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Enhancing sensing capabilities in project-based organizations: the role of knowledge transfer between commercial and operational teams

Marcos T.J. Barbosa [1,*], Marly M. Carvalho [2]

Polytechnic School University of São Paulo, Av. Prof Almeida Prado,128, Travessa 2, Bloco G 2, 2nd floor, Cidade Universitária Butantã - 05508900, São Paulo, SP, Brazil

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ABSTRACT

In today's rapidly evolving market landscape, the ability of project-based organizations to continuously adapt and sense opportunities is critical for maintaining competitiveness, yet it remains an under-theorized area. This study investigates how project-based organizations enhance their sensing capabilities through effective knowledge transfer between operational and commercial teams. Through a multiple case study of seven diverse project-based organizations, the research identifies key factors for evaluating business opportunities, such as financial and technical feasibility, risk assessments, resource availability, long-term sustainability, and strategic alignment. The study highlights the significance of integrating commercial and operational teams through formal and informal mechanisms, which enhances sensing capabilities and market responsiveness. It also emphasizes the importance of continuous learning and fostering a culture that encourages all employees to act as salespeople, driving innovation and competitiveness. The findings result in an innovative theoretical framework and four propositions, offering new insights into how knowledge transfer and sensing capabilities influence market interactions, which ultimately improves strategic planning and integration within project-based organizations.

1. Introduction

Project-based organizations (PBOs) are defined as organizations that deliver their primary products or services through projects (Fang & Zhang, 2021; Pemsel & Müller, 2012; Zerjav, 2021). These organizations generate revenue from the execution of projects and face challenges in creating consistent performance over time (Choi et al., 2018; Söderlund, 2005; Tikkanen et al., 2007). PBOs constantly seek new project revenues (Artto et al., 2015; Söhnchen & Albers, 2010) while balancing with existing revenue through project portfolio management (Melkonian & Picq, 2011). Additionally, PBOs keep the execution team updated on technologies (Davies & Brady, 2016) and manage the knowledge derived from projects (Moutinho & Silva, 2022; Salunke et al., 2019). Hence, it is crucial for PBOs to be constantly searching for business opportunities and new technologies, requiring them to develop dynamic capabilities (DCs). Scholars identify the development of DCs as a critical strategy for companies facing turbulent scenarios, such as those encountered by PBOs, to establish a competitive advantage (Hermano & Martín-Cruz, 2020; Salunke et al., 2019; Teece, 2018).

Teece (2007) formulated a framework dividing DCs into three classes of capabilities: sensing, seizing, and transforming. The first one, sensing, involves activities such as scanning, searching, and exploring across technologies and markets. It also includes monitoring competitors, probing customer needs, and assessing technological possibilities. Under the lens of market orientation, this capability is called market sensing capability (Day, 1994; Kowalik & Pleśniak, 2022; Likoum et al., 2020; Miocevic & Morgan, 2018). According to Teece (2007), sensing depends on acquiring new information and new knowledge. Most knowledge in

* Corresponding author.
E-mail addresses: mtjbarbosa@usp.br (M.T.J. Barbosa), marlymc@usp.br (M.M. Carvalho).

[1] Marcos T. J. Barbosa, PhD, earned his doctorate in Production Engineering at the Polytechnic School, University of São Paulo (USP), Brazil. He also holds an MSc in Electrical Engineering from USP, a BSc in Electrical Engineering from São Judas Tadeu University, and an MBA in Management from Fundação Getúlio Vargas. He can be contacted at

[2] Marly M. Carvalho is a Full Professor at the University of São Paulo (USP) in the Production Engineering Department of the Polytechnic School in Brazil. She is the head of Production Engineering Department and the coordinator of the Project Management Lab. She holds a BSc in Production Engineering from the University of São Paulo, and MSc and PhD degrees in the same area from the Federal University of Santa Catarina, and the Post-Doctoral Program at the Polytechnic of Milan. Marly has published 12 books and a number of articles in leading journals, and she can be contacted at

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PBOs resides within individuals involved in projects (Jiao et al., 2020; Yang et al., 2020) and expands through their absorptive capacity from external sources, including engagement within their ecosystem, technology partners, strategic business partners, learning from project execution, and client relationships (Ahankoob et al., 2021; Barbosa & Carvalho, 2024b; Moraes et al., 2020; Qiu et al., 2022).

Knowledge is a key asset that aids PBOs in achieving their strategic objectives and developing DCs (Barbosa & Carvalho, 2024a; Martinez Sanz & Ortiz-Marcos, 2020). Transferring project-derived knowledge to the PBO is crucial, especially for the commercial team. This enables the utilization of such knowledge as a sales tool to meet customer demands. Interactions with clients are thereby enhanced, facilitating the identification of opportunities through understanding client needs, anticipated changes, and strategic goals. Furthermore, armed with the knowledge generated within the PBO, the commercial team can propose enhanced practices, technological advancements, and process innovations to clients, thereby offering more effective and tailored solutions (Arnett & Wittmann, 2014). However, since PBOs rely on project revenues and each project is unique, it is crucial to establish criteria for evaluating identified opportunities and to determine how attractive they are for the company (Jaafari, 2001; Wood & Williams, 2014; Zaman et al., 2023).

We argue that sensing capabilities within PBOs can be developed and expanded through bidirectional knowledge transfer (KT) between the operational and commercial teams. The operational team can supply the commercial team with knowledge acquired through absorptive capacity, while the commercial team can provide the operational team with cutting-edge and valuable information about clients (Turkulainen et al., 2013). An effective understanding of market dynamics and client needs can place a PBO in a position of competitive advantage, as it helps in detecting new opportunities. This advantage is maintained as long as knowledge flows freely across organizational domains, facilitating integration (Barbosa & Carvalho, 2024b; Cooper & Budd, 2007; Durmic, 2017).

The temporary nature of projects, combined with organizational culture and context poses a challenge for PBOs in effectively transferring refined knowledge from projects to the broader organization (Aerts et al., 2017; Ajmal & Koskinen, 2008; Teng & Pedrycz, 2022; Zhou et al., 2022). Existing literature on KT within PBOs primarily focuses on the transfer of knowledge between projects and to the broader organization, exploring barriers and facilitators (Barão et al., 2017; de Souza et al., 2021; Duffield & Whitty, 2016; Eikelenboom & van Marrewijk, 2024; McClory et al., 2017; Zhou et al., 2020, 2022). However, there remains a dearth of research investigating KT specifically from operational to commercial teams, as well as the transfer of information detected through sensing capabilities into the operational team.

At the same time, the literature regarding the integration between commercial and operational teams emphasizes its importance for improving efficiency, ensuring smoother transitions from sales to execution, and enhancing customer satisfaction (Apaolaza et al., 2022; Cooper & Budd, 2007; Hengstebeck et al., 2022; Söhnchen & Albers, 2010; Turkulainen et al., 2013). Yet, these studies often underestimate how this integration can contribute to strengthening an organization's sensing capabilities through continuous knowledge exchange between commercial and operational functions.

The objective of this study is to deepen the understanding of how PBOs develop sensing capabilities. Additionally, it investigates the bidirectional KT mechanisms between operational and commercial teams and identifies key factors that influence the evaluation of sensed business opportunities. To further explore the research objectives, we formulated the following research questions (RQs):

(RQ1) How does bidirectional KT between operational and commercial teams support the development and expansion of PBOs' sensing capabilities?

(RQ2) What factors are identified as relevant to the evaluation of sensed business opportunities in PBOs?

This study focuses on seven PBOs operating in Brazil, selected for their distinct configurations of commercial and operational teams. The analysis is delimited to intraorganizational knowledge transfer processes, specifically those occurring between these two internal teams. As such, the study purposely excludes external knowledge flows involving clients, suppliers, or ecosystem partners, as well as longitudinal tracking of capability evolution. The aim is to deepen the understanding of internal mechanisms that support sensing capabilities within the organizational boundaries of these PBOs.

To address these questions, this paper is organized into six sections. The second section reviews the theoretical foundations and key challenges associated with PBOs, KT, dynamic capabilities, and market sensing. The third section details our methodology, which employs a multiple case study design using both deductive and inductive coding based on interviews with senior professionals from the commercial and operational teams of seven PBOs.

The fourth section presents empirical findings, demonstrating how bidirectional knowledge transfer enhances sensing capabilities while also providing detailed insights into the specific mechanisms and practices observed across the cases. The fifth section discusses these insights and introduces an innovative theoretical framework that links KT mechanisms to market sensing. Finally, the sixth section concludes by outlining the study's theoretical contributions, practical implications, limitations, and directions for future research, emphasizing the critical role of internal knowledge flows in strategic decision-making within PBOs.

2. Literature review

2.1. Project-based organizations and their need for knowledge transfer

PBOs are companies centered around projects, providing unique services and products to meet customer needs (Blindenbach-Driessen & Van Den Ende, 2010; Fang & Zhang, 2021; Pemsel & Müller, 2012; Zerjav, 2021). Their revenue relies heavily on project execution, making project management expertise and team competence critical to their competitive stance (Söderlund, 2005). These organizations undertake various project types, including those tailored to customer specifications or developing new technologies, systems, or products across diverse industries such as construction, telecommunications, shipbuilding, mining, information systems, industrial automation, oil and gas, and energy systems (Gann & Salter, 2000; Sydow et al., 2004).

PBOs face the challenge of maintaining consistent performance over time (Choi et al., 2018; Söderlund, 2005; Tikkanen et al., 2007). They constantly seek new revenue through new projects (Artto et al., 2015; Söhnchen & Albers, 2010). At the same time, they balance this with existing revenue through effective project portfolio management (Melkonian & Picq, 2011). The ability to align project activities with strategic objectives is a significant advantage for PBOs, enabling them to deliver specific, measurable results. However, challenges persist, such as updating operational teams with new technologies (Davies & Brady, 2016) and managing knowledge derived from projects (Moutinho & Silva, 2022; Salunke et al., 2019).

In this context, KT emerges as a critical process that enables PBOs to leverage past experiences, foster organizational learning, and improve cross-departmental performance, even in complex project environments (Braun & Sydow, 2019; Hadi et al., 2022; Nisula et al., 2022; Vaez-Alaei et al., 2024). Efficient KT processes enhance sustained competitive advantage (Ajmal & Koskinen, 2008; Argote & Ingram, 2000; Avença et al., 2024), supported by key enablers such as absorptive capacity, trust, collaborative relationships, and open communication (Barbosa & Carvalho, 2024b; Deep et al., 2023). Organizational structures, such as supportive cultures, managerial soft skills, hierarchical clarity, and information technologies, facilitate the creation, transfer, and reuse of knowledge (Avença et al., 2024; Denicolai et al., 2016; Landaeta, 2008).

Recent research by Murtic et al. (2024) highlights the critical role of project managers and senior leadership in structuring knowledge

transfer processes, which they divide into four stages: initiation, implementation, ramp-up, and integration. These stages reflect the central role of leadership in enabling sustained learning flows. Similarly, studies point to the relevance of early integration of domain-specific expertise (e.g., facilities management) into project planning to ensure the long-term application of knowledge (Jensen et al., 2019).

Digital platforms, such as collaborative tools and cloud-based knowledge repositories, have also emerged as vital tools for reducing barriers to tacit and explicit knowledge sharing, fostering collaborative learning in dispersed environments. Additionally, advanced technologies like transfer learning and knowledge graphs enhance KT in complex projects by bridging traditional and algorithmic methods (Xu et al., 2022). Nonetheless, significant barriers remain. These include cultural resistance within cross-functional teams, fragmentation of specialized knowledge in large organizations, and the absence of formal mechanisms for KT in high-turnover project environments, especially prevalent in industries such as construction (Jensen et al., 2019; Zhou et al., 2022).

Despite these efforts, the temporary nature of projects often hinders KT and long-term learning, as teams are disbanded after project completion, making it difficult to retain and institutionalize valuable lessons (Mahura & Birollo, 2021; de Souza et al., 2021; McClory et al., 2017). To mitigate this, PBOs must continuously adapt and learn from recurring projects (Pemsel et al., 2018).

Learning within PBOs is fundamentally a social process, relying on collaboration between individuals and teams to build collective knowledge. Social capital within organizations plays a critical role in enabling this learning, especially in domains such as market analysis, product development, and project management (Bartsch et al., 2013). Balancing cultural, structural, and technological dynamics remains a challenge in establishing effective organizational learning processes (Aerts et al., 2017).

Structured KT practices have been linked to improved innovation performance, emphasizing the role of absorptive capacity in mediating knowledge-sharing dynamics (Dabic et al., 2020; Zhao et al., 2020). Effective knowledge flows between projects and the broader organization are essential for ensuring that lessons learned are retained and used to inform future initiatives (Barbosa & Carvalho, 2024a; Löwstedt et al., 2018).

2.2. Integration between commercial and operational teams

While much of the literature on knowledge transfer in PBOs emphasizes project-to-organization flows, the integration between commercial and operational teams remains a critical yet underexplored dimension (Barão et al., 2017; Tshuma et al., 2022; Xu et al., 2022; Zhou et al., 2022). This integration facilitates a bidirectional flow of information that is essential for aligning client expectations with operational capabilities. Insights derived from executed projects can inform commercial strategies, while market intelligence gathered by the commercial team can drive innovation and improve project outcomes (Cooper & Budd, 2007; Nadae & Carvalho, 2017; Savolainen & Ahonen, 2015).

Bridging these domains strengthens organizational sensing capabilities, a vital component of dynamic capabilities, by ensuring that knowledge flows seamlessly across departments (Eikelenboom & van Marrewijk, 2024). For instance, by leveraging expert resources to complement their expertise, commercial professionals are expected to deliver greater value to customers and achieve more favorable outcomes (Hengstebeck et al., 2022). A critical factor in identifying new project opportunities is the integration of knowledge between commercial and operational teams (Apaolaza et al., 2022). This integration facilitates a bidirectional flow of information: insights derived from executed projects are transferred to the commercial team, while market intelligence, such as customer needs and competitor activities, gathered by the commercial team, informs operational practices and innovation efforts. In this sense, some PBOs involve project managers in sales teams to ensure better alignment between client needs and project delivery, highlighting the importance of technical expertise during the sales process (Savolainen & Ahonen, 2015).

From a strategic perspective, integration fosters alignment by promoting responsive decision-making and creating a learning environment supported by best practices, such as open knowledge-sharing cultures and continuous learning activities (Durmic, 2017; Eikelenboom & van Marrewijk, 2024). Structured processes to bridge the gap between commercial activities and operations are pivotal in achieving this alignment. Cooper and Budd (2007) emphasize that synchronized handovers are essential to ensure that operational teams can effectively deliver on commercial commitments, thereby reducing variability and mitigating risks associated with poorly planned transitions. Similarly, Turkulainen et al. (2013) highlight that cross-functional integration across project phases in global PBOs enhances project success by fostering mutual understanding between commercial and operational teams. In the context of industrial project businesses, Söhnchen and Albers (2010) argue that balancing project acquisition with operational capacity through effective pipeline management reduces uncertainty and enables firms to prioritize profitable solutions. From a broader perspective, commercial activities are increasingly viewed as a cross-functional process that requires close collaboration with operations to tailor offerings to client needs, particularly in complex and dynamic environments (Moncrief & Marshall, 2005; Storbacka et al., 2009).

Project managers play a vital role in this dynamic knowledge exchange (Avença et al., 2024; Teng & Pedrycz, 2022). By interacting closely with clients during project execution, they can identify new opportunities and convey valuable insights to both commercial and operational teams (Eikelenboom & van Marrewijk, 2024; Zhao et al., 2020). This exchange enhances organizational sensing capabilities, a component of dynamic capabilities that strengthens responsiveness to market demands and strategic positioning (Teece, 2007; Hermano & Martín-Cruz, 2020). However, knowledge fragmentation often undermines these processes, particularly due to the temporary nature of project teams (Mahura & Birollo, 2021; McClory et al., 2017). Continuous adaptation, creation, and restructuring of knowledge are essential to mitigate these challenges (Ajmal & Koskinen, 2008).

Ultimately, fostering effective integration between operational and commercial functions equips PBOs with the agility and alignment necessary to thrive in increasingly complex and competitive markets (Turkulainen et al., 2013).

2.3. Dynamic capabilities, sensing microfoundations, and market sensing capability

Dynamic capabilities relate to a company's ability to efficiently adapt its resource structure to meet the needs of current or potential markets and maintain a competitive advantage (Helfat et al., 2007). Teece (2007) detailed the microfoundations of DCs, constructing a framework that disaggregates DCs into three classes of capabilities: sensing, seizing, and transforming. These capabilities are crucial for companies navigating the rapidly changing business environment, enabling them to remain agile and competitive.

Recent research builds upon Teece's framework to emphasize the nuanced roles of DCs in PBOs and across different industries. For instance, Hermano and Martín-Cruz (2020) present a DCs framework tailored for PBOs, highlighting sensing, seizing, and transforming routines as drivers for enhancing project and organizational performance. They underscore the integration of project-layer and firm-layer routines to adapt to dynamic environments, emphasizing the importance of learning from projects as a strategic method for building and reconfiguring capabilities. This perspective is echoed by Leiringer and Zhang (2021), who identify how PBOs develop capabilities through internal learning mechanisms, such as codifying knowledge from previous projects and leveraging both exploration and exploitation processes. These

studies highlight the interplay between dynamic capabilities and the adaptability required for PBOs to thrive in dynamic environments.

Sensing refers to a set of activities that include scanning, learning, and interpretation. It involves understanding customer needs and demands, developing new markets and partnerships, and monitoring competitors. The microfoundations (MF) of sensing encompass processes, procedures, and skills that enable an organization to continuously scan the internal and external environment. This scanning detects technological, market, and other changes that could impact the organization. Additionally, sensing includes collecting and analyzing information to generate relevant insights, which may involve market research, competitor analysis, and trend monitoring (Teece, 2007). For example, companies might employ advanced data analytics tools to track market trends and consumer behavior patterns (Aslam et al., 2018; Miocevic & Morgan, 2018).

Zabel et al. (2023) explore the microfoundations of dynamic sensing capabilities within digital business ecosystems, identifying processes of opportunity screening and partnership scouting. Opportunity screening combines structured and spontaneous routines for monitoring technological trends and market needs. Partnership scouting involves identifying complementarities with ecosystem actors to foster co-creative processes and unlock tacit knowledge. As Pérez-Rave et al. (2023) demonstrate, critical dynamic capabilities such as synergy, ideation, absorption, integration, and coordination play a significant role in enabling project-specific sensing capabilities, which are path-dependent and shaped by the unique contexts of individual projects.

Wong and Ngai (2023) expand this perspective by situating sensing capabilities as critical for sustained competitive advantage in manufacturing under conditions of environmental uncertainty. Their study highlights the importance of advanced data analytics, real-time decision-making, and flexible manufacturing processes in adapting to dynamic environments. In the context of PBOs, Melo et al. (2021) emphasize the importance of integrating systematic capabilities for managing innovation projects through phased processes, demonstrating how sensing capabilities can evolve from individual projects to organizational practices.

Sensing capabilities, including market sensing capability (MSC), focus on detecting and interpreting environmental changes, forming the foundation for market-oriented strategies. MSC is defined as a firm's ability to sense and react to changes in the market environment, including technology advancements, consumer tastes, and value offerings (Alshanty & Emeagwali, 2019). MSC involves generating market intelligence related to customer needs and distributing this knowledge across the organization to respond effectively. This capability helps firms learn, perceive, and respond to market dynamics (Likoum et al., 2020).

MSC requires firms to monitor customers, competition, and the environment actively. Day (1994) identifies MSC as comprising sensing activities, interpreting information, and evaluating activities related to market assessment. The sensing process must focus not only on gathering information but also on drawing insights from this information for use in everyday decisions. MSC allows firms to become well-prepared to respond to market changes efficiently. This capability empowers supply chain managers to improve decision-making regarding capability execution and reconfiguration (Fainshmidt et al., 2016). Firms must sense market opportunities accurately and capitalize on them to improve performance. MSC involves a firm's ability to adopt a customer-centric belief system, guiding employee interactions with customers. Superior MSC helps firms detect changes in customer needs and develop innovative solutions (Heusinkveld et al., 2009). As the concepts of sensing capabilities by Teece (2007) and MSC by Day (1994) are well aligned, from this point forward, we will use sensing capabilities to refer to the effect of both constructs.

Incorporating insights from dynamic capabilities research, Huikkola et al. (2022) highlight how firms must reconfigure outdated routines and processes to remain competitive. This aligns with the sensing microfoundations discussed by Teece (2007), as firms must continuously adapt their capabilities to identify and respond to market changes effectively. Similarly, Gaimon and Ramachandran (2021) emphasize the role of absorptive capacity in integrating external knowledge into internal capabilities, facilitating firms' abilities to bridge performance gaps and respond to technological changes.

Despite increasing attention to knowledge transfer and dynamic capabilities, existing research has overlooked how intraorganizational interactions between commercial and operational teams influence the development of sensing capabilities. Most studies focus either on external market scanning or on knowledge transfer across projects, leaving a gap regarding the internal mechanisms that support opportunity recognition in PBOs. This study addresses this gap by examining how bidirectional knowledge flows contribute to sensing processes and inform strategic decisions.

3. Methodology

3.1. Research design

This study employs a multiple-case study approach to explore how KT between operational and commercial teams enhances sensing capabilities in PBOs, identifying both the barriers and facilitators in this process. The unit of analysis in this study is the KT process between the operational and commercial teams. The phenomenon is examined at the level of actions, drawing on the experiences of stakeholders from these two teams, including directors, managers, and other experts. The multiple-case study method is particularly advantageous for understanding complex phenomena, as it engages with diverse informants across a wide range of cases, providing a rich and comprehensive understanding (Eisenhardt & Graebner, 2007; Voss et al., 2002; Eisenhardt, 2021). Qualitative field research was conducted to generate in-depth insights into the phenomenon under investigation.

According to Yin (2010), qualitative case studies offer a robust empirical investigation framework, encompassing the logic of design, data collection, and data analysis, applicable to both single and multiple-case studies. This approach is characterized by the use of two main types of reasoning: deductive and inductive, each with its own features and utilities. Qualitative study with deductive and inductive coding is a methodological approach that allows for an in-depth and detailed analysis of non-numerical data, typically collected through interviews, focus groups, observations, or documents (Azungah, 2018; Linneberg & Korsgaard, 2019).

Deductive coding starts with a set of pre-determined categories or codes based on existing theories or specific hypotheses. This method is useful when the researcher has a clear understanding of the concepts they want to explore and aims to test a theory in a new context (Bingham, 2023).

Inductive coding is exploratory and allows the researcher to discover new themes and patterns emerging from the data (Martinsuo & Huemann, 2021). The process is iterative, where the researcher revisits the data multiple times to refine the codes and categories as new insights arise (Azungah, 2018; Bingham, 2023; Saunders et al., 2018)

The combined use of deductive and inductive coding provides a comprehensive and flexible approach to qualitative data analysis. Researchers can start with deductive coding to test specific theories and then apply inductive coding to explore new insights and unforeseen themes (Bingham, 2023; Davies et al., 2016). This research design is ideal for exploring the dynamic interactions within organizations, particularly in complex and diverse environments. By comparing several PBOs, the study identifies recurring patterns and insights that can inform practices across similar organizational contexts, making the findings more robust (Linneberg & Korsgaard, 2019).

The research design was guided by theoretical constructs drawn from seminal works by Day (1994), Teece (2007), and Ajmal and Koskinen (2008), which provided foundational insights on market sensing,

dynamic capabilities, and the cultural dimensions of KT within PBOs. These references shaped the initial conceptual framework and informed the definition of deductive codes.

The study followed a theoretical sampling strategy (Eisenhardt, 2021), selecting five PBOs initially based on their involvement in distinct sectors, including project engineering, industrial safety, medium voltage electrical panels, construction, and industrial automation, to ensure diversity of perspectives and contextual variation. As the study progressed, new elements relevant to the phenomenon, such as competitor monitoring and the commercial team's influence on technical decision-making, began to emerge, prompting the inclusion of two additional companies before data collection was completed. This expansion was driven by the principle of theoretical saturation (Eisenhardt, 1989; Saunders et al., 2018), allowing the study to examine KT mechanisms and sensing practices more comprehensively across different organizational settings.

3.2. Context and cases

This study focuses on seven PBOs operating in Brazil, selected to examine how KT between commercial and operational teams contributes to the development of sensing capabilities. These organizations span different industrial sectors, including project engineering, construction, industrial automation, panel manufacturing, and industrial safety systems, and apply their expertise across diverse markets such as oil and gas, automotive, chemical, government, and consumer packaged goods.

Following Eisenhardt's (2021) methodological guidance, the selection of cases was based on theoretical sampling. This approach ensured that the cases chosen were those in which the focal phenomenon of effective KT and its relationship to sensing capabilities was likely to be most evident. The diversity among the selected PBOs facilitated the analysis of both similarities and differences in KT mechanisms and sensing practices. Such variation strengthens the empirical grounding of the study, helps reduce alternative explanations, and enhances the transferability of the findings by showing how the phenomenon manifests across varied organizational settings.

All seven companies have more than 15 years of market experience and operate under a project-based structure, where commercial and operational teams work independently but are highly interdependent. This setup creates rich opportunities to observe how internal knowledge flows influence organizational responsiveness and opportunity recognition. Across cases, commercial teams typically manage client interactions and opportunity identification, while operational teams are responsible for project planning and execution. Collaboration between the teams varies from formal routines such as handover meetings and go/no-go committees to informal exchanges during ongoing projects. These interactions are often critical for ensuring project feasibility, aligning expectations, and enabling agile responses to market dynamics. Table 1 summarizes the background information of the participating companies.

Table 1
Background information on the target companies.

Company	Sector	Number of employees	Revenue (2023)	Years
PBO_A	Pulp and paper engineering company, specializing in cellulose production	Over a thousand employees.	R$ 393 million	66 years
PBO_C	Industrial safety engineering and low voltage panel manufacturing	85 employees	R$ 80 million	30 years
PBO_N	Engineering firm, specialized in consultancy for oil and gas.	800 employees	R$ 220 million	30 years
PBO_P	Engineering company, focused on oil, gas, biofuels and operational efficiency.	1100 employees	Not informed	64 years
PBO_S	Automation system integrator, focused on automotive and chemical market.	204 employees	R$ 90 million	34 years
PBO_T	Engineering company, focused on laboratory tests and construction.	3000 employees	R$ 574 million	70 years
PBO_V	SME specialized in manufacturing medium voltage panels and systems.	500 employees	R$ 50 million	16 years

3.3. Data collection

We initially consulted with a senior sales director from a leading multinational company in automation technology. This director oversees relationships with most engineering and construction project firms in the country. Together, we defined a profile of project-based organizations operating in the fields of engineering, construction, automation, and electrical systems. Based on his suggestions, we visited the official websites of each company to verify their alignment with our research objectives and to gather preliminary information. For each selected company, we were referred to a contact from either the operational or commercial team. During the interviews, we then obtained the contact information of a counterpart from the other team to ensure coverage of both perspectives.

The primary data collection was conducted through semi-structured interviews using a questionnaire developed by the authors with the support of an experienced researcher specializing in knowledge management in project environments. The questionnaire, presented in Appendix A, was based on the key constructs from the seminal works of Ajmal and Koskinen (2008), Day (1994), and Teece (2007), which address knowledge transfer, market sensing, and dynamic capabilities. Before launching the full study, a preliminary validation was conducted with two interviewees: a project manager from PBO_A (PM1) and a commercial director from PBO_S (CD4). During this step, the commercial director also recommended including the innovation director (ID1) in the study, given his relevant experience with innovative solutions. These interviews were retained in the analysis due to their valuable contributions.

Interviewees were selected for their seniority, direct involvement at the commercial–operational interface, and ability to provide deep insights into intra-organizational knowledge flows. All hold leadership or specialist roles and possess longstanding experience, enabling reflection on both strategic and operational dimensions of knowledge transfer. Among the sample, three occupy C-suite or founder positions (two executive directors and one founding partner), adding explicit top-management perspectives. To capture diverse views within each company, we included at least one representative from each function (commercial and operational), supplementing with additional informants whenever relevant roles were identified.

As the study aimed to investigate how KT between commercial and operational teams enhances market approaches through improved sensing capabilities, the level of observation was defined at the level of individual professionals. All interviewees are senior professionals with extensive experience in either operational or commercial teams, as detailed in Table 2.

The interviews lasted between 45 and 70 min, were recorded with participants' permission, and the questionnaire was sent in advance to allow for preparation. All interviews were transcribed using Transkriptor software and subsequently refined with ChatGPT to remove filler words and correct grammatical inconsistencies, ensuring clarity while maintaining the original meaning. The transcribed interviews were then returned to the interviewees for review. Fourteen out of seventeen participants responded with either confirmation or minor revisions, helping ensure the accuracy and validity of the data.

In the organizational structures of the studied PBOs, the roles of commercial director, operations director, executive director, and

Table 2
Interviewees profile.

Company	Interviewee	Role in the company	Experience
PBO_A	CM1	Commercial manager	14 years
	PM1	Project manager	20 years
	PS1	Project supervisor	38 years
PBO_C	TS1	Technical specialist	14 years
	CD1	Commercial director	36 years
PBO_N	PM2	Project manager	40 years
	CD2	Commercial director	33 years
PBO_P	ED1	Executive director	30 years
	CD3	Commercial director	25 years
PBO_S	FP1	Founding partner	36 years
	AC1	Account manager	30 years
	CD4	Commercial director	23 years
	PM3	Project manager	19 years
PBO_T	ED2	Executive director	28 years
	CC1	Commercial coordinator	34 years
PBO_V	OD1	Operations director	8 years
	CD6	Commercial director	21 years

founding partner are considered part of the top management. These professionals are involved in strategic planning, opportunity evaluation, and decision-making, ensuring that leadership perspectives are well represented in the analysis.

3.4. Data analysis

During the data analysis, we developed a coding book for the empirical data, guided by Gioia et al. (2013), due to its structured approach to linking empirical evidence with theoretical constructs. The process began with descriptive coding of the interviews and observations, informed by insights from studies by Teece (2007), Day (1994), and Ajmal & Koskinen (2008). These deductive codes, derived from a detailed reading of these frameworks, were instrumental in characterizing sensing and KT initiatives. Specifically, Teece's (2007) microfoundations of sensing were used as a basis for coding, encompassing the most relevant aspects MSC.

We used NVivo software to analyze the interview data systematically. Transcripts were thoroughly read, with key sections highlighted before being imported into NVivo for further coding. Relevant information was extracted and categorized, and as the analysis progressed, the coding process was refined through recoding, merging overlapping codes, and grouping related data. This iterative process revealed recurring patterns, leading to the identification of additional codes, which emerged inductively. These inductive codes complemented the predefined deductive codes and enriched the analysis (Saunders et al., 2018).

Next, we performed axial coding to examine the relationships among the first-order concepts, which allowed us to identify second-order themes and refine the emerging theoretical structure. These first-order concepts reflect the language and perceptions of the interviewees and served as the initial foundation for our analysis (Gioia et al., 2013). The second-order themes were then grouped into aggregate dimensions that helped describe and interpret the observed phenomena. Fig. 1 presents a summary of this coding structure and illustrates how empirical insights were progressively organized into a more abstract and analytical framework. This iterative approach culminated in the development of a new theoretical framework for understanding the dynamics of sensing capabilities, knowledge transfer, and their interrelations.

Building on the coding structure illustrated in Fig. 1, we advanced the analysis by consolidating the second-order themes into three broader analytical categories. Through this process, we identified six deductive codes related to the *microfoundations of sensing*, and four related to *knowledge transfer*. In addition, recurring patterns raised by interviewees led to the creation of four inductive codes, which we categorized as *strategic and organizational approaches*. These inductive codes complemented the deductive ones and contributed to a more comprehensive understanding of the phenomena under study.

Table 3 summarizes the final coding structure, presenting all fourteen codes grouped according to the three analytical categories. Each code is accompanied by a brief description, the number of interviewees who mentioned it, and the number of excerpts coded during the analysis. This table represents the outcome of the interpretive process that followed the initial identification of first-order concepts and highlights the integration of inductive and deductive insights within the Gioia framework.

4. Results

We conducted an in-depth analysis of the findings presented in Table 3, focusing on the three main categories: sensing capabilities, KT, and strategic organizational approaches, to evaluate their influence on the research objectives. To enhance the robustness of our findings, we performed a cross-case comparison among the seven PBOs, in line with the methodological recommendations of Eisenhardt (1989). This approach allowed us to identify patterns, similarities, and differences across the organizations, providing a stronger basis for our overall conclusions.

After the coding process, we conducted a detailed interpretive analysis to explore how the practices described by interviewees related to broader organizational mechanisms. This step involved comparing

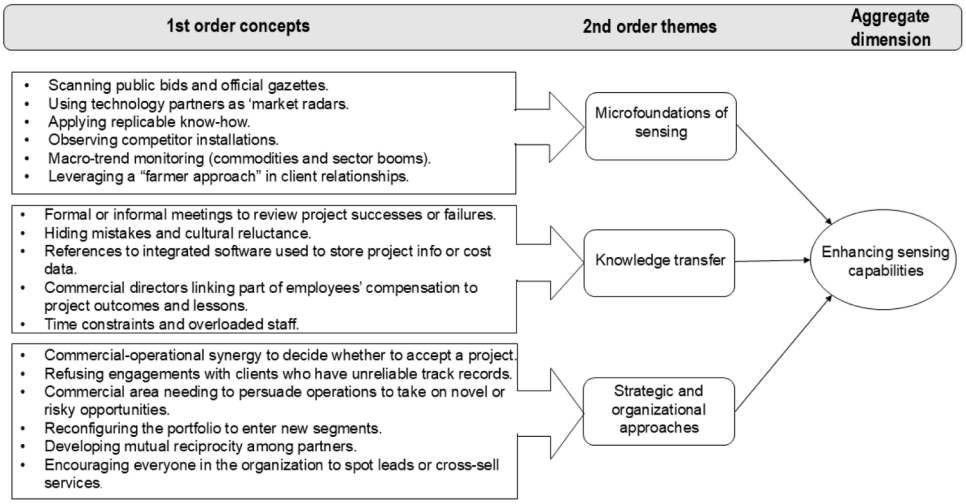

Fig. 1. Research coding structure.

Table 3
Final interviews codification.

Code	Code category	Description	Interviews	Excerpts
	1. Microfoundations of sensing (Teece, 2007; Day, 1994)	17	161	
MF1	Access to information and interpretation capacity	Opportunity creation and/or discovery by individuals require access to information. It involves interpreting available information in various forms, such as charts, pictures, conversations, news of breakthroughs, or customer feedback.	10	30
MF2	Acquired knowledge and ability to recognize opportunities and trends	The ability to recognize opportunities relies on acquired knowledge and the capacity to interpret information. This involves understanding market trends, customer needs, and technological advancements to identify potential business opportunities.	12	37
MF3	Cognitive capacities of R&D and Innovation	Explore how the cognitive and creative capacities of R&D teams drive innovation. This includes the ability to generate new ideas, solve complex problems, and apply knowledge to develop innovative products and solutions.	10	14
MF4	Dynamics of collaboration and external networks	Observe how collaboration with technological partners and external networks influences innovation and competitiveness. This involves leveraging external expertise, sharing knowledge, and forming strategic alliances to enhance capabilities and market position.	10	18
MF5	Monitoring competitor movements and staying ahead	Understanding competitor responses and monitoring changes are crucial for staying ahead in the market. This involves analyzing competitor strategies, adapting to industry shifts, and proactively responding to market dynamics.	5	10
MF6	Process to learn and understand client needs	Probing and reprobing of customer needs are essential to understand their expectations. This involves continuous interaction with clients, gathering feedback, and adapting offerings to meet their evolving requirements.	15	52
	2. Knowledge transfer (Ajmal & Koskinen, 2008)	17	186	
KT1	Barriers to KT	Most project tasks are conducted under strict timelines, leading to incomplete documentation and missed opportunities for sharing insights. Additionally, the lack of standardized processes and resistance to change hinders effective knowledge transfer.	14	32
KT2	Facilitators to KT	People learning through mentoring and one-on-one coaching. Encouraging open communication, creating a supportive environment, and leveraging technology to share knowledge effectively are essential facilitators of knowledge transfer.	16	59
KT3	Integration and knowledge sharing	According to Nonaka and Takeuchi (1995), new knowledge is created through continuous dialogue and collaboration between individuals. This integration process involves sharing experiences, insights, and best practices to enhance organizational learning and innovation.	17	57
KT4	Organizational culture	In many ways, these problems reflect inadequacies in organizational culture. Knowledge transfer involves communication among people, and although technology can handle explicit knowledge, intrinsic knowledge requires social interaction and human cognition. Organizational culture is crucial in this process.	14	38
	3. Strategic and organizational approaches	17	170	
SO1	Holistic evaluation of business opportunities	The decision to proceed with a business opportunity involves a comprehensive evaluation of its potential impact, feasibility, and	17	67

(*continued on next page*)

Table 3 (*continued*)

Code	Code category	Description	Interviews	Excerpts
		alignment with organizational goals. This includes assessing market conditions, resource availability, and potential risks to ensure informed decision-making and strategic alignment.		
SO2	Initiatives to approach the market	This code covers strategies by PBOs to identify and pursue new business opportunities. It includes managing client portfolios, distributing accounts by market segments, leveraging partnerships, offering additional services, and aligning product development with market trends.	12	36
SO3	Interpersonal and communication skills	This code highlights key interpersonal and communication skills for business success. It includes building relationships, fostering trust, effective communication, persuasion, motivation, and collaboration to ensure transparent client interactions and mutual respect.	10	33
SO4	Reconfiguring and strategic alignment	This code covers the strategies PBOs use to reconfigure assets and organizational structures in response to evolving market conditions. It includes identifying key employees, HR recruitment, and strategic planning across company departments.	12	34

codes across cases, identifying interrelations, and reflecting on recurring themes that revealed deeper insights into sensing capabilities and knowledge transfer. These analytical efforts supported the development of the conceptual framework presented in Fig. 5, which integrates the main dimensions observed across the cases.

During the interpretation stage, one code that gained prominence was *Holistic evaluation of business opportunities*. Because PBOs sell unique projects with varying degrees of risk, interviewees consistently described the need for structured criteria to evaluate potential opportunities. These insights contributed to the emergence of five subdimensions, which are further explored in Section 4.3

4.1. Microfoundations of sensing

The microfoundations of sensing coding structure identifies key capacities that enable organizations to detect opportunities within the studied companies. The MF codes are categorized into six types, as presented in Table 3. Together, these components provide a comprehensive understanding of sensing capabilities in the context of PBOs.

Table 3 shows that *Process to learn and understand client needs* had the highest incidence, representing 32 % of the coded excerpts. This aligns with the client-centric nature of the category, where understanding client needs is pivotal for identifying business opportunities (Day, 1994). Among the 52 coded excerpts to this MF, we found codes that generally emphasize the importance of prioritizing the comprehension and anticipation of client needs, maintaining a constant dialogue to ensure that projects meet their expectations. This frequent interaction with clients allows companies to identify challenges and opportunities, thereby developing capabilities through close and continuous relationships. Fig. 2 presents a summary of the coded excerpts in this category.

All companies in our sample demonstrate an ongoing effort to scan their external environment, although the methods and depth of analysis differ. For example, PBO_N and PBO_T mention frequent monitoring of public bids and official gazettes, while PBO_A tracks commodity prices to anticipate market fluctuations. At PBO_P, ED1 emphasizes a strategy of investing in sectors poised for growth, such as mining during "supercycles", supported by internal forecasting processes. Beyond these broad market observations, the ability to recognize opportunities stems from acquired knowledge and replicable solutions, closely aligning with *Acquired knowledge and ability to recognize opportunities and trends*. For instance, at PBO_P, ED1 describes transferring expertise about port security regulations to other types of projects, thus reinforcing the firm's capacity to pivot quickly into adjacent markets. Similar logic applies at PBO_S, where prior automation solutions are reconfigured for different clients once technical feasibility is confirmed. Several interviewees, such as CM2 at PBO_N, stress that promising leads are formally vetted by engineering before a final go/no-go decision is made, underscoring the importance of continuous alignment between commercial and operational teams.

Within the sensing category, a noteworthy finding is the relatively low incidence of coded excerpts to *Monitoring competitor movements and staying ahead*. The literature generally underscores the significance of understanding competitor behavior and positioning (Aslam et al., 2018; Hakeem, 2023; Miocevic & Morgan, 2018; Teece, 2007). Yet, we recorded competitor-related mentions in only 5 interviews, totaling just 10 codes. As a result, we examined the 10 competitor-related coded excerpts made by these 5 respondents more closely. The companies that explicitly referred to learning from competitors were mostly PBOs delivering products. For example, respondent CD4 remarked: "It is possible to learn from the competition by visiting opportunities where they have already worked inside client's plants. For example, when we visit a robotic system in the customer's plant, we can observe the solutions adopted by competitors and learn from them". Similarly, interviewee CD6 revealed: "Another example is when we directly observed competitor solutions at client sites. By comparing electrical panels, we revealed significant differences in solution compaction, which directly impacted the cost and commercial proposal of PBO_V". There seems to be a consistent difficulty in systematically observing competitors, partially disclosed by CD4: "Another important aspect is observing the competition during the sales process, trying to identify their strategies and solutions. However, after losing an opportunity, we often do not seek to understand the reasons for the defeat or learn from the competitor".

Among PBOs that focus on engineering services, we did not observe an active interest in studying competitors, possibly because we interviewed some of the most reputable companies in the market. According to the respondents, these firms tend to act more reactively, owing to their strong specialization in specific niches. As CM1 commented: "When analyzing the competition, we realize that several companies can offer the same service, but some stand out for the depth of their approach".

Nonetheless, competitive intelligence can still shape how companies refine their offerings. Both PBO_V and PBO_S noted the importance of visiting clients to observe competitor solutions, while PBO_P and PBO_N highlight "lessons from lost bids" or competitor successes as a basis for

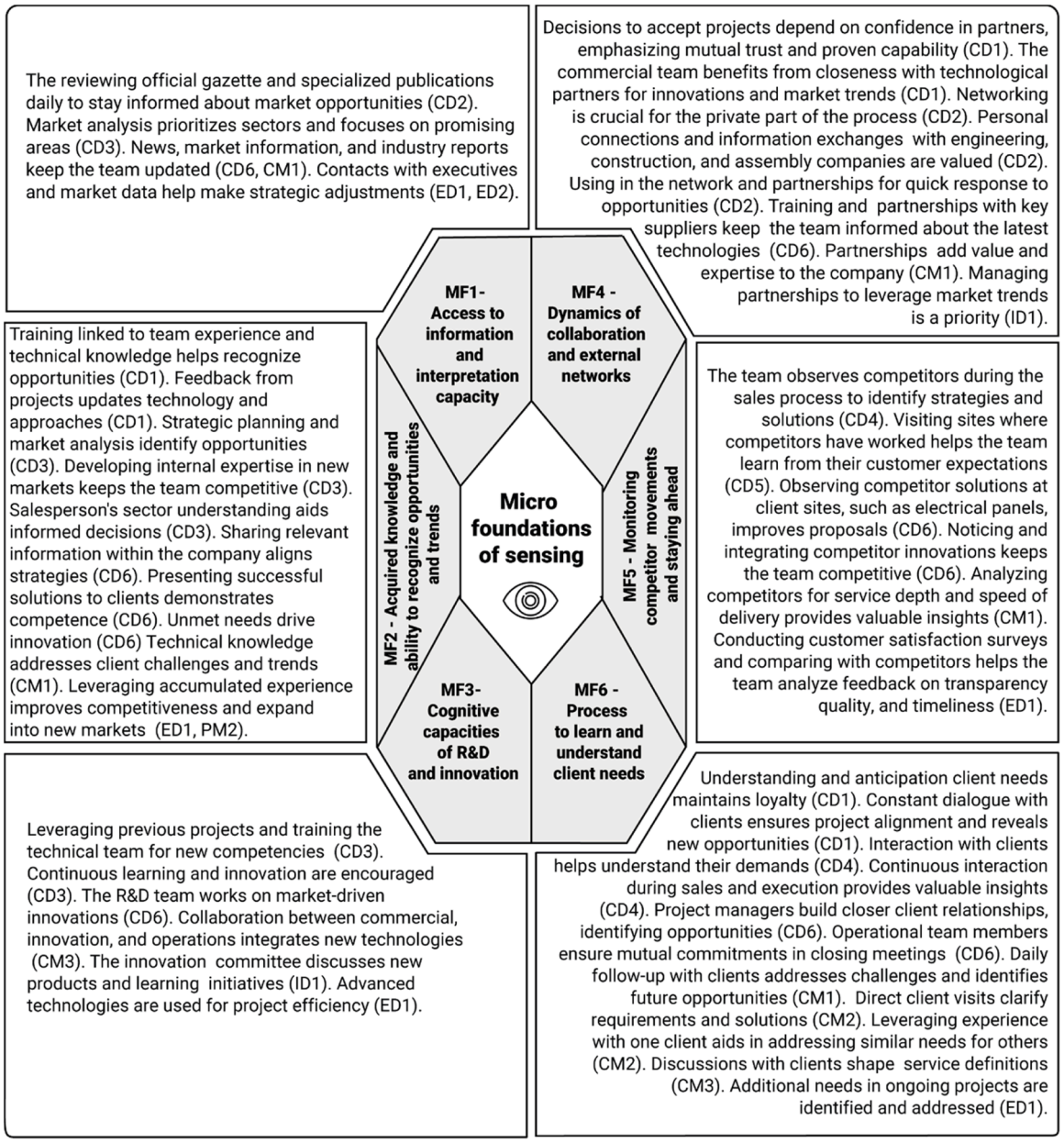

Fig. 2. Summary of coded excerpts related to MF of sensing.

adjusting proposals. However, the systematic documentation and analysis of competitor data remain inconsistent. Some respondents concede that they do not conduct a thorough post-mortem to understand why they lost a particular bid or why a competitor's strategy proved successful. This underscores a broader challenge in knowledge transfer: while many PBOs collect data on competitors, few integrate those insights into formal feedback loops or committees.

Efforts to promote R&D and innovation also vary across the firms, reinforcing their sensing capabilities in distinct ways. While PBO_S and PBO_T operate explicit innovation committees, PBO_V invests in a dedicated research unit for advanced automation. In contrast, PBO_C tends to rely on experienced personnel to assess whether a new technology justifies in-house development. However, it is often the commercial department that sells a concept first, propelling the engineering team to develop novel technical solutions. This phenomenon demonstrates how market sensing sometimes outpaces R&D planning, reflecting the interplay between commercial foresight and technical execution.

Another important aspect of the sensing microfoundations is *Acquired knowledge and ability to recognize opportunities and trends*. A closer look at the coded excerpts tied to this MF underscores that effectively recognizing opportunities and trends often requires specific mechanisms and practices. Firstly, the commercial training process and the technical knowledge of team members are critical, enabling effective sales strategies and the proposal of innovative solutions (CD1). Annual strategic planning likewise ensures readiness for emerging markets (e.g., green hydrogen, offshore wind farms, solar energy), as CD3 notes. Therefore, direct collaboration between commercial and operational teams encourages the identification of scope modifications and additional business possibilities during project execution, while internal committees, such as lessons-learned and innovation committees facilitate alignment with market changes (UM1).

Although it is common to think that more experienced and mature professionals have the most to teach, the technological advancement related to digitalization has shown that this is not necessarily the case. PBOs are embedded in a cutting-edge technological scenario. In this scenario, young professionals have a great ease with emerging

technologies, especially those related to digitalization and Industry 4.0 (Barbosa et al., 2019). For instance, at PBO_P, when top management realized the need to expand its expertise in solar energy to address the energy transition, they decided to develop knowledge in-house rather than relying on acquisitions or external hires. According to CD3, they assigned a junior commercial professional to explore solar energy documentation and a simulation and sizing software, effectively transforming that individual into a subject matter expert. Similarly, PBO_P (ED1) describes transferring knowledge in port security standards across various port projects, allowing the firm to capitalize on new business opportunities more rapidly.

4.2. Knowledge transfer

The KT coding structure outlines the key factors that facilitate or hinder the effective exchange of knowledge within the studied PBOs. It is divided into four codes, as defined in Table 3 and shown in Fig. 3.

(AI: artificial intelligence; ERP: enterprise resource planning; NCR: non-conformance reports; C-form: internal commercial form; ISO 9000: quality management system)

Analyzing these KT codes, it is interesting to note that the number of coded excerpts for the code *Barriers to KT* is notably lower than the code *Facilitators to KT*. In the *Facilitators to KT* code, we included only artifacts, software, platforms, and fixed meeting schedules that facilitate knowledge transfer. Here, ERP, ISO 9001, handover meetings, and other mechanisms appear. Additionally, the codes *Integration and Knowledge Sharing* and *Organizational Culture* indirectly act as facilitators of KT. This shows that although KT in PBOs is a significant challenge (Duffield & Whitty, 2016; McClory et al., 2017), the respondents provided several coded excerpts that demonstrate the effort to achieve integration and collaboration between the commercial and operational teams. This initiative aims to share insights from project learning on the operational side and market interaction learning on the commercial side.

A highlight within code *Organizational Culture* is the emphasis on the "We are all salespeople" mentality (CD3), which promotes proactive involvement from all employees in sales and customer value creation. This culture encourages learning by doing and investing in new areas, reinforcing long-term partnerships. It is also culturally typical for commercial professionals in the analyzed PBOs to have a technical background, as they usually come from operations. Moreover, PBOs encourage continuous learning and improvement through internal training (CD3, CD1). This means that in their interactions with the market, whether with clients or technological partners, these professionals find it easier to absorb technological trends and customer needs.

The predominant technical experience in the commercial team of the sampled PBOs enables commercial professionals leading an opportunity to acquire new knowledge, even if such an opportunity does not result in a sold project. This enhances their knowledge repository, facilitating their involvement in new sales processes. As stated by CM3, "This allows the commercial team to learn from the specific experiences and knowledge of each project, enriching its ability to understand market nuances and improve sensitivity to identify and exploit new opportunities." CD2 commented that "the technical training of the commercial team is important to make the most of the limited attention time that clients have." According to Ajmal & Koskinen (2008), organizational culture has the potential to constrain or facilitate knowledge creation and transfer within an organization, and this study identified culture as a facilitator of KT.

Yet, despite varying levels of formality, all interviewees highlight the centrality of knowledge-sharing to continuous improvement. Barriers arise from work overload, as seen in PBO_A and PBO_C, where technical teams struggle to allocate time for reflective processes such as lessons-learned meetings, limiting the systematic transfer and institutionalization of knowledge. In PBO_C and PBO_P, some directors (CD3, CD1) mention a cultural reluctance to record failures openly, issues sometimes referred to colloquially as "hidden mistakes."

Where companies have formalized routines, there is clear evidence of benefits. PBO_P, for instance, integrates non-conformance reports (NCRs) into ISO 9000-based workflows, facilitating robust discussions on cost overruns and technical pitfalls (ED1). At PBO_V, CD6 notes that these NCRs not only help correct errors but also reinforce positive practices, as any cost-saving measures are documented for future replication. Several firms (PBO_S, PBO_T) maintain intranet portals or approval gates (mentioned by ED2 and CM3) to store technical data, though actual usage rates can vary if staff are not incentivized to participate.

Moreover, the interactions between commercial and operations further drive or inhibit knowledge exchange. At PBO_A, handover forums after contract signing allow the commercial team to share client expectations, while project managers flag possible gaps. Similarly, weekly or monthly cross-department meetings at PBO_N and PBO_T formalize real-time sharing of progress, risks, and lessons. Yet, some respondents (CM3, PS1) still observe pockets of resistance where engineers prefer well-trodden paths over adopting suggestions from the commercial team.

4.3. Strategic and organizational approaches

During the content analysis, new patterns emerged from the interviews that required inductive coding to be captured appropriately (Azungah, 2018; Bingham, 2023). This approach allowed us to identify themes grounded in the participants' experiences, without relying on predefined categories. Rooted in cross-case analysis, the process revealed frequently mentioned strategies and practices, which were refined into distinct codes that reflect how PBOs approach business opportunities and respond to market changes. In line with Gioia et al. (2013), this method supports the discovery of insights that extend existing theoretical frameworks.

The four inductive codes: *Holistic evaluation of business opportunities, Initiatives to approach the market, Interpersonal and communication skills*, and *Reconfiguring and strategic alignment*, emerged as key dimensions for understanding how companies evaluate opportunities, interact with clients, and align their internal structures to respond to market demands.

The most relevant code mentioned is *Holistic evaluation of business opportunities*, which is not surprising because one of the questions in the questionnaire directly leads to this code, aiming to expose the main criteria used to evaluate the potential of a business opportunity. This means that even if sensing operates adequately (i.e., an opportunity is perceived and the PBO is capable of executing it), the criteria defined in this code can still lead to a rejection of that opportunity. We had 67 excerpts for this code, and they clarified the main factors for evaluating a business opportunity in the studied PBOs. It appears that the PBOs are concerned with keeping the business healthy and within their strategic parameters. Since the studied companies have been in the market for a considerable time, they impose limits based on their own history to decide whether to accept new projects. Thus, the factors listed act as guidelines for identifying new opportunities detected by sensing. This code acts as a strategic filter, guiding decisions throughout the sales process, from initial opportunity assessment to ongoing project alignment with corporate priorities.

Fig. 4 outlines the comprehensive inductive coding structure for *Holistic evaluation of business opportunities*, which is divided into five key child codes and further deployments. *Execution capacity and technical viability* evaluates whether the organization has sufficient know-how and technical competencies to meet project requirements, as well as resource alignment with the company's portfolio. *Innovation and sustainability* considers the project's potential for innovation, environmental impact, and the adoption of new technologies for long-term benefits. *Financial viability and risks* examines market financial potential, client capacity, profitability margins, and risk mitigation strategies to

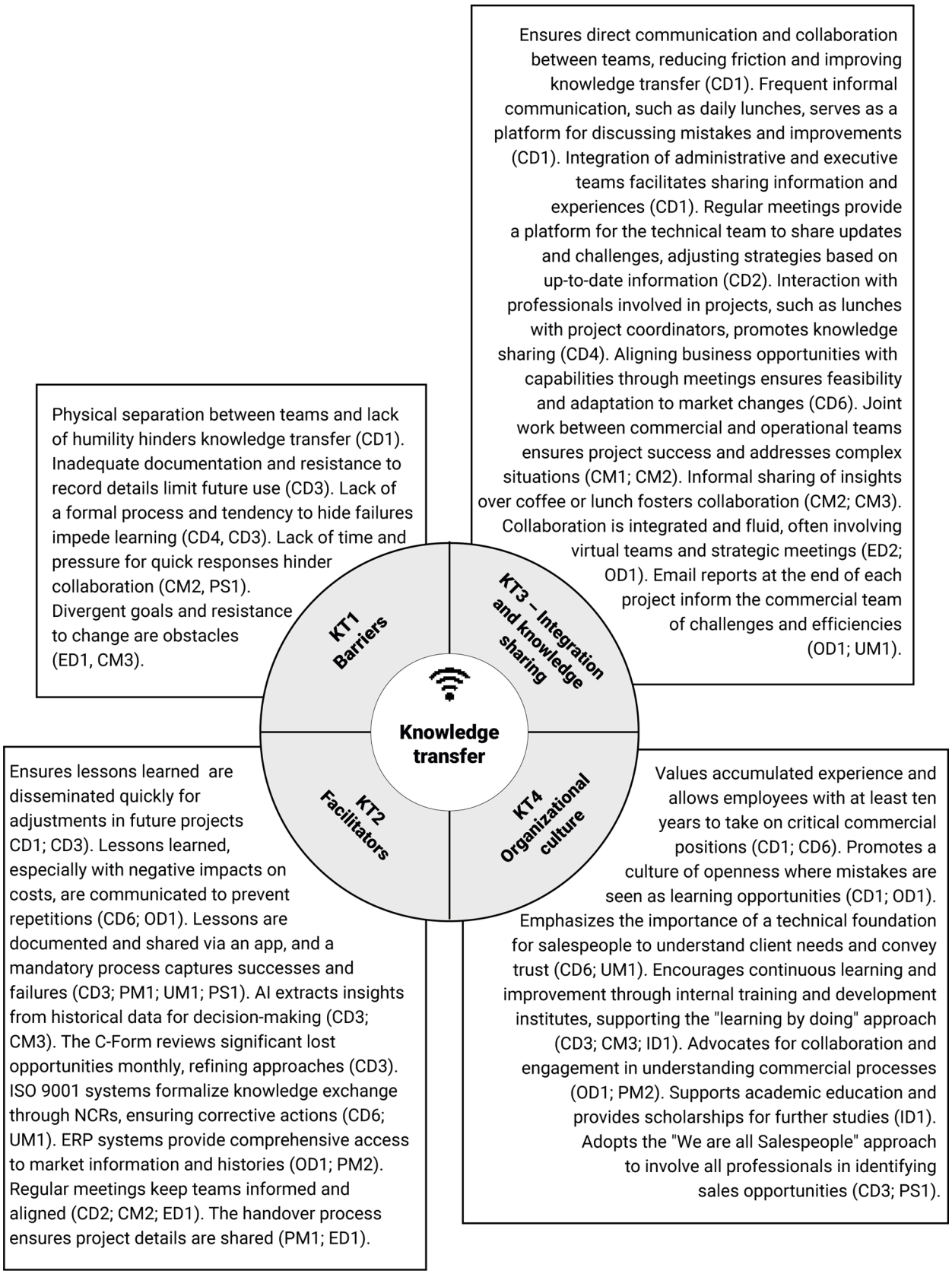

Fig. 3. Summary of coded excerpts related to KT.

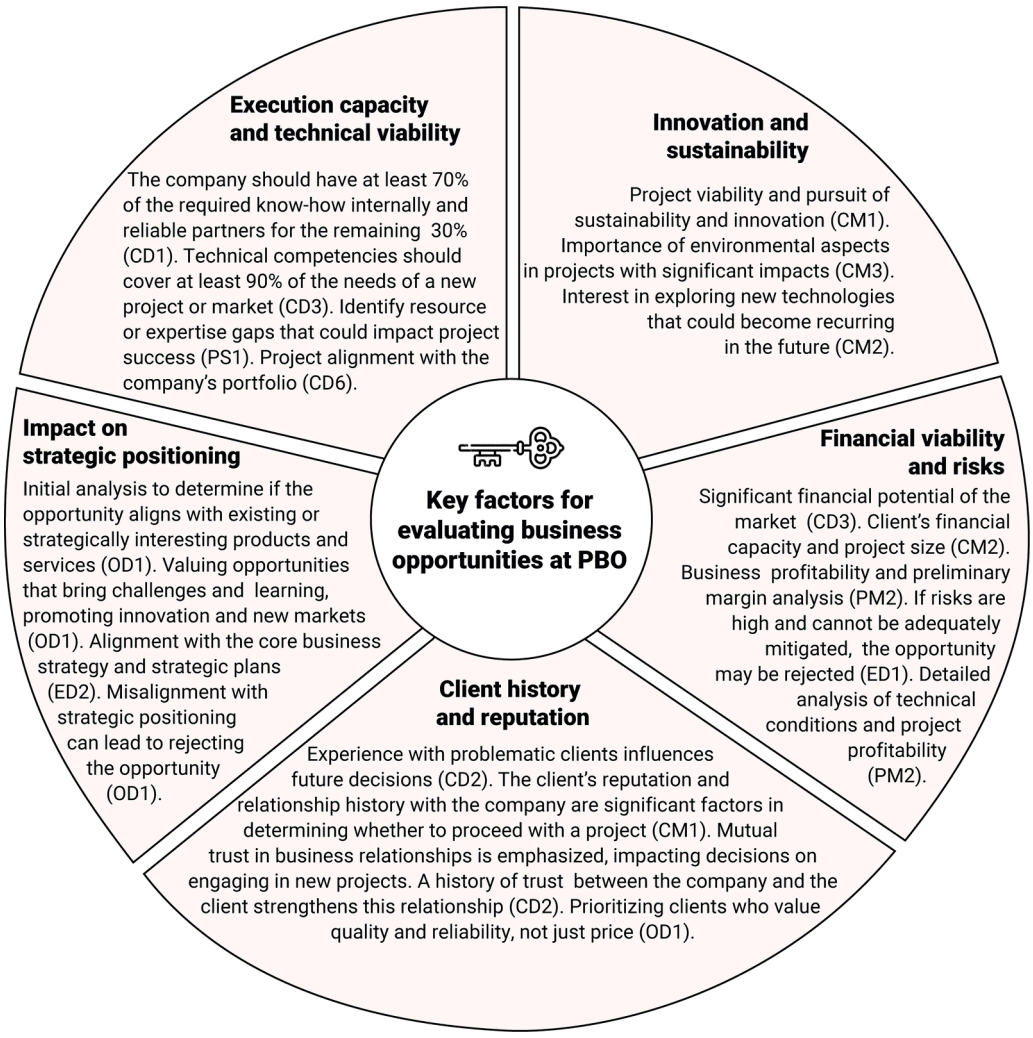

Fig. 4. Key factors for evaluating business opportunities at PBO.

ensure project success. *Impact on strategic positioning* assesses the alignment of opportunities with the organization's strategy, focusing on projects that bring innovation, learning, and new market prospects while avoiding misaligned initiatives. Lastly, *Client history and reputation* considers the client's relationship history, reliability, and trust, prioritizing partnerships with mutual trust and shared values. Together, these factors provide a structured approach to evaluating business opportunities for PBOs.

PBOs employ a strategic approach to managing business opportunities by prioritizing financial and technical viability, risk assessment, resource availability, and long-term sustainability. Projects are often declined if the client cannot afford the necessary service level (CD1), if there is insufficient internal expertise (CD2), or if the technical and financial risks are misaligned (CD4). The companies also reject opportunities involving complex technologies that require disproportionate resources (CM2). Therefore, PBOs ensure that decisions to decline opportunities are based on maintaining operational and financial sustainability, even if it means forgoing already-won contracts (PM2). This careful evaluation helps PBOs maintain high standards and focus on viable and strategic projects.

When it comes to strategic alignment, firms converge around a principle of holistic opportunity evaluation that weighs financial, technical, and market risks simultaneously. For instance, PBO_C and PBO_N give significant weight to a client's payment history and reputation before proceeding, while PBO_V and PBO_P veto projects if they conflict with core technological standards or strategic partnerships. In contrast, PBO_A frames expansions into new fields, such as biofuels and renewables, as contingent on hiring domain experts, ensuring that any strategic shift is underpinned by genuine technical competency.

Moreover, go/no-go committees are common. PBO_A and PBO_V typically convene cross-functional panels (including commercial directors, operational managers, and sometimes finance/legal representatives) to vet high-stakes bids. This mirrors a collective intelligence mindset, minimizing the risk of unilateral decisions. Interviewees like CM2 and CD4 likewise emphasize the internal selling dynamic: persuading technical staff that the revenue or learning potential justifies stepping outside the firm's comfort zone. Solid communication skills (argumentation, negotiation) thus appear pivotal, enabling commercial teams to secure buy-in from risk-averse engineers.

The code *Initiatives to approach the market* focuses on the practical and proactive steps PBOs take to identify, evaluate, and pursue business opportunities. It emphasizes the importance of dedicated representatives, collaboration between commercial and technical teams, strategic meetings, and detailed assessments of technical and financial viability. This approach differs from the sensing MFs codes, which are more about detecting and understanding market trends and signals to inform strategic decisions.

For example, PBO_C uses dedicated representatives and proactive salespeople to identify new business opportunities by visiting departments and engaging potential clients (CD1). Additionally, the commercial team collaborates closely with engineering to address technical complexities and prepare for upcoming market demands,

creating a virtuous cycle of readiness (CD4). Regular strategic meetings are also held to align commercial needs with company capabilities (CD6). Furthermore, pre-projects or consultancies are proposed for complex or innovative projects to assess their technical and financial viability before proceeding (CM2).

In the interviews, we also identified the need to practice good communication with the client and within the company itself. This good communication aims to smooth relationships, especially between teams within the PBOs. The excerpts in this code, *Interpersonal and communication skills,* indicate that selling internally is crucial for PBOs to secure the necessary support and resources for projects. This involves the commercial team persuading internal stakeholders about the importance and potential of opportunities to ensure alignment and commitment. For example, salespeople must secure internal backing (CD4), and the commercial team needs to convince employees of an opportunity's value (CM1). In addition, interpersonal skills are essential for overcoming resistance and fostering collaboration (CM2), while innovation often requires internal support from technicians to gain broader acceptance (ID1). This communication skill is inherent to the commercial team, and observing the coded excerpts makes this evident. Only ten interviewees have excerpts for this code. Among them, only the interviewee PS1 is from operations; all the others are from commercial.

Throughout the interviews, we observed actions aimed at reconfiguring to address market changes and explore unconventional opportunities. This led us to create the inductive code *Reconfiguring and strategic alignment*. The strategies PBOs use to reconfigure assets and organizational structures in response to evolving market conditions are multifaceted and dynamic, using many times cospecialization (Teece, 2007). As mentioned by CD2 "A crucial decision was to include specialized partners, ensuring the company's proposals met technical needs and were feasible". The company's adaptive strategy involves comprehensive planning across all departments, not just the sales team. This includes annual reviews to align market sensing with company strategies, enhancing responsiveness and agility in meeting market demands (CD3). Expanding services and global reach necessitate hiring experts and leveraging internal knowledge to anticipate future needs and guide project execution (CM1).

Furthermore, portfolio reconfiguration emerges as a recurring theme: PBO_T and PBO_P run annual strategic planning cycles that weigh shifting market demands, while PBO_S and PBO_A prefer ad hoc adjustments whenever the commercial team uncovers profitable niches. Nonetheless, all firms seek to balance new opportunities with in-house capacity, typically to avoid desperate projects that strain technical limits or clash with established partner relationships.

Evaluating new opportunities by drawing analogies from past projects ensures alignment with corporate strategy and technical expertise, minimizing risks (ED1). Identifying and allocating key employees for project operations, along with continuous HR recruitment adjustments, is essential as project demands evolve (ED2). When internal knowledge is lacking, the company seeks market experts to complement the team, ensuring effective responses to complex demands (PM1, PM2, ED1). To ensure project delivery capacity, the company considers outsourcing when internal resources are overstretched (TS1).

5. Discussion

This study aimed to investigate how bidirectional knowledge transfer between operational and commercial teams fosters the development and enhancement of sensing capabilities in PBOs and to identify the key factors shaping the evaluation of sensed business opportunities, which directly influence strategic decision-making and project viability. The findings highlight the mechanisms by which KT strengthens dynamic capabilities, with a particular emphasis on sensing, enabling PBOs to better anticipate and respond to market demands.

5.1. Knowledge transfer supporting sensing

The first research question (RQ1), "How does the bidirectional knowledge transfer between operational and commercial teams support the development and expansion of PBOs' sensing capabilities?" is addressed through the study's findings and analysis. The results highlight that KT plays a pivotal role in building sensing capabilities by ensuring that knowledge flows across departments, thereby enabling PBOs to adapt to market changes, identify business opportunities, and strengthen competitive positioning (Eikelenboom & van Marrewijk, 2024; Hengstebeck et al., 2022).

A critical insight from the study is the centrality of ongoing client interaction in the sensing process. The analyzed PBOs prioritize maintaining a deep understanding of client needs through continuous dialogue, which helps both commercial and operational teams identify emerging market trends and business opportunities during project execution (Day, 1994; Likoum et al., 2020; Savolainen & Ahonen, 2015). Among all findings, the most prominent theme was the emphasis on understanding client needs through ongoing interactions. This reinforces the idea that direct relationships with clients, both before and during project execution, play a critical role in enhancing market sensing capabilities. For example, regular interactions, whether in pre-sales negotiations or on-site project activities, enable PBOs to anticipate client demands and adjust their offerings accordingly, reinforcing their capacity to recognize opportunities and innovate. Therefore, we propose:

Proposition 1. *Sensing capabilities in PBOs benefit significantly from the integrated efforts of commercial and operational teams through direct communication and collaboration*.

However, while client-centric KT processes are strong, the study also reveals a significant gap in monitoring competitor movements. The low number of coded excerpts to competitor analysis suggests that many PBOs focus predominantly on client needs rather than systematically tracking competitor behavior. This imbalance poses a potential risk to their sensing capabilities, particularly in competitive markets where staying ahead requires continuous competitor monitoring. This finding aligns with Teece (2007), who emphasizes the importance of balancing internal knowledge flows with external market intelligence. The lack of formal mechanisms to monitor competitors could hinder PBOs' ability to detect shifts in the competitive landscape, potentially resulting in missed opportunities.

Furthermore, the findings highlight that strategic partnerships enhance sensing capabilities by providing access to external knowledge and fostering innovation. Partnerships contribute to knowledge sharing, collaborative decision-making, and achieving complex project objectives (Barbosa & Carvalho, 2024b; Vaez-Alaei et al., 2024). However, challenges such as miscommunication, skill gaps, and lack of trust can hinder these collaborations (Deep et. al., 2023). Several interviewees emphasized the importance of leveraging partnerships to complement internal expertise, ensuring that both operational and commercial teams have up-to-date market insights (Hengstebeck et al., 2022). These partnerships support the microfoundations of sensing by expanding the organization's capacity to identify and respond to emerging opportunities. Business and technological partners provide valuable knowledge that PBOs can leverage to detect opportunities and enhance project execution. At the same time, subcontractors extend operational capacity and help validate the maturity of sensed opportunities, as they work across multiple suppliers. This process reinforces the development of external networks and aligns with *Dynamics of collaboration and external networks*, enabling PBOs to stay competitive and innovative in their offerings. Hence, we propose:

Proposition 2. *PBOs that proactively cultivate external partnerships with subcontractors, technological and business partners, nurturing a healthy business ecosystem, are better strategically positioned to innovate and*

respond quickly to market opportunities.

The study also underscores the importance of both formal and informal KT mechanisms in enhancing sensing capabilities. Supported by senior leadership (ED1, ED2 and FP1), structured processes, such as handover meetings, cross-functional panels, and predefined routines, facilitate systematic knowledge exchange and alignment between teams. In parallel, informal interactions such as daily conversations and spontaneous feedback play a complementary role by promoting continuous learning and real-time knowledge sharing (Eikelenboom & van Marrewijk, 2024).

Together, these mechanisms reflect the practices described by Cooper and Budd (2007) and Ajmal and Koskinen (2008), who emphasize that effective KT processes mitigate the risks of unilateral decision-making and foster collaborative learning cultures. Additionally, the use of digital tools, such as ERP systems, internal platforms, and AI-based insights endorsed by top management, serve as key facilitators, helping to institutionalize knowledge and support the development of sensing capabilities. Therefore, we propose:

Proposition 3. *PBOs that adopt structured mechanisms (software, platforms, AI-generated insights and predefined routines) demonstrate enhanced sensing capabilities, particularly related to improving their ability to recognize opportunities and respond to client needs*.

Moreover, the emphasis on a culture where "everyone is a salesperson" fosters an environment conducive to continuous learning and knowledge sharing, which is critical for developing sensing capabilities (Ajmal & Koskinen, 2008; Hadi et al., 2022; Savolainen & Ahonen, 2015). This culture emphasized by top management supports the findings of Day (1994) and Likoum et al. (2020), who argue that market sensing capabilities are enhanced by organizational cultures that prioritize open communication and collaborative learning. Additionally, fostering a market-oriented culture that values "billability" helps assess potential revenue generation from projects, ensuring continuous client engagement and contract opportunities. Thus, we propose:

Proposition 4. *A culture emphasizing market orientation and team billability fosters alignment between the commercial and operational teams and enhances sensing capabilities*.

5.2. Evaluation of sensed opportunities

The second question (RQ2), "What factors are identified as relevant to the evaluation of sensed business opportunities in PBOs?" is addressed by identifying key evaluation criteria that guide companies in aligning opportunities with strategic and operational priorities (Fig. 4). Since these companies' revenue comes from projects, there is little margin for error in budgeting or project management (Bakker et al., 2011; Söderlund, 2005).

The analysis of the microfoundation *Access to information and interpretation capacity* reveals that PBOs prioritize staying informed about market opportunities through various channels, including official gazettes, specialized publications, and market reports. This ongoing monitoring process allows companies to identify potential opportunities early. However, recognizing an opportunity is only the first step. Strategic selection processes are central to managing sensed opportunities, particularly when aligned with long-term goals (Al-Sobai et al., 2020). The decision to pursue a project involves a thorough evaluation process that considers multiple factors, such as financial viability, technical feasibility, risk assessment, resource capacity, innovation potential, and strategic alignment (Nguyen et al., 2013). The use of such comprehensive frameworks ensures that PBOs make informed decisions, minimizing the risk of pursuing unprofitable or unsustainable projects.

A key factor in the evaluation process is the assessment of financial and technical viability. The analyzed PBOs conduct detailed analyses to ensure that projects are financially sound and technically feasible before committing resources. For instance, the findings reveal that companies prioritize projects with clear profit margins and manageable risks. This aligns with the literature on dynamic capabilities, which emphasizes the importance of aligning project opportunities with organizational resources and capabilities (Hermano & Martín-Cruz, 2020; Söderlund, 2005; Zerjav et al., 2018).

Risk assessment is another critical component of the evaluation process. PBOs systematically analyze potential risks associated with new opportunities, including financial, technical, and operational risks. The findings highlight that companies often veto opportunities that pose high risks or that cannot be adequately mitigated. This cautious approach ensures that PBOs maintain operational stability and long-term sustainability, even in dynamic market environments. For instance, the availability of internal resources, such as technical expertise and operational capacity, plays a significant role in the decision-making process for the studied PBOs (Wood & Williams, 2014; Cooper & Budd, 2007). According to Jaafari (2001), risk and opportunity management should permeate project activities, focusing on long-term business objectives and community expectations.

The opportunity evaluation process also considers the client's history and reputation. PBOs prioritize working with clients who have a proven track record of reliability and trustworthiness. The findings indicate that companies are cautious about engaging with clients with a history of problematic behavior, as this can increase project risks and complicate execution. This aligns with the literature on relationship management in PBOs, which highlights the importance of trust and mutual understanding in successful project delivery (Nadae & Carvalho, 2017; Savolainen & Ahonen, 2015).

In addition, the findings underscore the significance of innovation and sustainability in evaluating business opportunities. PBOs are increasingly prioritizing projects that contribute to long-term sustainability and align with emerging market trends, such as green energy and digitalization. According to Al-Sobai et al. (2020) strategic projects must be sustainable in both development and operation, with a focus on governance, risk management, and resource optimization.

Lastly, the findings highlight the role of strategic alignment in the evaluation process. PBOs ensure that new opportunities fit within their long-term goals and strategic vision. The use of go/no-go committees and cross-functional panels to vet high-stakes bids demonstrates the importance of collective decision-making in ensuring that projects align with organizational priorities. This approach mirrors the concept of collective intelligence, minimizing the risk of pursuing misaligned opportunities (Turkulainen et al., 2013). Cooper and Budd (2007) emphasize the critical interface between sales and project execution phases, underscoring the need for proper planning to avoid financial risks and scheduling problems. These criteria serve as filters to maintain high standards and focus on viable, strategic projects, ensuring the PBOs' sustainability and alignment with long-term organizational goals (Wood & Williams, 2014).

5.3. Framework for integrated market sensing and knowledge transfer in PBOs

Based on our findings, we developed the framework shown in Fig. 5, which synthesizes how knowledge transfer between commercial and operational teams enhances sensing capabilities in PBOs. The framework visually integrates the roles of microfoundations, evaluation filters, external partnerships, and organizational enablers such as culture, integration, and digital mechanisms. It emphasizes how both teams contribute to detecting and evaluating opportunities through structured and informal exchanges, while also highlighting the influence of business ecosystems in sustaining competitiveness.

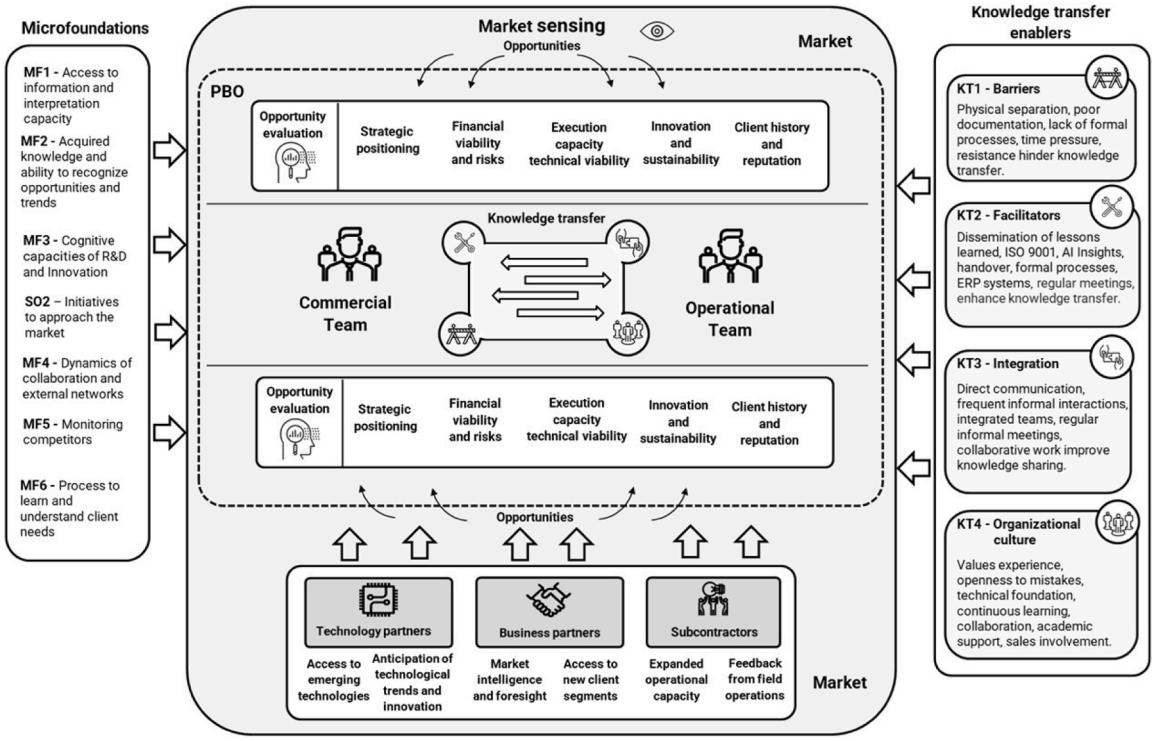

Fig. 5. Framework for integrated market sensing and knowledge transfer in PBOs.

6. Conclusions

6.1. Theoretical implications

The project management literature lacks studies on Teece's dynamic capabilities microfoundations, as noted by Keinz et al. (2021) in the special issue on open innovation through projects. The authors called for further research on sensing capabilities within project contexts, particularly concerning the identification and assessment of opportunities. This study offers a novel contribution by unveiling the internal dynamics between commercial and operational teams within PBOs, showing how bidirectional knowledge transfer enhances sensing capabilities and strengthens competitiveness. Previous research on dynamic capabilities often focuses on external sensing mechanisms, but this study highlights the importance of internal processes, particularly how commercial teams influence operational teams to align with market demands.

A key contribution of this study is the identification of opportunity evaluation factors that act as filters in the commercial process. This research shows that PBOs deliberately decline opportunities that do not align with their resources or strategic goals, balancing risk management with long-term sustainability. This finding adds new insights into the decision-making processes within PBOs.

Another important insight is the emphasis on external partnerships and their role in enhancing sensing capabilities. This study shows that partnerships with technological and business partners provide valuable market knowledge, which is often overlooked in existing frameworks. Moreover, the study brings forward the concept of "internal selling," where commercial teams influence operational teams to support innovative market approaches. This study demonstrates that such internal collaboration is essential for effective KT and market responsiveness. In addition, the research identifies practical KT mechanisms that combine formal and informal practices, strengthening both explicit and tacit knowledge sharing.

This brings a second important contribution by exploring the connection between knowledge transfer and sensing capabilities. Recent literature highlights the need for further research to bridge knowledge management and dynamic capabilities in the project context (Alves and Carvalho, 2023; Barbosa and Carvalho, 2024a, b; de Souza et al., 2021). As far as we know, it is the first study focusing on sensing capabilities and knowledge transfer in the PBO context, bringing new insights to this sensing microfoundation. This article makes significant contributions to the literature on dynamic capabilities in PBOs by exploring how bidirectional KT between commercial and operational teams enhances sensing capabilities. The research highlights the importance of continuous learning to stay updated with technological advances for improving market sensing and adapting to evolving customer demands.

Finally, we introduce a new framework for *Integrated market sensing and knowledge transfer in PBOs* and raise four propositions, with the framework being a unique contribution to PBO literature. It offers a structured way to understand KT mechanisms linked to sensing capabilities. Additionally, this study introduces new inductive codes that complement existing theoretical frameworks. For example, the code *Holistic evaluation of business opportunities* shows how PBOs filter opportunities, balancing risk and strategic alignment. The *Initiatives to approach the market* code further develops the sensing microfoundation by showing the proactive role of commercial teams in market sensing. Finally, the *Interpersonal and communication skills* code demonstrates the importance of communication flexibility for successful KT across teams.

6.2. Implications for practice

This study provides practical insights for professionals in the commercial, project management, and operational teams of PBOs. The integration and daily interaction between these teams are essential for competitiveness, particularly in identifying market opportunities and ensuring project alignment. The research shows that commercial teams play a key role in internal selling, influencing operational teams to support innovative approaches. To strengthen this collaboration, operational teams should enhance their communication skills and foster better internal and external relationships, while exploring new digital technology and artificial intelligence, as highlighted in KT codes. For example, sharing lessons through an app and using AI to extract insights

from historical data for decision-making.

PBOs should establish structured KT mechanisms, such as cross-functional meetings, lessons learned sessions, and digital platforms for knowledge sharing. Encouraging operational teams to participate in the sales process can improve project alignment and foster innovation. Additionally, PBOs must pay close attention to opportunity evaluation factors, which act as go/no-go filters before committing to new projects. Proper evaluation of risks, client history, and project feasibility ensures alignment with strategic goals.

The study also highlights the importance of monitoring competitors' movements. This can be done through client visits, social media, and marketing events to better understand market trends. Moreover, external partnerships with technological and business partners offer valuable insights that PBOs can leverage to enhance innovation and execution. Strengthening these collaborations improves sensing capabilities and boosts market responsiveness.

6.3. Limitations and future research agenda

While the findings are valuable, this study presents limitations. It relied on a multiple case study of seven PBOs from diverse sectors and sizes, all of which are located in Brazil, although some of them are multinational organizations. This may limit the generalizability of the results. Organizational culture and national culture, which are influential factors in PBOs (Chang et al., 2023), should be mentioned as a limitation and can be the object of further investigation in future studies. Moreover, some aspects of the proposed framework could be context-dependent, influenced by the specific characteristics of the companies under study (Voss et al., 2002). However, several factors enhance the rigor and validity of our research, including the seniority and expertise of the respondents, the relevance of the selected PBOs in their respective markets, the comprehensive number of interviews conducted, and the transparency of the methodology applied.

The KT mechanisms between teams have demonstrated significant importance in enhancing the sensing capabilities of PBOs. However, certain aspects remain inconclusive, leaving room for future research. Additionally, the influence of both organizational and national culture must be considered as a limitation. Since the companies analyzed are based in Brazil, the findings may not be directly applicable to PBOs in different cultural contexts.

The study also identifies practical KT mechanisms, including formal tools like digital platforms, artificial intelligence, and structured meetings, as well as informal practices such as daily interactions and client follow-ups. The combination of these mechanisms strengthens both explicit and tacit knowledge sharing across teams, a critical factor for developing sensing capabilities. In particular, understanding the implications of these new tools for sensing opportunities and the proposal phase (Holzmann et al., 2024; Silva et al., 2024) is a promising direction for future research agenda.

Although it was important to conduct this study with directors and managers, understanding the perspective of a second layer of professionals, such as salespeople and engineers, in a larger sample could reduce the bias of top management's views, which might reflect how things should be rather than how they actually are. Other studies could explore sensing in two parts: influenced by team interaction and by entrepreneurial activities. Moreover, the turnover effect on commercial teams, talent retention, on the effect on sensing opportunities and knowledge transfer (Jensen et al., 2019; Zhou et al., 2022), could be an interesting area for the new research agenda.

Empirical studies could investigate the impact of different types of structured mechanisms and KT facilitators on an organization's ability to enhance market sensing capabilities. Additionally, future research should examine how the dynamics of PBOs' business ecosystems influence market sensing capabilities across industries and organizational contexts.

Project duration is a key factor in knowledge transfer. Longer projects, such as those in engineering and construction, allow for deeper learning and more structured KT, while shorter projects may rely on faster, informal exchanges. This variation affects how knowledge is shared and retained over time, influencing the effectiveness of KT processes. Future research could further explore how project length shapes KT and sensing capabilities in PBOs.

Finally, future research should focus on empirically validating the four propositions presented in this article to understand their impact across diverse organizational contexts, investigating their implications for organizational innovation and competitive advantage. Such research endeavors are crucial for advancing our understanding of effective organizational strategies for navigating complex market landscapes.

CRediT authorship contribution statement

Marcos T.J. Barbosa: Writing – review & editing, Writing – original draft, Methodology, Investigation, Formal analysis, Conceptualization. **Marly M. Carvalho:** Writing – review & editing, Supervision, Formal analysis, Conceptualization.

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Appendix A

Interviews with Senior Professionals in the Operations Team:

1. Tell us a little about yourself and your company.
2. Does your team participate in the process of identifying business opportunities? How would you describe this process within your company?
3. What are the key criteria considered when evaluating the potential of a business opportunity?
4. How does the project team contribute to (1) identifying and (2) evaluating business opportunities? Is there openness to this?
5. Can you provide examples of business opportunities that arose from prospecting with the support of the project team and whose solution was potentially innovative?
6. How does the knowledge acquired from previous projects influence the identification and evaluation of new opportunities?
7. Is there a structured process that takes into account the knowledge already acquired in projects during the evaluation of opportunities?
8. Mention mechanisms, processes, or tools that your company employs to align identified opportunities with existing capabilities and resources.
9. Could you share specific examples of occasions when the project team faced the dilemma of pursuing a potential business opportunity or opting to reject it? In this case, what criteria are most relevant?
10. How does the operations team receive and use market insights provided by the commercial team to improve the detection of trends in current and future projects?
11. What mechanisms exist to facilitate knowledge transfer between the project and commercial teams, especially regarding the sharing of relevant market information (customers, trends, and competitors)?
12. What barriers or facilitators exist in this knowledge transfer?
13. Can you provide examples of how feedback and market data collected by the commercial team led to adjustments or reconfigurations in the operations team?

Interviews with Senior Professionals in the Commercial Team:

1. Tell us a little about yourself and your company.
2. How does the commercial team identify potential business opportunities within your company? Is there a defined prospecting or reaction process?
3. Is there an internal and/or external commercial training process for alignment (1) technological, (2) with customer needs, and (3) business partners?
4. What main criteria are used to evaluate the potential of a business opportunity? How do these criteria influence the decision to proceed?
5. Is there joint work between the commercial and operations teams in prospecting for business opportunities with potentially innovative solutions? Can you detail how it works?
6. Can you provide examples of sales opportunities that arose in these cases? What was decisive?
7. How do lessons learned from past experiences influence the identification and evaluation of new sales opportunities?
8. Mention mechanisms, processes, or tools that your company employs to align identified opportunities with existing capabilities and resources.
9. Can you share a specific example where the commercial team faced the dilemma of pursuing a business opportunity or opting to reject it? What were the decisive criteria?
10. How does the commercial team develop its market sensing capability (e.g., interaction with customers, following trends, and monitoring competitors)? Can you share examples of how this capability has positively affected project sales?
11. How does the commercial team use the knowledge acquired in projects to strengthen its approach to clients and identify innovative business opportunities?
12. What barriers or facilitators exist in this knowledge transfer?
13. How are the information and insights obtained through market opportunities shared with the operations team to help in the detection (sensing) of new technologies, trends, and customer needs?
14. How are the knowledge transfer processes structured between the commercial and operations teams to ensure that sensing is aligned with the company's capabilities and strategies?
15. Can you describe specific situations where the sensing capability of the commercial team directly influenced the selection, design, or execution of projects?
16. How does the synergy between the commercial and project teams enhance the perception of market changes and customer needs, contributing to the organization's competitive advantage?

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