for fostering a vibrant OI ecosystem. Their research illuminates the multifaceted process of managing knowledge in a way that not only supports the OI framework but also amplifies its potential to drive forward innovative outcomes.

One of the cornerstones of effective OI, as identified by Bierly et al., is the fluid and seamless sharing of knowledge across organizational boundaries. This process involves not just the dissemination of explicit knowledge, such as patents or publications, but also the more tacit forms of knowledge that reside in the experiences and skills of individuals. By establishing channels through which this knowledge can flow freely between internal teams and external partners, organizations can significantly enhance their innovation capacity. Bierly et al. highlight the necessity of creating a culture that values open communication and

the mutual sharing of insights to catalyze collaborative innovation efforts.

The authors also emphasize the pivotal role of collaboration tools in enabling effective OI practices. In today's digital age, technology platforms that facilitate virtual teamwork, idea sharing, and joint problem-solving are crucial for bridging the geographical and organizational divides that often separate collaborators. From cloud-based project management software to social networking platforms tailored for professionals, these tools help knit together disparate contributors into a cohesive innovation network. Bierly et al. argue that the judicious selection and implementation of these tools can significantly enhance the efficiency and productivity of collaborative innovation efforts, enabling participants to co-create value in ways that were previously unimaginable.

The sustainability of OI efforts, according to Bierly et al., is heavily dependent on an organization's ability to retain critical knowledge. This entails not only capturing the outputs of collaborative efforts but also ensuring that the insights and expertise gained through OI activities are embedded within the organizational knowledge base. The authors suggest implementing systematic approaches to documenting processes, outcomes, and lessons learned, as well as fostering a learning environment where employees are encouraged to reflect on and share their experiences. Knowledge retention is vital for building an accumulative innovation capability that leverages past efforts to inform future projects.

Bierly, Damanpour, and Santoro further discuss the importance of managing intellectual property (IP) within the OI ecosystem. Navigating the complexities of IP rights in collaborative ventures is critical for protecting the interests of all parties involved and ensuring that innovations can be commercialized effectively. They advocate for transparent agreements that clarify IP ownership and usage rights from the outset, thereby minimizing conflicts and fostering trust among collaborators.

Lastly, the authors underscore the significance of cultivating an innovation culture that supports OI initiatives. This involves creating an organizational ethos that embraces risk-taking, celebrates creativity, and rewards collaborative achievements. Such a culture not only attracts talented individuals who are keen to engage in innovative endeavors but also creates an environment where OI can flourish.

Bierly et al., (2009) work provides a nuanced understanding of how knowledge management practices underpin the success of OI efforts. By addressing these key areas, organizations can harness the full potential of OI to drive transformative innovation.

2.5.5. Society of open innovation (SOIn) annual conferences

The Society of Open Innovation (SOIn) annual conferences stand at the forefront of fostering discussions around the most recent trends and innovations within the domain of Open Innovation (OI). As Lee, Lim, and Pathak (2018) articulate, these gatherings are not merely academic events but pivotal platforms where the pulse of OI is both gauged and influenced. They bring together a diverse confluence of scholars, industry practitioners, policymakers, and innovation enthusiasts from around the globe, creating a vibrant ecosystem dedicated to the exchange of ideas, experiences, and insights on OI.

At the heart of the SOIn annual conferences is the exploration of cutting-edge trends that are shaping the landscape of OI. Topics such as the integration of digital technologies (e.g., AI, blockchain, IoT) in OI practices, the evolution of OI ecosystems, and the role of OI in fostering entrepreneurship and intrapreneurship receive prominent attention. These discussions are crucial for identifying new pathways through which OI can contribute to technological advancement and innovation management.

The conferences provide a critical forum for presenting and debating theoretical advancements in OI. Researchers present findings from empirical studies that challenge existing paradigms, propose new frameworks for understanding OI processes, and explore the dynamics of collaboration and competition within OI ecosystems. This academic discourse enriches the OI literature, offering fresh perspectives and deepening the understanding of how OI can be effectively leveraged across different contexts and sectors.

The practical applications of OI, as highlighted during the SOIn annual conferences, demonstrate the real-world impact of OI strategies and practices. Case studies and success stories presented by industry leaders illustrate how OI has been instrumental in solving complex problems, driving innovation in products, services, and business models, and contributing to sustainable development goals. These narratives provide valuable lessons and insights for organizations seeking to adopt or enhance their OI initiatives.

Lee, Lim, and Pathak (2018) emphasize the significant contribution of the SOIn annual conferences to the broader discourse on OI, particularly in addressing complex challenges and promoting sustainable development. The conferences serve as a catalyst for cross-fertilization of ideas between academia and industry, facilitating the co-creation of knowledge and encouraging the translation of theoretical insights into practical solutions. By fostering a collaborative and inclusive environment, the SOIn annual conferences play a critical role in advancing the global OI community's efforts towards creating a more innovative and sustainable future.

Through the lens of Lee, Lim, and Pathak's (2018) analysis, it is evident that the SOIn annual conferences are more than just academic gatherings; they are pivotal events that shape the trajectory of OI, bridging theory and practice, and fostering a global community committed to innovation and sustainable growth.

2.5.6. Synthesis and future directions

This comprehensive review meticulously aggregates insights from a wide array of scholarly works, shedding light on the pivotal role of Open Innovation (OI) in catalyzing a paradigm shift across various domains. The essence of OI in nurturing collaborative ecosystems stands out as a recurring theme, underscoring the methodology's capacity to knit together diverse knowledge sources, skills, and technologies beyond traditional organizational boundaries. This collaborative ethos not only accelerates the pace of technological innovation but also democratizes the innovation process, allowing for a more inclusive approach to problem-solving.

The literature vividly illustrates how OI acts as a driving force behind technological innovation, enabling both established corporations and burgeoning startups to leapfrog conventional R&D limitations. By embracing external collaborations and knowledge exchanges, firms can tap into a broader innovation landscape, exploring new technologies and applications that may have remained elusive within the confines of a closed innovation system. This open approach is particularly effective in addressing complex, multifaceted global challenges — from climate change to public health crises — by amalgamating insights and expertise from across sectors and disciplines.

West and Bogers (2017) advocate for the exploration of OI's yet uncharted dimensions, suggesting that future research delve deeper into how OI can be further optimized to champion inclusive and sustainable innovation. This call to action resonates with the pressing need to ensure that innovation not only propels economic growth but also contributes to societal well-being and environmental stewardship. Investigating areas such as the role of OI in low-resource settings, its impact on social entrepreneurship, and its potential to foster circular economies could unveil novel strategies for leveraging innovation for the greater good.

2.6. Solving complex problems using open innovation

Organizations must be able to stand out and differentiate themselves from each other to obtain a competitive advantage using different skills, with innovation being one of the most important dynamic capabilities that an organization can have (Birchall and Tovstiga, 2005), becoming the key to the success and survival of any organization (Hazem and

Zehou, 2019). Innovation is the method of using new practices, techniques, and the best suggested ideas, to create greater value for the organization. Innovation is the process by which existing knowledge and contributions are creatively and efficiently recombined to create new and valuable results (Felin and Zenger, 2014), and to promote innovation and creativity, organizations must be willing and prepared to adopt a more "flexible" (Amabile, 1997) and adaptable culture. There are two types, innovation as a closed model and as an open model. The most traditional and used by organizations to date is the closed model, where the necessary research, ideas, resources, and developments are generated internally.

For the most part, companies have realized with the constant changes, evolutions, and greater complexity that exists, that this innovation (closed model) is no longer enough to keep up with the market, and no matter how much companies try to focus on solving their problems only internally, it is possible that they will not be able to present the best ideas and resources, as, during the process, ideas end up being scarce, whether in the initial phase or in the development phase. It becomes important to explore various approaches to achieve greater differentiation and innovation. For this same reason, a new approach has emerged called OI (Chesbrough, 2003).

OI is the use of purposeful inflows and outflows of knowledge to accelerate internal innovation and expand markets for the external use of innovation, respectively (Chesbrough, 2006). In other words, OI allows companies with internal capabilities to increase their capabilities through external sources of knowledge, resources, and ideas (Teece, 2020), with collaboration between companies, as the market and technologies advance. When organizations use this innovation, they are taking advantage of resources and ideas externally, reducing their costs and thus being able to remain competitive in the market.

Complex problem solving can be a significant source of competitive advantage in the context of open innovation. Open innovation emphasizes the importance of capturing external knowledge and technology and converting it into innovative products and services (Inauen and Schenker-Wicki, 2011). This approach allows firms to access a broader competence base through partnerships, which can contribute to their competitive advantage (Henttonen and Lehtimäki, 2017). Additionally, open innovation enables firms to reach external sources of knowledge and technology, facilitating internal innovation processes and generating additional value in innovation by reaching external channels to market outside the traditional business of the firm (Rangus, 2017).

Furthermore, the concept of open innovation involves leveraging external sources of innovation and commercializing them, which can contribute to a firm's competitive advantage (West and Bogers, 2013). It also emphasizes the dynamic process of interaction, integration, and coordination of innovative elements, which can enhance an enterprise's innovation levels (Feng and Feng, 2018). Moreover, open innovation can break organizational boundaries, continuously inject innovative ideas into enterprises, and improve their innovation levels (Shao and Bi, 2021).

In the context of open innovation, the ability to engage in complex problem solving is crucial. Complex problem solving is considered an important transversal skill that includes knowledge acquisition and its application in new and interactive situations (Greiff et al., 2014). It involves taking actions that solve substantive problems and follows the framework of complex problem solving (Graesser et al., 2017). Therefore, in the context of open innovation, firms that excel in complex problem solving are better equipped to capitalize on external sources of innovation and leverage them to enhance their competitive advantage.

To understand how Knowledge Management and Research Practices (KMRP) can contribute to complex problem solving, it is essential to consider the role of knowledge management in facilitating problem-solving processes. Knowledge Management (KM) involves innovating, spreading, sharing, and using knowledge assets (Dou et al., 2007). Effective KM practices can greatly benefit organizations by enhancing problem-solving capabilities and performance (Giampaoli et al., 2017). KM frameworks provide a structured approach to managing knowledge activities and critical success factors, which can be instrumental in addressing complex problems (Heisig, 2009). Furthermore, KM dynamics have been linked to the loss of explicit and tacit knowledge during a project's lifecycle, highlighting the importance of effective KM in preserving and leveraging knowledge for problem solving (Narazaki et al., 2020).

Research practices also play a crucial role in contributing to complex problem solving. Evidence-informed management knowledge, developed through systematic review methodologies, can enhance practice by producing reliable knowledge and context-sensitive research (Tranfield et al., 2003). Additionally, the integration of empirical, technical, and practical wisdom has been found to be instrumental in solving practical problems in specific contexts, such as in public service reform (Bynner and Terje, 2021). Moreover, the role of knowledge formation and learning in managing complex projects is essential for expanding project capability boundaries to include knowledge uncertainty and indeterminacy, thereby contributing to problem-solving perspectives (Ahern et al., 2014).

In the context of open innovation, which emphasizes the importance of capturing external knowledge and technology, effective KMRP can significantly contribute to complex problem solving. By leveraging external sources of innovation and integrating empirical, technical, and practical wisdom, organizations can enhance their problem-solving capabilities and competitive advantage (Fig. 1).

The EPS (Ecosystem Partnership Strategy) can significantly contribute to complex problem solving by leveraging the dynamics of innovation ecosystems and strategic partnerships. The EPS approach emphasizes the nature and microfoundations of sustainable enterprise performance, providing a framework that highlights critical capabilities for sustaining the evolutionary and entrepreneurial fitness of the business enterprise Teece (2007). Additionally, EPS involves coopetition in innovation ecosystems, which facilitates effective knowledge transfer configurations, emphasizing the importance of knowledge sharing in coopetitive ecosystem partnerships (Bacon et al., 2020). Furthermore, managing strategic partnerships with universities in innovation ecosystems is crucial for developing companies' entrepreneurial and innovation development capacities, which can contribute to addressing complex problems (Schiuma and Carlucci, 2018).

Moreover, understanding problem types and open innovation governance modes at the project level is essential for choosing the appropriate partnership strategies to solve complex problems when relevant knowledge is not hidden (Bagherzadeh et al., 2022). The

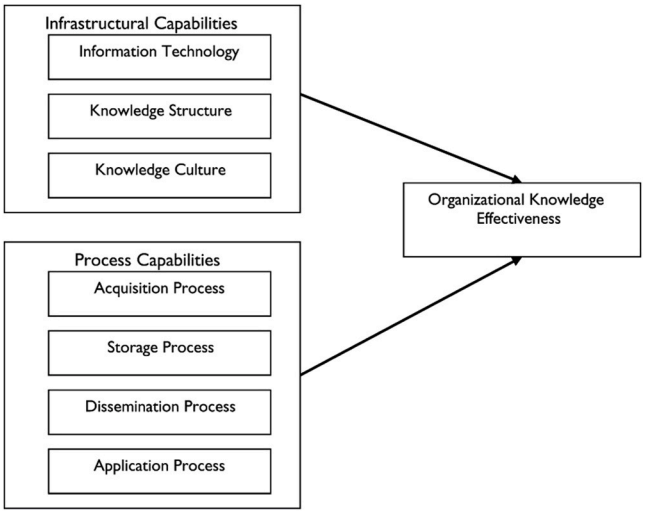


Fig. 1. Knowledge Management Capabilities and Organizational Effectiveness adapted from Bharadwaj et al. (2015).

Innovation Ecosystem framework directed to Sustainable Development Goal #17 partnerships implementation highlights the dynamic and purposive multi-stakeholders' networks with complex relationships built on trust, co-creation of value, and exchange of complementary technologies or competencies, which are essential for addressing complex problems (Duarte et al., 2021). Additionally, industry platforms and ecosystem innovation play a significant role in facilitating partnerships and sustaining a platform position, which can contribute to addressing complex problems (Gawer and Cusumano, 2013).

Understanding the power strategies that actors in cross-sector partnerships deploy to shape collective decisions to their advantage is crucial for navigating complex problem-solving processes (Dewulf and Elbers, 2018). Embracing integrated watershed revitalization and learning from global case studies can provide insights into addressing complex problems by creating a win–win strategy for wider stakeholders (Kim et al., 2021). Additionally, project and process management of public-private partnerships involves coping strategies and managerial tensions, which are essential for developing effective, innovative, and sustainable solutions that enjoy legitimacy and support from the local community (Krogh and Thygesen, 2022).

Science, Technology, and Society (STS) can significantly contribute to complex problem solving by providing a holistic understanding of the interplay between scientific and technological advancements, societal dynamics, and the ethical implications of innovation. STS emphasizes the need to critically interrogate the modernist project and highlights the diversity of voices and values of those involved in and affected by technoscientific change Simon et al. (2019). This critical perspective is essential for addressing complex problems that often involve diverse stakeholders and ethical considerations.

Moreover, STS provides a framework for understanding the sociotechnical dimensions of innovation and sociotechnical transitions, which are crucial for addressing complex problems that require systemic and interdisciplinary approaches (Slayton and Spinardi, 2016). The field of STS has also advocated for a 'participatory turn' in science, technology, and innovation, emphasizing the importance of involving diverse stakeholders in problem-solving processes (Delvenne and Macq, 2019). This participatory approach is particularly relevant for addressing complex societal challenges that require input from various actors and perspectives.

STS also plays a vital role in promoting the integration of science, technology, and society in education, which is essential for developing students' critical thinking, problem-solving abilities, and 21st-century competences (Voogt and Roblin, 2012; Yuenyong and Wongsila, 2019; Jumriani and Prasetyo, 2022; Saavedra and Opfer, 2012). By incorporating STS principles into the curriculum, students are provided with opportunities to apply their understandings to real-world situations, think critically, and work collaboratively, which are essential skills for addressing complex problems.

STS has been instrumental in exploring the implications of novel technoscience for society and the constitutive role of social factors in scientific knowledge and technological artifacts (Pickersgill, 2012). This perspective is crucial for understanding the broader societal impacts of technological innovations and for addressing complex problems that have far-reaching social, ethical, and environmental implications.

Technology Foresight and Strategic Planning (TFSC) can significantly contribute to complex problem solving by providing a systematic approach to anticipate and address future challenges and opportunities. TFSC involves the systematic exploration of potential future developments in science, technology, and innovation, and the formulation of strategies to leverage these developments for competitive advantage and societal benefit (Masara et al., 2021; Lew et al., 2019; Zhang et al., 2022).

Strategic foresight, enabled through scenario-planning and roadmapping, is a well-recognized method for dealing with uncertainty and complexity in the current business environment (Lew et al., 2019; Ho and O'Sullivan, 2018). By engaging in TFSC, organizations can anticipate potential future problems, identify critical technologies and research areas, and develop strategic plans to address these challenges (Masara et al., 2021; Almansoori et al., 2022). This proactive approach allows decision-makers to think strategically and immerse themselves in possible future scenarios, thereby enabling them to formulate effective strategies for complex problem solving (Almansoori et al., 2022).

Moreover, TFSC provides a comprehensive framework for long-term socioeconomic priorities, innovative strategies, and the development of national innovation systems ("undefined", 2021). It allows for the identification of technological trends, breakthroughs, and grand challenges, which are essential for strategic planning and policy-making in complex technological systems with high public interests (Ho and O'Sullivan, 2018; "undefined", 2021). Additionally, TFSC can be used to assess emerging technologies and identify areas of strategic research likely to yield the greatest economic and social benefits, thereby contributing to the proactive management of technological innovation (Chen and Daim, 2008).

TFSC methodologies and best practices can be applied to analyze technology innovation dynamics as part of public-private industrial sector-level strategic planning, providing insights into the implications of technological change for the economy, policy-making, and society (O'Sullivan et al., 2021). This approach is particularly valuable for addressing complex technological innovations and managing the standardization of smart systems, where TFSC can support the strategic foresight of standardization in heterogeneous areas (Ho and O'Sullivan, 2017).

2.7. Final remarks in open innovation

Yun et al., (2016) underscore the evolutionary trajectory of OI, highlighting how digital transformation and globalization have reshaped the innovation landscape. Their study delineates the transition from closed innovation models towards more dynamic, open ecosystems that leverage external knowledge and collaborations. The authors argue that this shift is not merely a strategic choice but a necessary adaptation to the increasing complexity of technological development and market demands (Yun et al., 2016).

Further extending the discussion on innovation ecosystems, Yun et al., (2020) examine how OI practices facilitate the creation of value within and across organizational boundaries. They identify critical factors such as network effects, knowledge diversity, and the role of intermediaries in enhancing the efficiency and effectiveness of innovation processes. This work emphasizes the importance of strategic ecosystem management in maximizing the potential of OI (Yun et al., 2020).

Addressing the interplay between OI and technological advancements, Park et al. (2018) explore how emerging technologies, such as artificial intelligence (AI) and the Internet of Things (IoT), are integrated into OI strategies. Their research highlights the dual role of these technologies as enablers of innovation processes and as focal areas for OI activities. The study provides insights into how organizations can harness these technologies to spur innovation while navigating the associated risks and uncertainties (Park et al., 2018).

Yun, Won, Park, and others have also contributed to understanding the societal impacts of OI. They advocate for leveraging OI not only for commercial success but also as a mechanism for addressing societal challenges such as sustainability, healthcare, and education. Their research calls for a broader application of OI principles to foster social innovation and drive meaningful change (Yun et al., 2020).

Building on the foundational works of Yun, Park, and their contemporaries, future research in OI should explore uncharted territories such as the implications of OI in emerging markets, the role of OI in promoting inclusive growth, and the measurement of OI's impact on innovation performance. These avenues promise to enrich the OI discourse and offer practical insights for organizations navigating the complexities of the modern innovation ecosystem.

Table 1 presents key topics from the literature review and lines of

Table 1
Main topics and lines of research.

Authors (Year)	Main Topics	Lines of Research
Simon et al. (1987)	Discusses decision-making and problem-solving in organizations, pointing out the significance of effective decision-making processes for solving complex problems.	Examines the impact of decision-making and problem-solving methodologies on organizational efficiency, performance, and the ability to navigate complex challenges.
Nonaka, (1991)	Focuses on knowledge as a source of competitive advantage, highlighting the importance of tacit and explicit knowledge in innovation. The importance of capturing, sharing, and effectively utilizing knowledge within organizations to gain a competitive edge and innovate continuously.	Investigates how the creation, sharing, and application of knowledge contribute to the innovation process and competitive advantage.
McLeod et al., (1995)	Organizations that fail to develop an appropriate structure run the risk of having the problem-solving process become an inefficient operation.	Increased competitiveness because of solving complex problems.
Chesbrough (2003), (2006)	OI framework revolutionizes the way companies approach innovation, advocating for the integration of external and internal ideas and technologies to bolster innovation efforts. This approach emphasizes the benefits of utilizing external knowledge to enhance innovation processes, while also acknowledging the challenges in adopting such a strategy	Explores strategic management of Open Innovation, the impact on R&D, the necessity for adaptive business models, and the development of innovation ecosystems.
Laursen and Salter (2006)	Focus on the breadth and depth of Open Innovation practices, analyzing how firms can benefit from engaging with a wide range of external sources for innovation while managing the risks associated with openness.	Investigates strategies for effectively managing relationships and collaborations with external partners to maximize innovation outcomes.
Mueller et al., (2007)	Decision-making is important due to the profound and substantial impact it has on the company's performance.	Does the collection of information delay the decision-making process, depending on the environment in which we live, whether it is stable or characterized by rapid changes?
Dahlander and Gann (2010)	Investigate the dynamics of open versus closed innovation models, particularly in terms of how companies interact with external partners and the governance mechanisms that support these interactions.	Explores the organizational, cultural, and operational challenges companies face in adopting Open Innovation practices and how to overcome them.
Carmeli et al., (2013)	Sharing knowledge to obtain quality solutions, to effectively address complex problems.	The impact that sharing knowledge in a team (team creativity) provides, as it is an organizational process.
West and Bogers (2013)	They emphasize the collaborative aspect of Open Innovation, including the roles of users, communities, and external networks in the innovation process. Their work highlights the importance of managing external collaborations to enhance innovation outcomes.	The significance of collaboration with external entities such as customers, research institutions, and other firms in driving innovation.
Lyles (2014)	Acquiring new external knowledge, as it allows direct contact with the advanced knowledge of other companies.	How communication within the company provides an environment conducive to knowledge sharing.
Ederer et al., (2015)	Improved performance and productivity because of the skills used to solve complex problems.	The importance of training people for organizational benefit.
Helfat and Peteraf (2015)	Increased competitiveness as a consequence of solving complex problems.	The importance of individual contribution to the process of solving complex problems.
Teece (2020)	Open innovation allows companies with internal capabilities to increase their capabilities through external sources of knowledge, resources, and ideas.	The role of open innovation in maintaining competitive advantage among outsourcing companies.

research.

3. Methodology

This research arises in response to the increasing complexity, technological advances, and competition in today's world. The solutions that companies had a few years ago are no longer sufficient for today's difficulties, due to the increasing complexity of the environment, constant change, and the non-linear nature of problems. Today, most jobs consist primarily of decision-making and problem-solving work, many of which are highly complex. Companies are increasingly looking for methodologies, tools, and knowledge that keep them in a relevant position in the market and differentiate them from the competition.

After an extensive review of the literature on this topic, it was not possible to reach a definitive conclusion regarding the best practice for solving complex problems. The authors propose different hypotheses, methodologies, organizational structures, practices, and even problem analysis methods. However, each complex problem is unique, making it difficult or impossible to find a general method that works in all scenarios. On the other hand, most authors agree that companies that strive to improve their organization, innovation, and knowledge acquisition become more prepared and capable of dealing with possible changes and challenges. However, considering some disagreement in the revisited literature, the relevance of this study arises. Thus, four main research questions were defined, and the main objective was to assess whether solving complex problems is a source of sustainable competitive advantage for organizations (Table 2).

To achieve the previously established research objectives, it was decided to carry out a qualitative approach, based on conducting interviews. The target audience was workers from different companies whose sector of activity was consultancy and who, in carrying out their various daily functions, included people management. The choice of workers with these characteristics was because they are workers from different companies, where different perspectives on the same topic are considered, which increases the heterogeneity of the sample. Second, consultancy workers, as their day-to-day work involves solving complex problems and this model is increasingly used in this sector to evaluate the competitive advantages of companies (Barney and Hesterly, 2010; Kubr, 2002). Thirdly, the choice of professionals who manage people on a day-to-day basis is because they have greater visibility into the impact that solving complex problems can have on both team performance and organization performance, and thus interviewees will have a greater

Table 2
Research questions and objectives.

Key research questions	Does the resolution of complex problems represent a source of competitive advantage for organizations?	
Lines of Future Research (Authors, Year)	Research Questions	Research Objective
The importance of individual contribution to the process of solving complex problems (Helfat and Peteraf, 2015). The importance of training people for organizational benefit (Ederer et al., 2015).The value of Open Innovation processes to solve complex problems Chesbrough (2003), (2006)	RQ1: Do you consider that solving complex problems generates value for your organization?	RO1: Assess whether solving complex problems generates value for organizations.
Does the collection of information delay the decision-making process, depending on the environment in which we live, whether it is stable or characterized by rapid changes? (Mueller et al., 2007).	RQ2: Do you consider that solving complex problems is rare?	RO2: Assess whether solving complex problems is rare for organizations.
The role of open innovation in maintaining competitive advantage among outsourcing companies (Teece, 2020). How communication within the company provides an environment conducive to knowledge sharing (Lyles, 2014).	RQ3: Do you consider solving complex problems to be inimitable?	RO3: Assess whether the resolution of complex problems is inimitable, that is, whether they are difficult for competitors to imitate.
The impact that sharing knowledge in a team (team creativity) provides, as it is an organizational process (Carmeli et al., 2013). The importance of all steps in the process of solving complex problems, aiming to achieve a faster and more effective resolution (McLeod et al., 1995). The importance of open innovation culture and knowledge in solving complex problems Nonaka, (1991)	RQ4: Do you consider that your organization is organized to enhance and explore the resolution of complex problems effectively?	RO4: Assess whether an organization can organize itself to enhance and explore the resolution of complex problems effectively.

perception of the added value that solving complex problems can represent for the organization and how these should or should not be incorporated into its strategy.

Twenty interviews were carried out, a number considered reasonable to validate the sample of a qualitative study (Creswell and Poth, 2016; Polkinghorne, 1989). These interviews lasted between 15 and 20 min and were conducted using Microsoft Teams and before each interview consent was requested for their recording. Regarding the structure of the interviews, they consisted of three parts and covered a total set of seven questions (Table 3). The initial part consisted of a brief introduction to the interviewees about the relevance of the study and introducing concepts that were crucial for a deeper understanding of the interview. In the second part, three descriptive questions were presented about the profession, professional experience, and the number of people responsible, to adequately characterize the sample and ensure its relevance for the study. The last part consisted of four interpretative questions, considering the central focus of the interview, where each one was

Table 3
Objectives, questions, and types of research questions.

Research objective	Question	Type of Question
Ensure the relevance and heterogeneity of the sample	1. What is your current role at the entity where you work?	Descriptive question
Ensure the relevance and heterogeneity of the sample	2. Number of years of professional experience?	Descriptive question
Ensure the relevance and heterogeneity of the sample	3. Is the function you perform, in your day-to-day life, the management and coordination of people/ teams? If yes, how many?	Descriptive question
Assess whether solving complex problems generates value for organizations	4. Do you consider that solving complex problems generates value for your organization?	Interpretative question
Assess whether solving complex problems is rare for organizations	5. Do you consider that solving complex problems is rare?	Interpretative question
Assess whether the resolution of complex problems is inimitable, that is, whether they are difficult for competitors to imitate	6. Do you consider solving complex problems to be inimitable?	Interpretative question
Assess whether an organization can organize itself to enhance and explore the resolution of complex problems effectively	7. Do you consider that your organization is organized to enhance and explore the resolution of complex problems effectively?	Interpretative question

directed to one of the VRIO requirements, to capture each interviewee's perspective on whether solving complex problems represents a source of competitive advantage for organizations. Regarding these four final questions, interviewees were instructed to respond in a binary manner, choosing "yes" or "no" and, in addition, they were asked to provide a brief explanation to support their answers. Once the interviews were finally completed and the relevance of each of them was ensured, the video content was transcribed into text format, using Word online and, subsequently, these transcriptions were compiled into a single document to facilitate the processing of information.

To assess whether solving complex problems leads to sustainable competitive advantage, the research applied the VRIO framework as a comprehensive criterion (Barney, 2002). The VRIO analysis evaluates resources or capabilities based on four criteria: Value, Rarity, Inimitability, and Organization:

Value: The research first assessed whether solving complex problems is valuable to organizations. This involves determining if this capability enables the company to exploit an opportunity or neutralize a threat in its environment, thereby enhancing efficiency and effectiveness.

Rarity: The rarity criterion examines whether solving complex problems is a capability that few competitors possess. This involves assessing if the capability is unique to the firm or if it is possessed by numerous competitors, which would make it less likely to provide a competitive advantage.

Inimitability: This aspect evaluates how difficult it is for competitors to imitate the problem-solving capability. The more costly and challenging it is to replicate, the more likely it is to provide a sustainable competitive advantage. Factors contributing to inimitability include unique historical conditions, causal ambiguity, and social complexity.

Organization: Finally, the organization criterion assesses whether a firm is organized to capture the value created by its ability to solve complex problems. This includes having the proper structures, processes, and policies in place to fully exploit the capability.

In conducting interviews using the VRIO framework, the methodology was structured to directly align with VRIO's four components: Value, Rarity, Inimitability, and Organization. The interviews were divided into two parts: the initial part aimed at characterizing the sample through descriptive questions about the interviewees'

profession, professional experience, and their role in managing people. This was essential for ensuring the relevance and heterogeneity of the sample, given the focus on consultancy sector professionals who are frequently involved in solving complex problems as part of their daily work.

The core of the interview process involved four interpretative questions, each tailored to one of the VRIO dimensions. Interviewees were asked to provide binary "yes" or "no" answers to questions on whether solving complex problems is Valuable, Rare, Inimitable, and whether their Organization is structured to exploit this capability effectively. These questions were designed to capture the interviewees' perspectives on the strategic importance and uniqueness of their problem-solving capabilities, as well as the organizational support for these activities. For each VRIO aspect, respondents were also requested to elaborate on their answers to provide depth and context, helping to understand not just whether these aspects were present but how they manifested within the organization.

This approach ensured that the data collected were directly relevant to assessing the potential of complex problem-solving as a source of sustainable competitive advantage. By structuring the interviews around the VRIO framework, the research was able to systematically evaluate each component's presence and effectiveness in the context of the interviewed organizations, thereby providing a robust analysis of complex problem-solving capabilities within the consultancy sector.

The study meticulously selected interviewees and designed measures to ensure the reliability and validity of their responses through a comprehensive approach. Interviewees were chosen from the consultancy sector, particularly targeting professionals in leadership roles such as Chief Executive Officer (CEO), Chief Financial Officer (CFO), Directors, Managers, and Senior Managers. This selection aimed to capture insights from individuals likely to face complex problem-solving in their routine activities, ensuring a relevant and informed participant pool. Each participant was required to have over five years of professional experience, with a significant number having more than two decades, ensuring a depth of industry knowledge and experience in handling complex issues.

Furthermore, the focus was on individuals who managed or coordinated people, specifically those overseeing at least three team members, with some managing teams of fifteen or more. This criterion was vital for including perspectives from those with firsthand experience in solving complex problems within a team context, which could significantly influence organizational performance and strategic outcomes.

The structure of the interviews was carefully planned, consisting of seven questions that included both descriptive and interpretative elements based on the VRIO framework—Value, Rarity, Inimitability, and Organization. This structured approach aligned with the research objectives, aiming to directly assess the strategic importance of complex problem-solving. The process of transcribing and analyzing the interviews using qualitative data analysis software further ensured the reliability of the findings, grounding the analysis in the collected data. Through this meticulous selection and structured interview process, the study aimed to provide reliable and valid insights into the impact of complex problem-solving on competitive advantage.

4. Data analysis

This section presents the qualitative analysis of the interviews conducted through data processing and the corresponding findings. This analysis was carried out using KH Coder 3 software and Microsoft Office Excel.

4.1. Characterization of the sample

This research was developed by conducting interviews with a group made up of 20 professionals who occupy ethical or leadership positions and are responsible for coordinating people as part of their tasks. The detailed characterization of the sample plays an important role in ensuring the quality and relevance of the information acquired. In this context, the sample selection for this study focused on three main aspects: profession, professional experience, and coordination of people/teams.

4.1.1. Profession

Regarding the profession of the interviewees, five divisions of different categories were made: Chief Executive Officer (CEO), Chief Financial Officer (CFO), Director, Manager, and Senior Manager. It is possible to verify, through Fig. 2, that all interviewees hold management and decision-making positions, of which 30% are in the position of Director and 25% are CEOs.

4.1.2. Professional experience

In terms of the professional experience of the interviewees, it is possible to observe that all professionals have a career of more than 5 years (Fig. 3) with a large proportion of professionals (40%) having a professional career of at least 20 years of experience (Table 4).

4.1.3. Coordination of people/team

Regarding the number of people that the interviewees are responsible for managing in the performance of their duties, it is possible to observe, as shown in Fig. 4, that only 1 professional has no one to manage on a day-to-day basis and the remaining professionals manage at least 3 people, with 30% of them ending up coordinating a team made up of at least 15 people and 55% ending up coordinating a team with less than 10 members (Table 5).

4.2. VRIO model

Given the growing importance that organizations attribute to solving complex problems and the numerous challenges that have emerged in the business context, together with the possible advantages that these resolutions can bring and some uncertainty in the existing literature on the subject, we chose to apply the VRIO model to a representative sample of 20 interviewees, to evaluate whether the resolution of complex problems can effectively represent a source of sustainable competitive advantage for them. Therefore, as shown in Fig. 5, it becomes clear that 90% of interviewees have the opinion that this resource results in competitive parity between companies, with the remaining 10% considering that this resource results in a temporary competitive advantage. Regarding Table 6, it is possible to observe the compilation of all the answers given by the interviewees.

4.2.1. Value

Concerning the first pillar of the VRIO model, whose purpose is to analyze whether a certain internal resource generates value for an organization, it is possible to verify that all interviewees answered "yes",

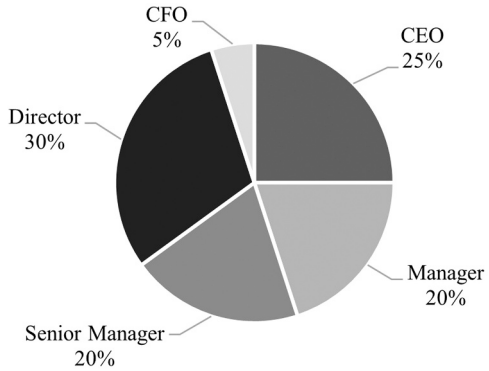


Fig. 2. Interviewees' professions and categories. Source: Authors.

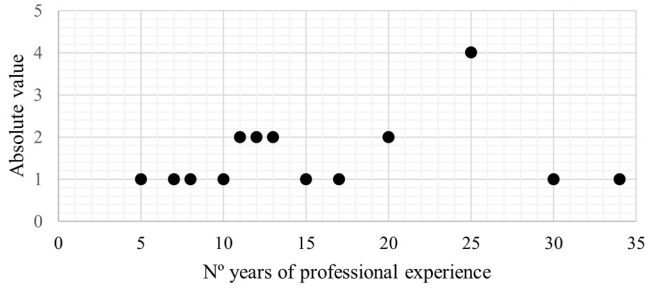


Fig. 3. Professional Experience. Source: Authors.

Table 4
Professional Experience.

	Absolute Value	Value Percentage
$x < 10$	3	15%
$10 \leq x < 15$	7	35%
$15 \leq x < 20$	2	10%
$x \geq 20$	8	40%

x —Number of years of professional experience
Source: Authors.

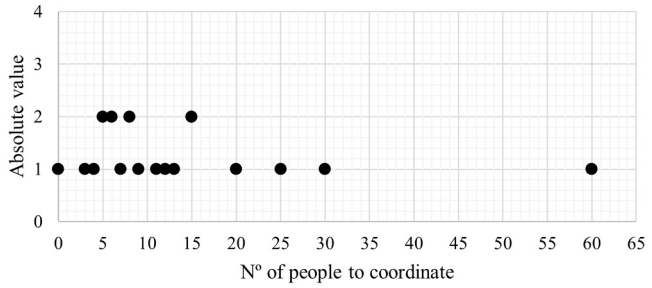


Fig. 4. Coordination of people. Source: Authors.

Table 5
Coordination of people.

	Absolute Value	Value Percentage
$N < 10$	11	55%
$10 \leq N < 15$	3	15%
$15 \leq N < 20$	2	10%
$N \geq 20$	4	20%

N - Number of people to coordinate
Source: Authors

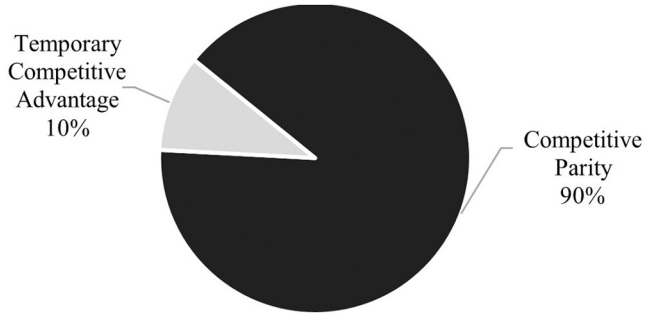


Fig. 5. VRIO model. Source: Authors.

Table 6
Interviews – responses.

	VRIO model			
	Valuable?	Rare?	Inimitable?	Organization?
Interviewee 1	Yes	Yes	No	Yes
Interviewee 2	Yes	No	No	Yes
Interviewee 3	Yes	No	Yes	Yes
Interviewee 4	Yes	No	No	Yes
Interviewee 5	Yes	No	No	Yes
Interviewee 6	Yes	No	No	Yes
Interviewee 7	Yes	No	No	Yes
Interviewee 8	Yes	No	No	Yes
Interviewee 9	Yes	No	No	Yes
Interviewee 10	Yes	No	No	Yes
Interviewee 11	Yes	No	No	No
Interviewee 12	Yes	No	No	Yes
Interviewee 13	Yes	No	No	Yes
Interviewee 14	Yes	Yes	No	No
Interviewee 15	Yes	No	No	Yes
Interviewee 16	Yes	No	No	Yes
Interviewee 17	Yes	No	No	Yes
Interviewee 18	Yes	No	No	Yes
Interviewee 19	Yes	No	No	Yes
Interviewee 20	Yes	No	No	Yes

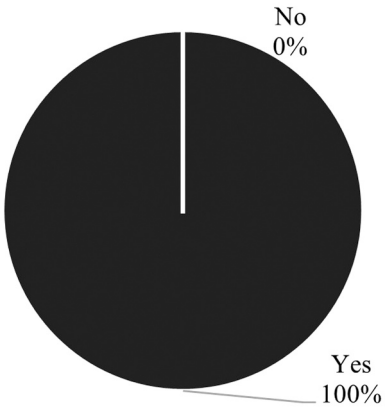


Fig.6. VRIO model – value. Source: Authors.

considering that solving complex problems generates value for your organization (Fig. 6).

Given the answers given by the interviewees to this question, it is important to analyze the main justifications presented by them. Firstly, using the word frequency list (Fig. 7) and word cloud (Fig. 8), both text mining tools, it is possible to examine a global perspective of the main trends, identifying the keywords that had the highest recurrence during the interviews. The most used keywords were “business”, “revenue”, and “client” which have relevance as they are associated with the topic in question. It is also important to highlight some words, such as “grow”, “competition”, and “differentiate”, which are frequently mentioned as a result or reason why companies believe that solving complex problems provides value to organizations (Fig. 8).

Moreover, to analyze their relevance with a greater degree of certainty and frame these words, two other text mining tools were applied, Bigram and Trigram, which allowed us to establish a direct connection more precisely between the words and formulate more solid conclusions. Thus, the most frequently identified expression through Bigram (Table 7), is business growth, which reinforces the idea mentioned previously by the interviewees who consider that the resolution of complex problems generate value for the organization. Additionally, it is important to note the importance given to solving customer problems (resolve problems clients) being the most identified expression through the Trigram (Table 8), since this aspect allows organizations to differentiate themselves from the competition (able differentiate

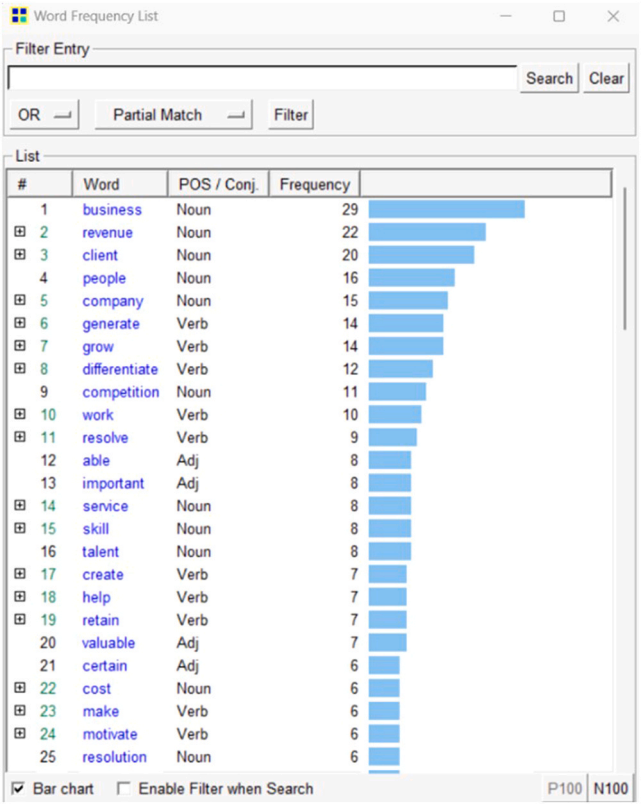


Fig. 7. Word frequency list: value. Source: KH Coder 3.

competition), triggering a progressive increase in customers and business opportunities, contributing to the company's growth (help business grow) and, therefore, an increase in revenue (generate higher revenue).

Also, by analyzing the mind map shown in Fig. 9, it is possible to confirm the results obtained from the analyses carried out previously. The relationship between the ability to solve complex problems and the benefits they provide to the organization becomes even more evident. In yellow, purple, orange, and blue, we can see the aspects that the interviewees consider fundamental to achieving success and in obtaining greater value in solving complex problems for their organizations. Even so, when observing the mind map in greater detail, in the most central area, in light green, the word "competition" stands out, making clearer the advantage of the ability to solve complex problems, which, in turn, is highlighted in red, a relationship between business growth, increased revenue and the resolution of customer problems.

4.2.2. Rarity

By analyzing the second pillar of the VRIO model which means that a resource is rare when it is acquired by one or a few competitors, 90% of those interviewed consider that the resolution of complex problems is not rare. Thus, these resolutions may lead to competitive parity as numerous organizations have the same resource (Fig. 10).

Using the analysis of the word frequency list (Fig. 11) and the word cloud (Fig. 12), regarding the justifications given by the interviewees to this question, it became clear that words such as "people", "internally", "usual", and "externally" were the words most used by them. Furthermore, it is important to highlight that based on the research results, the words "tools", "team", and "methodologies" also appeared frequently in the interviewees' responses.

When analyzing Bigram (Table 9) and Trigram (Table 10), it is possible to see that the most frequent expression in Bigram is external problems (Problems externally), as it is linked to the business model adopted by the companies of the professionals who were interviewed.

Moreover, it is important to highlight that they identified that there are also internal problems (problems internally), being able to solve problems internally (able resolve internally), although this ability is conditioned on the inherent complexity of the problems (depending problems) themselves. Regarding solving external and internal problems it was mentioned that they face a big challenge which are issues related to people (Biggest challenges people). People must be competent in solving existing complex problems and they must have the capabilities, methodologies, and tools (People tools methodologies) necessary to effectively address these problems.

Finally, looking at the mind map in Fig. 13, it becomes evident in yellow, the importance given to issues related to people which are important for the effective resolution of complex problems, both internal and external, with the use of appropriate methodologies and tools, justified in purple as being one of the biggest challenges mentioned by

Table 7
Bigram: value.

N-gram	Frequency
Business grow	7
Generate revenue	5
Problems clients	5
Able differentiate	4
Help business	3

Table 8
Trigram: value.

N-gram	Frequency
Resolve problems clients	5
Help business grow	3
Differentiate make business	2
Generate higher revenue	2
Able differentiate competition	2



Fig. 8. Word cloud: value. Source: Tag Crowd.

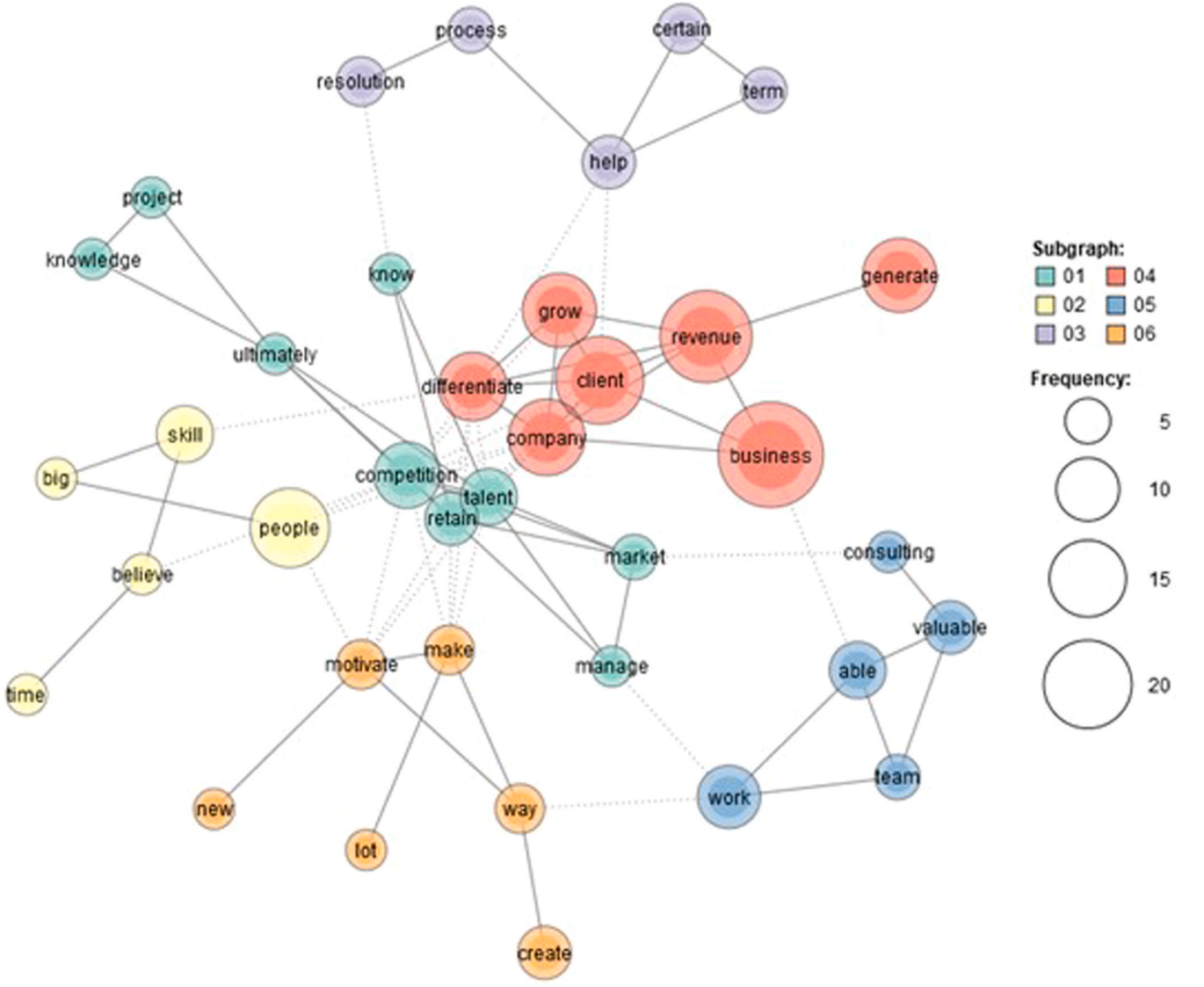


Fig. 9. Mind map: value. Source: KH Coder 3.

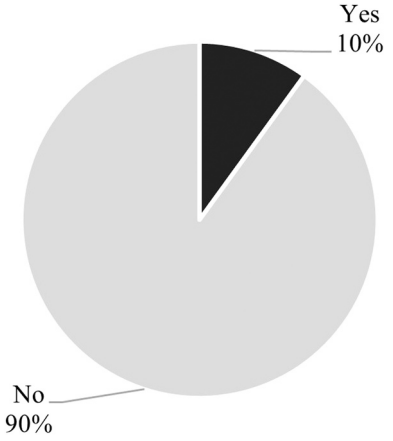


Fig. 10. VRIO model – rarity. Source: Authors.

the interviewees. In light green, the resolution of internal problems is linked to the existing complexity, both in the problem itself and in the project in question. Meanwhile, in green, the importance attributed by interviewees to solving complex external problems is notable, as their resolution is usual and mandatory given that it is the business model of these companies and interviewees go so far as to express that non-compliance may result in bankruptcy.

4.2.3. *Inimitability*

Regarding the third pillar of the VRIO model, which determines whether a resource is difficult for competitors to imitate, it is possible to observe that 90% of interviewees consider that resolutions are easy for competitors to imitate (Fig. 14).

Using the word frequency list (Fig. 15) and word cloud (Fig. 16) tools, it is evident to highlight words such as “imitate”, “competitor”, and “methodology” in the interviewees’ responses. These words appear to be some of the most frequently used by professionals, which contribute to the understanding of the main reasons highlighted by them when considering that the resolution of complex problems can be imitated.

Additionally, words such as “organization”, “people”, “process”, and “technology” are also mentioned by interviewees.

Moreover, it is possible to verify that the expression most frequently mentioned by interviewees is process optimization (optimization process) (Table 11). Process optimization and the search for more efficient

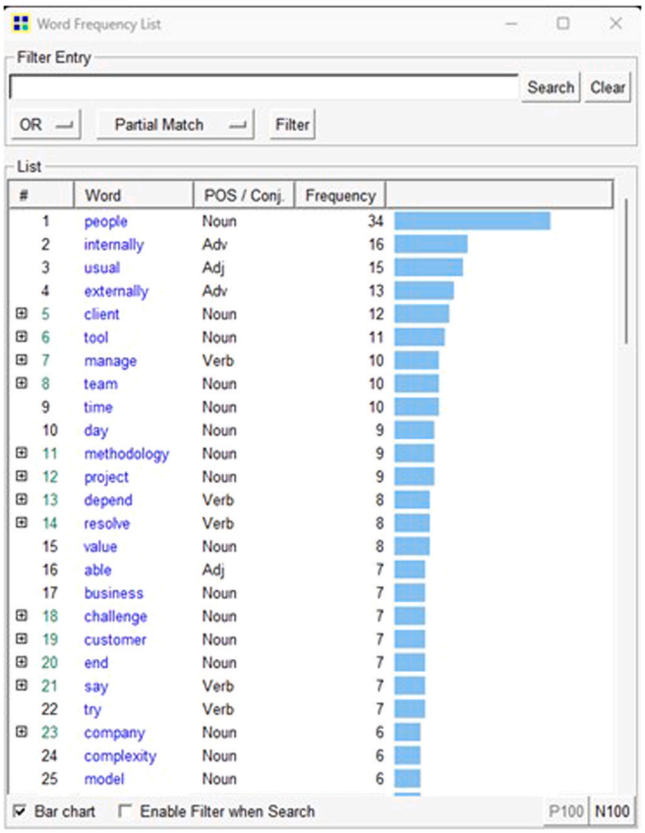


Fig. 11. Word frequency list: rarity. Source: KH Coder 3.

ways to address challenges are considered essential by interviewees. They also emphasize the importance of people suggesting that companies that promote collaborative work environments and cultivate a collaborative mindset (collaborative people mindset) have an advantage in solving complex problems, as people are a valuable resource, with their contributions and insights, being better positioned to address complex challenges comprehensively. Interviewees also mentioned the importance given to adopting technological innovation (adopting innovative technology) to boost efficiency in solving problems (Table 12).

Furthermore, when analyzing the mind map in Fig. 17 we can identify several important relationships and needs for companies. Firstly, we highlight the importance of the ability to imitate the competition (orange). This is not only limited to the replication of best organizational practices but also covers efficient processes and successful methodologies (light green). This ability to imitate plays a fundamental role in maintaining the company's competitiveness in the market and attracting customers (yellow).

4.2.4. Organization

Regarding the last pillar of the VRIO model which explores the ability of an organization to be sufficiently well organized to leverage and exploit a given resource appropriately and effectively, it is observed that 90% of those interviewed answered "yes", despite not evaluating that solving complex problems is rare and inimitable, consider that their organization is sufficiently organized and can use this resource appropriately and effectively (Fig. 18).

By analyzing the word frequency list (Fig. 19) and the word cloud (Fig. 20), it is possible to verify words such as "structure", "efficiency", and "motivation", as being the words most mentioned by interviewees.

Furthermore, it is important to mention words such as "retention", "communication", and "improvement", since all these words have the purpose of identifying the predominant reasons mentioned by the interviewees that explain why their organization has abilities to organize and enhance the resolution of complex problems.

Moreover, it is possible to verify that the expression most frequently mentioned by interviewees is talent retention (Table 13). Interviewees mentioned that it is important to create an environment that motivates people which encourages them to regularly participate in training (talent retention training), to preserve and cultivate talent (Table 14). Furthermore, the interviewees mentioned that it is essential not only to encourage this search for these development opportunities but also to maintain the motivation to continue improving their capabilities and retaining the knowledge acquired (knowledge retention) since by retaining talented people with more developed skills they will be better prepared to solve complex problems more effectively (Table 13).

Table 9
Bigram: rarity.

N-gram	Frequency
Problems externally	7
Business model	6
Tools methodologies	4
Problems internally	4
Challenges people	4
Depending problems	3

Table 10
Trigram: rarity.

N-gram	Frequency
Biggest challenges people	4
Depending problems complexity	3
Issue scarce resources	3
Resolving problems externally	2
Able resolve internally	2
People tools methodologies	2



Fig. 12. Word cloud: rarity. Source: Tag Crowd.

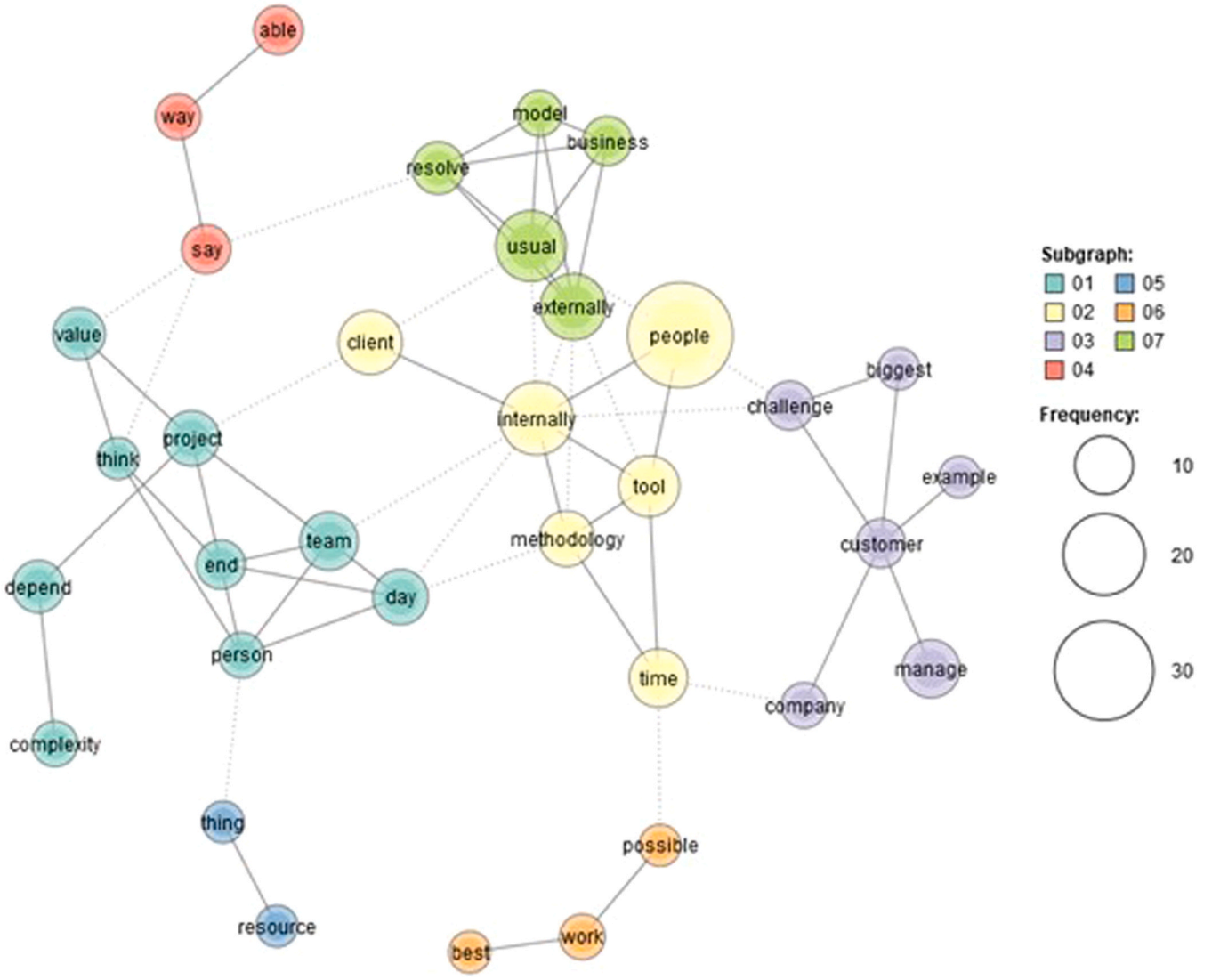


Fig. 13. Mind map: rarity. Source: KH Coder 3.

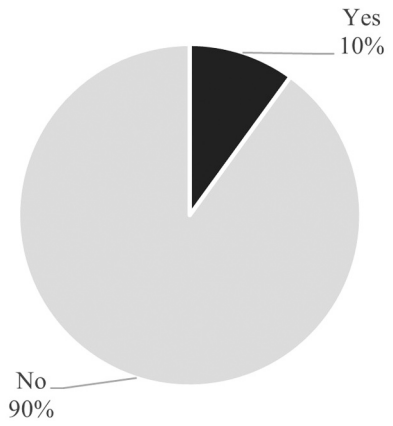


Fig. 14. VRIO model – inimitability. Source: Authors.

Another theme that is highlighted by the interviewees is that these organizations are committed to continuous improvement (commitment continuous), which reflects how organizations are constantly innovating and evolving to maintain their competitiveness and effectiveness in the market. It is essential that organizations remain strategically structured (organization strategically structured), to support the constant search for improvements and making the most of their resources.

Finally, through the analysis of the Mind map (Fig. 21) it is possible to observe the focus of companies on retaining talent and the importance they give (yellow), as it is not just about retaining people but keeping them motivated and committed, as a motivated team is more likely to seek improvements and efficiencies in their work (purple) by taking advantage of the effective knowledge they have. To ensure that motivation is effective, communication plays a fundamental role (light green) as a structured organization that promotes efficient communication can align goals and expectations so that all team members are in agreement.

5. Results and discussion

The central objective of this chapter is to identify the main results relating to the research questions addressed and point out their main contributions to the study. Therefore, the answers to the 4 research questions associated with the application of the VRIO model will be presented.

RQ1: Do you consider that solving complex problems generates value for your organization?

As for the value that solving complex problems can provide, all

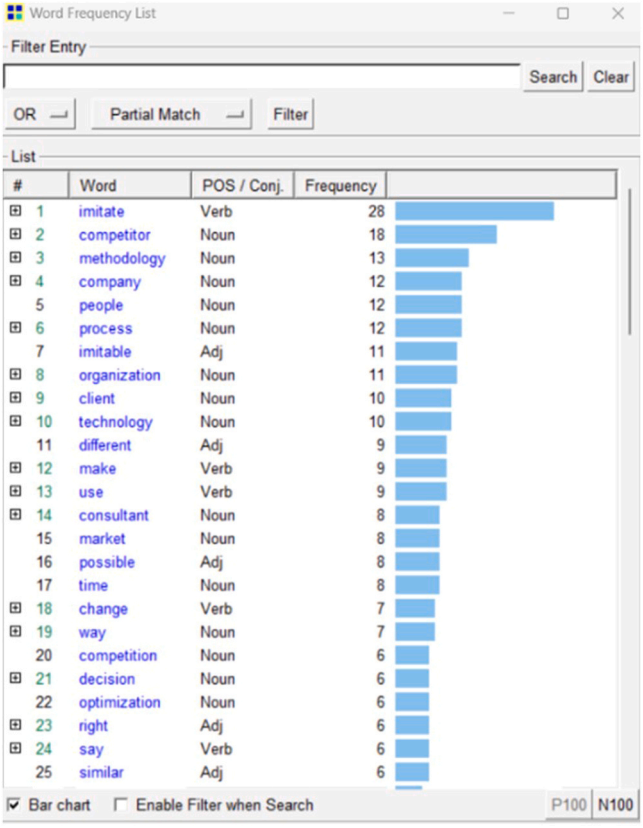


Fig. 15. Word frequency list: inimitability. Source: KH Coder 3.

interviewees considered that this skill generates value for their organizations. Ederer et al. (2015) considered that the skills used to solve complex problems by organizations result in an improvement in performance and productivity which in turn drive business growth and an increase in organizations' revenues (Ederer et al., 2015), with these results being highlighted as one of the main justifications in the interviews to justify the added value generated by these resolutions. All organizations deal with numerous sets of problems and challenges and these problems and challenges must be overcome efficiently and effectively (Iuga and Rosca, 2017). The interviewees highlighted the importance given to resolving the issues of its customers as a means of remaining competitive in the market. Thus, following the ideas exposed by Helfat and Peteraf (2015), who argued that solving complex problems provides an increase in the level of competitiveness, and since this resource is classified as valuable, organizations must recognize the value of this resource as it plays a fundamental role in the ability of organizations to remain competitive in the market (Helfat and Peteraf, 2015).

RQ2: Do you consider that solving complex problems is rare?

Regarding the intended assessment of whether the resolution of complex problems is rare, whether it is held by one or a few competitors, 90% of the interviewees considered that these resolutions are not rare, therefore it is a resource that is available to several organizations. They considered that resolutions to problems are easy to adopt due to their common practice, as they are common in their organizations and are part of their business model which ends up making them more frequent. They also identified that one of the biggest challenges they faced in solving complex problems was related to people, where they recognized the importance they have, and that the resolutions would not be viable without them. Also, the decisions they made had a profound and substantial effect on the company's performance (Mueller et al., 2007), and their success depends on the high-quality strategic decisions that must be made (Bresser and Powalla, 2012).

RQ3: Do you consider solving complex problems to be inimitable?

Concerning the analysis on whether the resolution of complex problems is inimitable, that is, if it is difficult for competitors to imitate, 90% of those interviewed considered that they are not inimitable. The interviewees considered that these resolutions are possible and easy to imitate by any organization, and with the ability to adjust them to their own needs. They also considered the importance of adopting innovative technologies to improve efficiency and productivity, reduce repetitive and time-consuming tasks, and obtain greater capacity in carrying out advanced data analysis. Also, interviewees mentioned the mentality of collaboration between people to stimulate creativity through developed

Table 11
Bigram: Inimitability.

N-gram	Frequency
Optimization process	6
Collaborative people	6
Possible imitate	5
Methodology optimization	5
People mindset	3
Adopting innovative	2
Innovative methodology	2

Table 12
Trigram: Inimitability.

N-gram	Frequency
Methodology optimization process	5
Collaborative people mindset	3
Yes possible imitate	3
Adopting innovative technology	2
Changing industry dynamics	2
Information make decision	2
Innovative methodology optimization	2



Fig. 16. Word cloud: inimitability. Source: Tag Crowd.

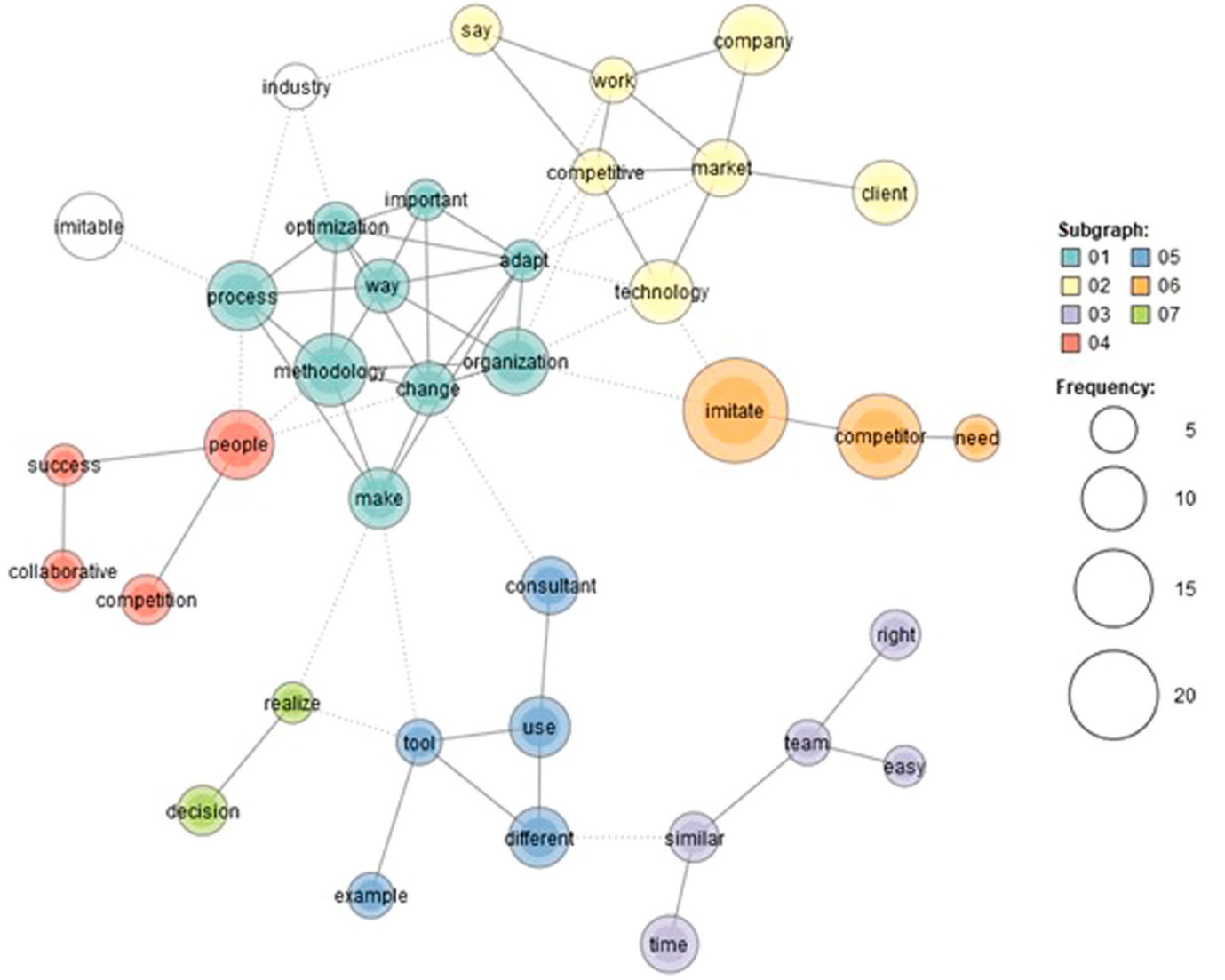


Fig. 17. Mind map: inimitability. Source: KH Coder 3.

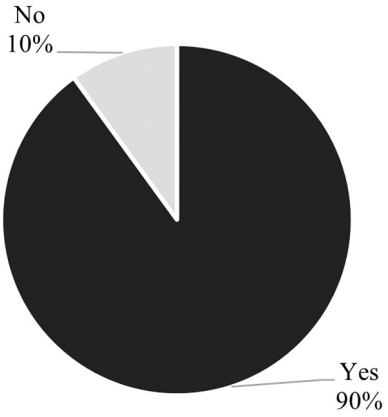


Fig. 18. VRIO model – organization. Source: Authors.

methodologies and tools. Finally, the interviewees mentioned that it is equally important to obtain knowledge, resources, and ideas not only through internal capabilities but also through external sources, as it allows to be in direct contact with the advanced knowledge of other companies (Lyles, 2014), making them more attentive and willing to imitate the competition, which leads to better innovation results (Teece, 2007; West and Bogers, 2011) to solve complex problems as efficiently and quickly as possible.

RQ4: Do you consider that your organization is organized to enhance and explore the resolution of complex problems effectively?

Finally, when assessing whether organizations had sufficient capabilities to organize themselves to adequately enhance and explore the resolution of complex problems, 90% of those interviewed considered that their organizations have the necessary capabilities to organize themselves to leverage this resource appropriately and effectively. However, they considered that there is room for improvement and development since it is a complex topic that changes depending on the type of problem and its complexity. They also considered the importance of retaining talent as one of the most cited reasons for solving complex problems, as it directly impacts a company's ability to face problems, thus allowing organizations to maintain experts with accumulated experience and maintain a constant focus on customer needs over time. It was also identified by the interviewees that it is important to share knowledge and improve communication about problems to obtain

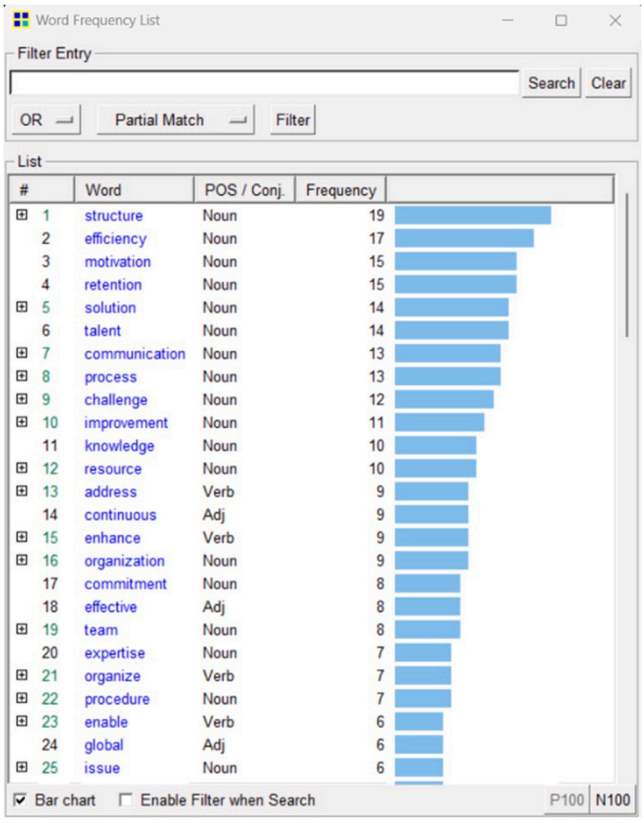


Fig. 19. Word frequency list: organization. Source: KH Coder 3.

quality solutions, making their resolution easier (Carmeli et al., 2013). Also, it was mentioned an important challenge for organizations which involves developing an appropriate structure to be able to have an effective complex problem-solving process, an idea defended by McLeod et al., (1995), who stated that organizations that failed to develop an appropriate structure ran the risk of having the problem-solving process as an ineffective operation (McLeod et al., 1995).

Therefore, as the four distinct indicators present in the VRIO model were analyzed and the model was applied to the resolution of complex problems in response to the central question of this research, the resolution of complex problems does not represent a source of sustainable competitive advantage for companies, but it leads to it being at competitive parity with its competitors since this resource was considered valuable, but not rare, by most professionals, as shown in Table 15.

Moreover, investigating this resource will not result in a competitive advantage, however, the lack of exploitation of it can place a company in a position of competitive disadvantage, thus companies must incorporate these resolutions, as a way of guaranteeing, at least, its position in the market.

Therefore, after having demonstrated and substantiated the value arising from solving complex problems and the ability of organizations to structure themselves, it becomes essential for them to overcome the non-rarity and inimitability associated with this resource.

As for the non-rarity associated with solving complex problems, it is essential to adopt solutions that are easier and more innovative than others. The way an organization can differentiate itself from the rest by solving complex problems makes it unique and capable of attracting customers and being more resilient to change. It must acquire rare and distinct capabilities compared to its competitors to increase its value perceived by its customers. Thus, organizations must reveal creativity and stimulate development for the implementation of new resolutions to add value.

Although companies may have the ability to develop solutions to rare complex problems if they cannot make them inimitable organizations end up achieving only a temporary competitive advantage.

Obtaining a sustainable competitive advantage by organizations involves constantly overcoming various obstacles over time. This involves creating an environment that promotes creativity, experimentation, and learning. It remains essential to invest in training and skills development for employees to ensure that they acquire the necessary skills to address

Table 13
Bigram: organization.

N-gram	Frequency
Talent retention	11
Continuous improvement	9
Retention motivation	8
Commitment continuous	4
Knowledge retention	4
Yes organization	4
Training motivation	3
Motivation communication	3
Organization strategically	2
Effective communication	2

Table 14
Trigram: organization.

N-gram	Frequency
Commitment continuous improvement	4
Talent retention training	4
Knowledge retention motivation	3
Retention training motivation	3
Organization strategically structured	2
Ensuring seamless collaboration	2
Commitment client satisfaction	2
Retention motivation enabling	2
Efficiency continuous improvement	2
Yes organization strategically	2



Fig. 20. Word cloud: organization. Source: Tag Crowd.

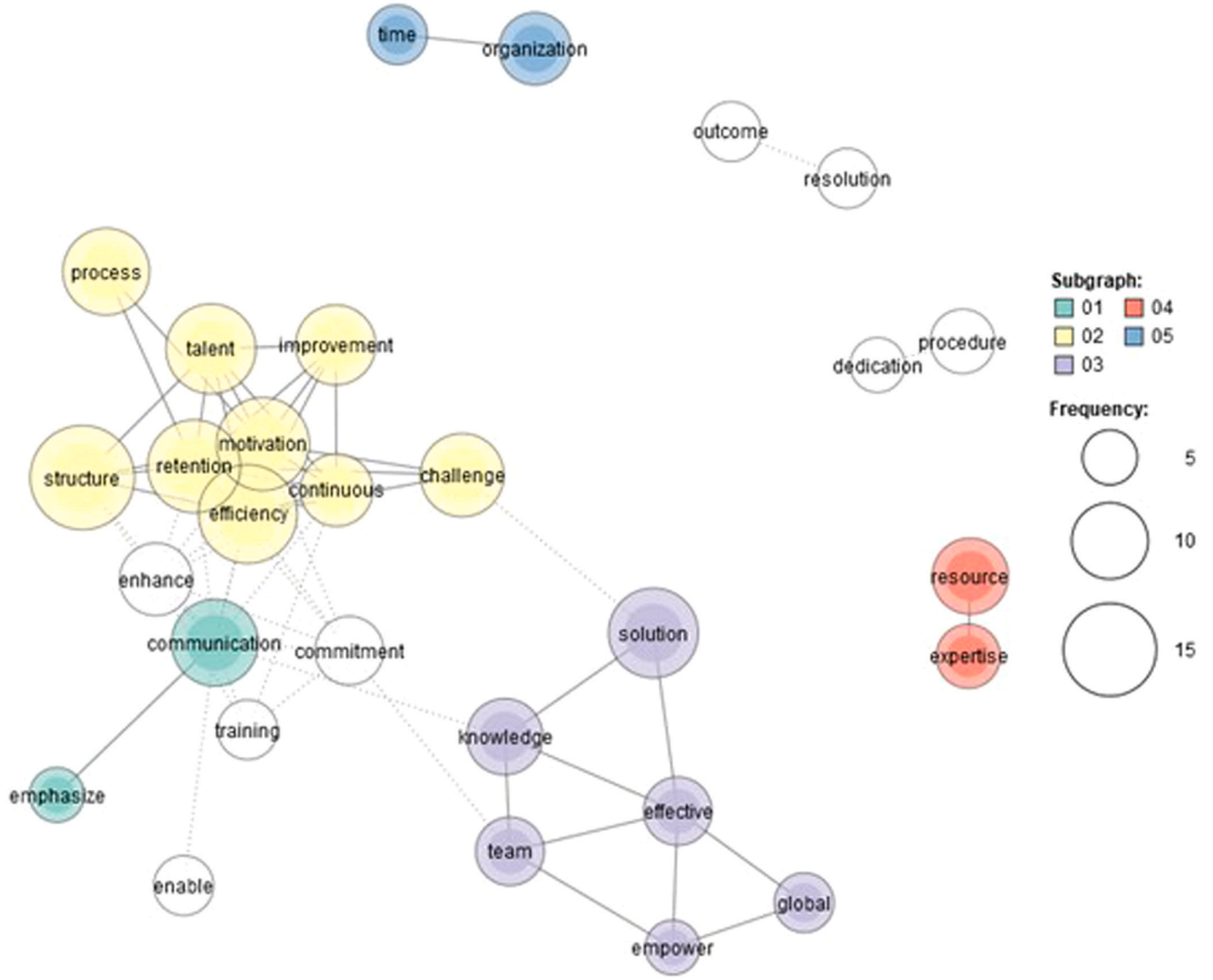


Fig. 21. Mind map: organization. Source: KH Coder 3.

Table 15
VRIO model – results. Source: adapted from Barney (2002).

Value?	Rare?	Hard to imitate?	Exploited by the Firm?	What is the result?	Results (%)
No	-	-	-	Competitive Disadvantage	0%
Yes	No	-	-	Competitive Parity	90%
Yes	Yes	No	-	Temporary Competitive Advantage	10%
Yes	Yes	Yes	No	Unusual Competitive Advantage	0%
Yes	Yes	Yes	Yes	Sustainable Competitive Advantage	0%

complex problems which contributes to the retention of organizational talent. Additionally, effective communication and teamwork play a fundamental role in addressing the complexity inherent to challenges. Furthermore, top managers must have a clear vision, make use of the appropriate technological tools, and be adequately prepared to manage the risks associated with solving complex problems.

The role that management teams must develop becomes important to guarantee the inimitability of solving complex problems, developing innovative methodologies and tools in the market, and maintaining the knowledge used to create them internally so that they persist in the organization in the long term. The more innovative and complex the resolutions to complex problems, the greater the likelihood of establishing a sustainable competitive advantage (Table 16).

6. Conclusion

Through this study, it was possible to analyze that solving complex problems is an extremely important skill and is considered an essential element in organizations. Moreover, the impact that these resolutions have on organizations and their ability to deal with them was addressed, as the ability to identify innovative and effective solutions to complex problems not only improves operational efficiency but also strengthens the position of organizations in the market.

Thus, the results obtained suggest that the resolution of complex problems represents a source of competitive parity for organizations. After applying the VRIO model to evaluate whether solving complex problems represents a source of sustainable competitive advantage, it was possible to access that although it was considered valuable it was considered not rare, thus providing competitive parity. However,

Table 16
Main theoretical and practical contributions.

Authors (Year)	Main Topics	Theoretical/Practical Contribution
McLeod et al., (1995)	Organizations that fail to develop an appropriate structure risk having the problem-solving process become an ineffective operation	Need to have an appropriate structure for the problem-solving process to be effective
Chesbrough (2003), (2006)	Introduction of Open Innovation; Benefits of leveraging external knowledge and technologies; Challenges and strategies in implementing Open Innovation.	Practical guidance on implementing Open Innovation strategies, highlighting case studies or examples where firms have successfully navigated complex problems by engaging with external partners, startups, or through crowdsourcing platforms.
Dahlander and Gann (2010)	Dynamics between open and closed innovation models.	Case analyses demonstrating how companies have toggled between open and closed innovation approaches to address specific complex problems, providing lessons on the situational effectiveness of each model.
Mueller et al., (2007)	Decision-making is important because of the profound and substantial effect it has on company performance	Possibility of adjusting the resolution of complex problems to the needs of organizations and individuals
Carmeli et al., (2013)	Sharing knowledge to obtain quality solutions to solve complex problems effectively	Sharing knowledge makes it possible to obtain quality solutions in solving complex problems
West and Bogers (2013)	Collaborative aspects of Open Innovation; Role of external networks and user communities.	Insights into the management of Open Innovation ecosystems, offering strategies for effective collaboration and knowledge sharing that can be applied to complex problem-solving scenarios.
Lyles (2014)	Obtain new external knowledge, as it allows to be in direct contact with advanced knowledge from other companies	Using external knowledge to keep the organization competitive
Ederer et al. (2015)	Improved performance and productivity as a result of skills used to solve complex problems	Productivity growth resulting from implementing complex problem-solving
Helfat and Peteraf (2015)	Increased level of competitiveness as a result of solving complex problems	Resource considered valuable, playing a fundamental role in competitiveness
Teece (2020)	Open innovation allows companies with internal capabilities to increase their capabilities through external sources of knowledge, resources, and ideas	Obtaining external knowledge enables the development of more efficient solutions to solve complex problems

companies must recognize the importance of incorporating these resolutions as they play a fundamental role in maintaining their competitiveness, and failure to incorporate them can place an organization in a position of competitive disadvantage.

Concerning the value generated by solving complex problems, it was possible to analyze that these resolutions contribute to the growth of the organizations' business and, therefore, the increase in revenue, because organizations are concerned with resolving their customers' problems which allows the organizations to differentiate themselves from competitors.

It was also possible to observe that problem-solving has been an increasingly relevant and common topic in business, due to constant change, growing complexity, technological advances, and competition in today's world.

At the level of inimitability, it was also concluded that the incorporations of these resolutions are easy to be imitated by the competition, highlighting the importance of people, as they are a valuable resource, and that companies must promote collaborative work environments that cultivate a collaborative mindset.

Finally, even though resolutions to these problems are not rare or inimitable, it was found that organizations believe they have the necessary capacity to explore and leverage this resource, giving special importance to retaining talent, creating an environment in which it motivates people, stimulating them and, above all, that they can improve their abilities and retain the knowledge acquired because people with more developed skills can solve complex problems more quickly and effectively.

Therefore, solving complex problems is an extremely important and valuable skill that can boost the success of any organization. Understanding the nature of the problem and its value allows organizations to adapt more effectively to market changes and thus achieve a strong position in a dynamic business scenario to seek a lasting competitive advantage.

7. Implications and limitations

The research identifies several key implications and contributions to the understanding of complex problem-solving within organizational contexts and its relation to competitive advantage. The study underscores that while complex problem solving is a valuable skill that enhances organizational performance and productivity, contributing significantly to a company's ability to remain competitive, it alone does not guarantee a sustainable competitive advantage due to its non-rarity and potential for imitation by competitors.

The implications of this research are multifaceted. Firstly, it highlights the necessity for organizations to develop a structured approach to complex problem-solving that incorporates both internal and external knowledge sources, emphasizing the importance of knowledge sharing and collaboration. This approach can enhance the quality of solutions and maintain organizational competitiveness. Secondly, the findings suggest that organizations need to focus on creating environments that foster innovation, support continuous learning, and encourage the development of unique problem-solving capabilities to achieve a competitive edge.

In terms of contributions, the study enriches the dynamic capabilities framework by providing insights into how complex problem-solving capabilities can be effectively leveraged within the context of open innovation. It also offers practical guidance for managers on structuring their organizations to maximize the potential of complex problem-solving skills, emphasizing the role of strategic foresight, knowledge management, and the cultivation of a collaborative culture. Additionally, the research contributes to academic discussions on the strategic management of technological innovation and the importance of fostering an organizational environment conducive to problem-solving and innovation.

During this research, although the results played an important role in answering the research question and achieving the objectives, it is important to mention the limitations that emerged throughout the study.

Concerning the interviews, these were carried out only with professionals in the consultancy sector and it is important to have a more comprehensive perspective that includes different sectors of activity about this topic. Additionally, these professionals were also selected based on their management and team coordination functions which excluded the opinions of other company employees, not reflecting the impact of solving complex problems on all professionals. Furthermore, the number of interviews conducted was 20 and despite the sample

being quite heterogeneous this may not be a sufficient sample size to adequately apply the population's opinions.

Regarding data analysis, the use of the KH Coder 3 resulted in less consistent conclusions than expected, as some difficulties arose in identifying connections between the justifications provided by the interviewees, generating the impression that certain crucial points mentioned in the interviews were not properly represented, as they were not mentioned as frequently throughout the interviews.

Finally, the last limitation identified in this study concerns the lack of detail in the analysis, that is, during the interviews professionals express different opinions on various resolutions of complex problems which leads to the hope that when applying the VRIO model to each resolution could lead to different results being obtained. Furthermore, given that the study focused exclusively on a specific sector of activity, we can assume that when applying this model to another sector of activity, the results could be different.

Ethics statement

All individuals gave appropriate verbal informed consent before data collection, but the need for informed consent was waived by the Ethics Committee of the University Institute of Lisbon.

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CRediT authorship contribution statement

Catarina Veríssimo: Investigation, Writing – original draft, Formal analysis. **Leandro Pereira:** Conceptualization, Methodology, Funding acquisition, Supervision. **António Fernandes:** Conceptualization, Methodology. **Raquel Martinho:** Writing – review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data Availability

Data is available on request from the corresponding author.

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