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Qualitative comparative analysis of the personal traits of managers, scientists, and innovators in corporate science

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A B S T R A C T

This study examined the personal traits that contribute to the success of corporate science projects in Peru by focusing on the roles of CEOs, scientists, and innovators. Although Peru has seen economic progress in recent decades, integrating scientific research into business strategies requires improvement, reflecting a common trend in emerging economies. Through a fuzzy set qualitative comparative analysis (fsQCA) and a sample of 56 participants, the configurations of personal characteristics that contribute to the success of such projects were identified. The results indicate that success depends not on a single attribute but on a combination of various capabilities. This study emphasizes the importance of adaptability and collaboration among key actors and suggests a management approach that blends technical skills with interpersonal competencies. The practical implications of this study emphasize the need to align corporate leadership with scientific and market dynamics, foster empathy and teamwork, and leverage external networks to enhance innovation. Strategies must be adapted to the specificities of emerging economies where science, technology, and innovation systems are still developing.

Introduction

Corporate science involves conducting scientific research funded by companies to generate knowledge that facilitates the introduction of new products into the market or the implementation of processes that improve business efficiency (Zahra et al., 2018). Academic literature has pointed out that success in these projects requires the participation of entrepreneurs with a long-term vision (Simeth & Cincera, 2016), supported by scientists who prioritize practical application over scientific curiosity (Armstrong & Green, 2022) and innovators capable of extracting value from existing knowledge (Moon & Acquaah, 2020). However, it is important to note that corporate science is not just about individual capabilities. It also requires a suitable environment that favors it (Pisano, 2010). This underscores the complexity of the field and the need to consider external factors that can significantly influence the success of corporate scientific projects.

In the context of corporate science, CEOs, scientists, and innovators are key actors who bring distinctive, complementary competencies to each phase of the innovation process. Through transformational leadership (Bass, 1999), CEOs create an organizational environment that aligns individual goals with those of the organization, facilitating technology adoption and strategic decision-making in constantly changing environments (Chen et al., 2014; Zuraik & Kelly, 2019). Scientists play a fundamental role in generating and transferring knowledge, supported by the concept of open innovation, which allows knowledge to flow within and outside an organization, strengthening strategic alliances that optimize results (Ottonicar et al., 2020; Sá et al., 2023). Finally, innovators, as 'translators' of science, facilitate the transformation of scientific knowledge into commercial applications, integrating this knowledge into the company and adapting it to the market, in line with knowledge appropriation theory (Boehm & Hogan, 2013; Hislop, 2003).

Developed countries favor investment in scientific research to maintain their growth and competitiveness (Alsebai et al., 2022). Although Peru experienced significant economic progress in the first two decades of the 21st century (Rodriguez et al., 2024), the integration of scientific research into business activities is limited (Sagasti, 2021). This is reflected in multiple aspects such as a significant gap in research and development (R&D) investment (Turpo-Gebera et al., 2021), limited interaction between academia and business (Borda-Rivera & Ortega-Paredes, 2021), ineffective public policies to promote scientific research (Quispe et al., 2023), technological dependence on companies

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(Ricalde-Chahua & Libaque-Saenz, 2023), and resistance to change and adoption of new technologies by companies (Seclen-Luna & Alvarez-Salazar, 2021). These aspects, in addition to the predominance of extractive industries, do not generate a favorable environment for corporate science (Lust, 2016).

However, some Peruvian companies have successfully developed corporate science projects. For example, startups such as Quantum Talent and Laboratoria innovate in education and training in digital technologies, thereby strengthening human capital in the country (IDB Lab, 2021). Similarly, established companies such as AGP, a producer of laminated glass with global reach, invest in corporate science projects and collaborate with academic institutions, benefiting from public programs (PRODUCE, 2021). In addition, 74 other companies have benefited from tax incentives for research, which has allowed them to implement successful corporate science projects in Peru (CONCYTEC, 2022).

Despite the literature on corporate science identifying various factors that facilitate the integration of scientific research into business, there is limited exploration into how the specific personal traits of key corporate science actors—CEOs, scientists, and innovators—contribute to success in emerging economies such as Peru. This gap in the literature motivated the present study, which addressed the following research questions:

- What personal characteristics of CEOs, scientists, and innovators contribute to the success of corporate science projects in emerging economies, such as Peru?
- How are these personal characteristics configured in different combinations to foster an environment favorable to corporate science in contexts with limited R&D infrastructure and policy support?

To answer this question, a descriptive scoping study was conducted (Creswell & Creswell, 2018) using a fuzzy set qualitative comparative analysis (fsQCA) to identify the necessary characteristics that contribute to project success (Ragin, 2023). We worked with 56 scientists and managers involved in corporate science projects in Peru. Using fsQCA, this study makes an innovative contribution by examining the configurations of personal traits in the context in which corporate science projects face unique challenges.

This study draws on transformational leadership theory (Bass, 1999), open innovation theory (Chesbrough, 2003), and knowledge appropriation theory (Nonaka, 1994). Transformational leadership explains how CEOs align individual and organizational interests, open innovation highlights internal and external collaboration with scientists for corporate science success, and knowledge appropriation describes how innovators transform knowledge into commercial applications. By providing empirical evidence on how the specific personal traits of CEOs, scientists, and innovators influence corporate science success in emerging economies, this study offers new theoretical contributions to transformational leadership, open innovation, and knowledge appropriation theories under conditions of systemic limitations.

Our findings reveal that corporate science relies on adaptability and collaboration among key actors. There is no single formula for success but, rather, multiple effective combinations of personal characteristics.

Literature review

Corporate science

Corporate science is a business strategy that seeks to generate scientific knowledge to drive business development or improve an organization's operational efficiency (Zahra et al., 2018). Unlike science for academic purposes, corporate science prioritizes productivity and economic benefit generation (Vitale, 2017), focusing on creating value for a company and its stakeholders by applying knowledge to foster innovation (Bolívar-Ramos, 2023).

The corporate science process integrates managerial decision-making, the definition of operational activities, and the formalization of inter-organizational agreements (Clayton et al., 2018). This process is divided into four stages: (i) investment, in which resources are allocated and projects are selected; (ii) discovery, in which research activities are conducted; (iii) transfer, in which findings are transformed into commercial applications; and (iv) appropriation, in which marketable products or process improvements are generated (Zahra et al., 2018).

The outcomes of corporate science range from knowledge generation and scientific publications (Yang et al., 2023) to the creation of marketable products (Zahra et al., 2018) through interactions with research entities (Jong & Slavova, 2014), technology licensing (Yan et al., 2023; Krieger et al., 2024), and the adoption of new technologies to reduce costs (Chen et al., 2024). These interconnected elements maximize innovation and sustainability, allowing them to remain competitive and adaptable in constantly evolving markets. Consequently, a corporate science project is deemed successful when it not only generates or integrates scientific knowledge but also translates that knowledge into tangible value for the organization.

To understand how the key actors in corporate science contribute to its success, this study draws on three fundamental theories: transformational leadership (Bass, 1999), open innovation (Chesbrough, 2003), and knowledge appropriation (Nonaka, 1994). These theories offer complementary perspectives on organizational leadership, research collaboration, and the integration of knowledge into commercial applications, all of which are essential to the corporate science process.

Key actors in corporate science

Three key players in corporate science have been identified: CEOs, scientists, and innovators. Each actor brings a distinct theoretical perspective that defines their roles and contributions to the process. Alvarez-Salazar and Bernal-Pérez (2023) identified each actor's main characteristics.

Transformational leadership and the CEO's role in corporate science

Transformational leadership theory posits that leaders promote organizational change by aligning the interests of organizational members with broader objectives (Bass 1999). In doing so, they create a conducive environment for corporate science. This type of leadership influences the adoption of new technologies and product innovation, fostering a more agile and adaptable environment that enables companies to effectively face technological and competitive challenges (Y. Chen et al., 2014; Zuraik & Kelly, 2019). The creative dimension of CEOs' leadership is crucial for innovation effectiveness in high-tech firms (Makri & Scandura 2010).

In the context of corporate science, nine aspects that differentiate CEOs involved in corporate science stand out. First, the CEO's strategic vision allows scientific research to align with corporate strategy, facilitating adaptation to environmental changes. This vision, coupled with leadership skills, strengthens companies' responsiveness and creates a favorable position for corporate science by motivating teams to exploit new ideas and approaches (Friedman et al., 2016). In addition, a CEO's ability to anticipate future trends contributes to organizational flexibility and responsiveness (Su et al., 2023). Another essential aspect is market understanding, which enables firms to make strategic decisions and explore new opportunities (Rao et al., 2024).

Commitment to corporate science is another crucial CEO attribute, as it fosters an environment conducive to innovation by welcoming new ideas from the team (Rao et al., 2024). This commitment translates into a culture of innovation that improves business performance and the ability to adapt to new challenges (Luo et al., 2024). In addition, openness to new technologies gives companies a competitive advantage in technological development (Rosier, 2022). Best practices indicate that CEOs committed to innovation increase their investment in research and support innovative initiatives (Loukil et al., 2020).

Knowledge of scientific processes is also mentioned as an essential CEO characteristic, as it fosters curiosity and a long-term vision of the company. CEOs with STEM backgrounds can better evaluate and manage real options in research projects (Alderman et al., 2022), resulting in more remarkable originality and value of innovation (Song et al., 2023).

Generating professional networks is critical for the success of corporate science initiatives. CEOs who actively participate in technology communities and start-ups facilitate knowledge integration and encourage investment in research (Faleye et al., 2014). Finally, CEOs' entrepreneurial capacity complements these characteristics, manifesting in their ability to identify opportunities and generate new ideas. According to Keil et al. (2017), the CEO's entrepreneurial orientation can increase firm value, fostering a culture of innovation and improving market performance (Luo et al., 2024).

In summary, a CEO's transformational leadership and strategic vision not only create a conducive environment for corporate science but also lay the groundwork for other key actors, such as scientists, to drive knowledge generation and collaboration within the organization.

Based on these insights, we propose the following sufficiency hypothesis:

> H_1: The combination of strategic vision (stratV), commitment to innovation (engage), knowledge of the scientific process (sciPro), professional networks (proNet), entrepreneurial traits (entreT), scientific focus (sciFoc), technological experience (techEx), sustainable motivations (motiv), and risk-taking ability (riskTk) in the CEO is sufficient to achieve success in corporate science projects.

This sufficiency hypothesis is suitable in this context because the characteristics outlined contribute to creating a favorable environment for corporate science success without asserting that these are the only characteristics that could lead to such success.

Open innovation and the scientist's role in corporate science

The theoretical implications of open innovation theory highlight how collaboration with internal and external scientists facilitates companies in generating helpful knowledge for their strategies (Ottonicar et al., 2020). This flow of knowledge, circulating within and outside the organization, fosters the creation of strategic alliances that enhance corporate science outcomes (Sá et al., 2023). Research on open innovation has shown that integrating scientists into the innovation process establishes a solid research agenda that optimizes the organizational impact (Randhawa et al., 2016). Furthermore, incorporating scientists into business strategies allows companies to better leverage external knowledge, thereby increasing their competitiveness and sustainability (Chesbrough & Appleyard, 2007).

The environment fostered by a CEO's transformational leadership enables scientists to work in a setting that values collaboration and knowledge generation (Jiang & Chen 2018). This supportive environment is essential for scientists to contribute effectively to corporate science success through open innovation, where the flow of internal and external knowledge is harnessed for the organization's benefit (Huang et al., 2022).

In this context, corporate scientists possess vital characteristics for a discovery process that is oriented toward business goals. First, their alignment with organizational objectives drives scientific productivity. For example, corporate models have been leveraged in the biomedical field to foster teamwork (Valantine et al., 2014). Business strategy must align with corporate science to overcome challenges and maximize commercialization benefits (Zahra et al., 2018). This alignment enhances business innovation and sustainability, reinforcing the positive impact of corporate science on organizational development.

Second, corporate scientists seek a balance between a project's short- and long-term goals, thereby contributing to the success of corporate science (Wasowicz, 2021). This balance promotes short-term value creation and long-term sustainable organizational growth and innovation.

The third relevant characteristic is scientists' ability to seek practical applications that translate research results into successful products, processes, and services, thereby contributing to business innovation (Herrera, 2020). Scientists must apply fundamental business strategy concepts, define value propositions, and establish strategic collaborations (Nguyen & Nguyen, 2020).

Finally, corporate scientists must balance the cost and efficiency of corporate science projects. This is achieved by assessing the profitability and feasibility of projects using performance indicators and risk assessment methods such as discounted cash flows, Monte Carlo simulations, and decision tree analysis (Serikov et al., 2020).

Based on these insights from open innovation theory, we propose the following sufficiency hypothesis:

> H_2: The combination of organizational alignment (orgAln), specialization (specia), management skills (manSci), and temporal balancing capacity (dualTe) in scientists is sufficient to contribute to the success of corporate science projects.

Scientists' contributions establish a robust foundation for knowledge within the organization, providing the groundwork that innovators leverage to transform discoveries into marketable applications and commercial success.

Knowledge appropriation and the innovator's role in corporate science

Knowledge appropriation theory explains how innovators transform knowledge into innovation. Collaborations between science and business allow innovators to appropriate and apply this knowledge in a company (Boehm & Hogan, 2013). Furthermore, appropriation is not only an individual process but also requires social integration within the organization to foster innovation (Romero-Rodríguez et al., 2020). This integration process facilitates the generation of new ideas based on science, transforming them into commercial applications that drive organizational growth (Hislop, 2003; Wang & Chen, 2010).

The role of innovators in translating scientific knowledge into commercial applications aligns with the strategic visions established by the CEO (Teece, 2006). This alignment allows innovators to tailor their efforts to organizational priorities and promote innovation in products and services that reflect the growth and competitiveness goals outlined by organizational leadership (Hensmans, 2022).

In this context, innovators can be distinguished on the basis of seven key characteristics. The first is their ability to coordinate with scientists, relying on structured and unstructured strategies that facilitate the integration of the knowledge and skills needed for innovation (Isaeva et al., 2024).

Another salient feature is empathy and alignment with scientists, which strengthen collaboration. Empathy improves the understanding and connection between team members and positively contributes to performance (Keusters et al., 2024). Alignment ensures that work objectives and methods are synchronized and meet challenges coherently (Keusters et al., 2024).

In addition, innovators are distinguished by their knowledge of the market, which influences companies' scientific research agendas, provides information on customer needs and trends, and guides the direction of research (Zahra et al., 2018). This knowledge allows companies to adapt their scientific strategies to develop products and services that respond to actual demand, thereby increasing the likelihood of commercial success (Diaz Ruiz, 2022).

In summary, innovators act as translators between scientific discoveries and commercial applications by applying their specialized knowledge and interdisciplinary skills to convert technical concepts into viable products. This involves engaging inventions beyond the technical feasibility of commercialization (Vekinis, 2023). They must also understand intellectual property issues and regulations to protect their innovation and secure a competitive advantage (Van Norman & Eisenkot, 2017).

Based on knowledge appropriation theory, we propose the following sufficiency hypothesis for the role of innovators in corporate science:

H_3: The combination of bidirectional coordination (biCoor), opportunity focus (oppFoc), market orientation (markOr), research agenda alignment (resAgn), knowledge transformation (knTran), internal coordination (intCoo), and empathy (empath) in innovators is sufficient to contribute to the success of corporate science projects.

The sufficiency of this configuration lies in how these characteristics enable innovators to adapt knowledge to market needs, facilitate collaboration between science and business, and respond to organizational demands without assuming that this is the only possible configuration.

In summary, throughout the corporate science process, as described by Zahra et al. (2018), transformational leadership theory (Bass, 1999), open innovation theory (Chesbrough, 2003), and knowledge appropriation theory (Nonaka, 1994) provide a cohesive framework for understanding how each key actor contributes to corporate science success. Transformational leadership theory illustrates how, through strategic vision and creative leadership, CEOs establish an environment that enables knowledge discovery, transfer, and appropriation, ultimately leading to technological advancements and fostering product and process innovation (Friedman et al., 2016; Su et al., 2023). Open innovation theory emphasizes the role of scientists in generating and integrating internal and external knowledge, thereby facilitating collaborations that strengthen the corporate science process and optimize organizational outcomes (Randhawa et al., 2016; Sá et al., 2023). Finally, knowledge appropriation theory highlights the role of innovators as essential translators who bridge scientific knowledge with commercial applications, transforming discoveries into viable market solutions (Romero-Rodríguez et al., 2020; Wang & Chen, 2010). Each actor's contribution, interlinked with others, forms a dynamic and interdependent system in which leadership, knowledge generation, and knowledge application propel corporate science forward.

Methodology

Design

The fsQCA method was employed to identify configurations of personal characteristics of CEOs, scientists, and innovators that contribute to the success of corporate science in an emerging country with an unfavorable research environment. The fsQCA method was selected because it can handle the multidimensionality and uncertainty inherent in the study data (Pavlačková et al., 2023).

The fsQCA approach is an appropriate methodology for analyzing complex attribute configurations, as it allows the exploration of specific combinations of factors—in this case, the characteristics of key actors—that are sufficient to achieve success in corporate science rather than identifying isolated individual factors. This is essential in studies such as the present one, in which multiple combinations of characteristics can lead to success, something that traditional regression and SEM methods do not adequately address (Khedhaouria & Thurik, 2017).

Unlike regression or SEM, fsQCA allows for the analysis of multicausality and asymmetry, meaning that different combinations of conditions can lead to the same outcome, a phenomenon known as equifinality (Ding, 2022). This configurational approach is essential for understanding how different sets of personal characteristics can converge in achieving success, providing a comprehensive perspective of multiple causality, in which each combination represents a unique "causal recipe" for the desired outcome (Kopplin, 2023).

Additionally, fsQCA is particularly suitable for studies with small sample sizes. Given that the sample size in this study was 56 cases, fsQCA allowed for precise analysis without the extensive sample size requirements of methods such as regression or SEM, which require larger sample sizes to ensure statistical reliability (Tho, 2018).

Finally, fsQCA facilitates the analysis of complex interactions among multiple conditions, thus capturing specific configurations unique to corporate science in emerging economies. This capability to handle nonlinear and configurational interactions makes it a robust method for this study, in which combinations reflecting the complexity of individual characteristics and their alignment with organizational goals are explored (Alsebai et al., 2022).

This methodological approach has been widely validated in the literature, highlighting its ability to reveal complex causal configurations in organizational contexts (e.g., Khedhaouria & Thurik, 2017; Leppänen et al., 2023; van der Valk et al., 2016; Vergne & Depeyre, 2016). We anticipate that this will allow us to identify the combinations of personal characteristics that are necessary and sufficient for the success of corporate science projects in an emerging country's business environment.

Data

For the analysis, information was used from companies that have benefited from research and innovation incentive programs in Peru, specifically the National Innovation Program for Competitiveness and Productivity (PNICP) and the National Innovation Program for Fisheries and Aquaculture (PNIPA). Data on companies that benefited from Law No. 30,309, which offers tax deductions to those developing R&D projects, were also included. A sample frame of 174 projects financed over the last five years was constructed from these databases.

Given the scarcity of companies involved in corporate science projects in Peru, a purposive sampling approach was essential to ensure the inclusion of relevant cases. This approach focused on identifying key actors, primarily scientists and managers, engaged in projects deemed successful according to the success criteria defined by public science funding programs in Peru. This purposive sample, which comprised 93 potential participants, was selected to represent companies that have demonstrated alignment with government policies and financial incentives for science-based initiatives, following similar practices in fsQCA studies with small samples and constrained contexts. Fifty-six responses to the questionnaire were received, representing a response rate of 60.2%. The questionnaire was administered between February and July 2024.

While targeted, the sampling strategy may present limitations in terms of representativeness as it predominantly includes companies with experience in accessing public funding or tax incentives. Consequently, the study may not fully represent all firms with a potential interest in corporate science, particularly those that lack resources or alignment with government-supported programs. This focus on publicly funded or incentivized firms could introduce selection bias, potentially limiting the generalizability of the results to companies with less access to these resources.

To mitigate non-response bias, several measures were implemented to encourage participation and reduce the potential for bias, including periodic reminders and personalized communications. With a 60.2% response rate, efforts were made to maximize engagement; however, we recognize that the limited response may still introduce partial response bias. However, fsQCA is robust in settings with limited responses because of its emphasis on data quality over quantity, allowing for the extraction of meaningful causal configurations, even with incomplete data (Pietraszek & Skrzypczak-Pietraszek, 2014). In fsQCA, data quality is more critical than quantity (Hao et al., 2021; Kolossa & Kopp, 2018). Thus, 56 cases were deemed suitable for the objectives of this study.

In conclusion, while fsQCA and the quality of the collected data support the validity of the findings, it is important to interpret the results with an understanding of the potential representational limitations stemming from the sample design and partial response.

Variables and measurement

The variables were based on the results of the exploratory qualitative research developed by Álvarez-Salazar and Bernal-Pérez (2023). We highlight a set of variables (personal characteristics) that could determine the success of corporate science in Peru. Based on this and taking the conceptual framework as a reference, definitions were proposed for the variables analyzed. Table 1 presents the proposed definitions of CEOs, scientists, and innovators.

All of these characteristics behave as latent variables and are reflected in specific behaviors. Considering the conceptual framework, an instrument was proposed to collect behaviors that demonstrate the presence of these latent variables (Sarstedt et al., 2017) and to identify the existence of outcomes in corporate science (Zahra et al., 2018). Given the sample size, applying factor analysis was impossible; therefore, we used PLS-SEM (Alvarez-Salazar & Seclen-Luna, 2023). The instrument consisted of 76 observable variables measured using a five-point Likert scale. Researchers and managers rated their level of agreement with statements reflecting desired personal characteristics (20 latent variables) and conditions reflecting corporate science success (one latent variable). Following the guidelines of Hair et al. (2017), the instrument was evaluated, discarding five observable variables and ensuring that reliability and validity criteria were met for measuring latent variables in all cases. Appendix A presents the assessment of the validity and reliability of the instrument.

Table 1
Definition of variables.

Actor	Feature	Definition
CEO	Strategic vision	Ability to lead innovation aligned with corporate strategy, taking advantage of market opportunities and adapting to changes.
	Engagement	Encourages innovation and actively supports technological development in the company.
	Scientific process knowledge	Understanding the scientific process, its continuous updating, and its ability to identify innovative opportunities.
	Professional networks	Ability to use professional networks to foster collaboration and access resources.
	Entrepreneurial trait	Ability to innovate, see beyond day-to-day operations, and seize opportunities that emerge from corporate science.
	Scientific focus	Focus on science and research for innovation.
	Technological expertise	Experience and knowledge in technological areas, applying innovative strategies in the company's development.
	Motivations	Focus on sustainability and long-term impact.
	Risk-taking	Ability to make risky decisions based on knowledge, facing challenges in a calculated manner.
Scientist	Organizational alignment	The degree to which they align their research with organizational objectives and strategies.
	Specialization	Level of expertise and ability to provide innovative, high-value solutions.
	Managing scientist	Ability to manage projects and communicate findings.
	Dual temporality	Ability to balance projects with immediate results and long-term benefits.
Innovator	Bi-directional coordination	Ability to communicate and collaborate with R&D, managers, and business leaders.
	Opportunity focus	Proactively identifying market problems and solutions and seeking new opportunities from corporate science.
	Market-oriented	Ability to develop products with market potential, anticipating and responding to their needs.
	Research agenda orientation	Orientation toward research projects aligned with the business, taking risks to satisfy the market.
	Knowledge transformation	Ability to adapt scientific knowledge to practical and relevant applications and communicate it in the business environment.
	Internal coordination	Ability to translate research into understandable concepts, fostering collaboration between science and business.
	Empathy	Understanding and empathy toward scientists, facilitating collaboration and joint exploration of research topics.

Own elaboration based on Alvarez-Salazar and Bernal-Pérez (2023).

Procedure

Data on the personal characteristics of corporate science actors and the results of corporate science projects were obtained from PLS-SEM application estimates and standardized values, with mean zero and standard deviation one. These data were calibrated following the guidelines proposed by Duşa (2018). Ragin (2023) indicated that calibration accuracy is essential for analysis validity. Thus, the 10th percentile was used as the exclusion criterion, making it possible to identify cases with low membership in each set. This approach is relevant for effectively discriminating cases at the lower extremes of the distribution (Schneider & Wagemann, 2012). The crossover point was set slightly below the 50th percentile to avoid ambiguous values close to 0.5, which could hinder the interpretation of the results (Duşa, 2018). This adjustment ensured that cases close to the crossover point were classified more clearly, thereby reducing the uncertainty associated with intermediate membership values. The median is a common reference point in calibration because it represents a central value in the distribution and allows for balanced calibration (Schneider & Wagemann, 2012). Finally, the 90th percentile was taken as the inclusion point, a threshold used to identify cases with high membership in the set, that is, those that ultimately fulfilled the condition. Selection of the 90th percentile ensured that only the most representative cases of the phenomenon under study were classified as full members of the set, which increased the precision and significance of the results obtained (Schneider & Wagemann, 2012).

Calibrated data identified the characteristics necessary for successful corporate science. The tool used for this analysis was the QCA package in R (Duşa, 2024). Features sufficient for corporate science success were evaluated using the same package in R. This analysis identified specific combinations of features that guaranteed the outcome and provided insight into possible causal configurations (Ragin, 2023).

The truth table is a central component of fsQCA. It shows all possible combinations of conditions and the number of cases corresponding to each combination, thereby facilitating the identification of robust causal configurations (Rihoux & Ragin, 2009). Following standard methodological recommendations, an inclusion threshold of 0.8 was set to determine which combinations were sufficient for the outcome (Ragin, 2023).

In addition, a Boolean logic-based minimization was performed to simplify the combinations of the features, which allowed the identification of the essential configurations that explain the outcome (Ragin, 2014). Thus, complex, intermediate, and parsimonious solutions were identified, providing a comprehensive view of the causal configurations (Schneider & Wagemann, 2012).

Finally, robustness tests were conducted to validate the results, including sensitivity analysis at different consistency thresholds. Despite some inherent limitations of the fsQCA method, the results are valid and reliable, providing insight into the causal configurations in Peru's corporate science.

Results

Sample description

The study sample was characterized by a preponderance of scientists (80.4%) over managers (19.6%). There was a higher representation in engineering and technology fields (46.4%), followed by social sciences

(35.7%) and natural sciences. The participants' degree of experience varied, with 35.7% having more than 10 years of experience, suggesting a solid knowledge base and practice in the field.

Regarding education, 39.3% had a master's degree and 30.4% had a doctorate, indicating high academic training. Most participants (82.1%) had worked on one to five projects, suggesting familiarity with the research process. The size of the projects was diverse, with the majority (39.3%) being less than US$10,000, reflecting funding limitations in the Peruvian context.

Data calibration

By setting the exclusion threshold at the 10th percentile, the crossover point at the median, and the inclusion threshold at the 90th percentile, it was possible to correctly classify the cases under study and identify those with low, moderate, and high membership for several key characteristics (see Appendix B).

Calibration ensures that the data accurately reflect the degree of membership of each case, eliminating ambiguities and providing clarity in classification. This allows for reliable analysis tailored to different data distributions (Duşa, 2018). The identification of cases with low, moderate, and high membership levels demonstrated the effectiveness of the calibration process. As Schneider and Wagemann (2012) argued, the absence of cases with high membership in specific features suggests that these are not individual conditions necessary for successful corporate science but may be in combination with sufficient conditions. The predominance of moderate membership indicates greater complexity and diversity in the routes to success, underscoring the importance of assessing multiple characteristics to identify practical causal configurations.

Truth tables

Truth tables for CEOs, scientists, and innovators reveal various combinations of personal characteristics and their relationships with success in corporate science in Peru (see Appendix C). Many combinations had only one associated case, suggesting limited representativeness and high variability in emerging ecosystems, possibly because of the small sample size. However, the analysis in this exploratory study is still informative (Schneider & Wagemann, 2012). Despite the limited number of cases per combination, the configuration provided essential insight into corporate science in emerging systems.

On the other hand, combinations with high consistency (incl. > 0.80) and low proportional reduction of inconsistency (PRI < 0.75) suggest that certain sets of conditions tend to lead to success (Duşa, 2024). The combination of all conditions indicates that multiple simultaneous characteristics could be sufficient for the success of corporate science projects in Peru. Thus, the variability in combinations reflects the diversity of actor characteristics in the Peruvian ecosystem, and each unique combination may merit additional attention.

Analyzing the truth tables allows us to identify the conditions that, when present together, create an environment conducive to success. They show that the characteristics of CEOs (12 cases; incl. $= 0.87$; PRI $=$ 0.77), scientists (16 cases; incl. $= 0.84$; PRI $= 0.71$), and innovators (20 cases; incl. $= 0.88$; PRI $= 0.76$) were sufficient for the success of corporate science in Peru. The total absence of these conditions also highlights that these projects tend to fail (CEOs, four cases; scientists, 14 cases; and innovators, eight cases). Although many configurations have only one case (CEOs, 24; scientists, five; innovators, 14), this underscores the importance of exploring and documenting these configurations to better understand the complete picture. The following sections discuss the necessity and sufficiency of the configurations identified in the empirical data.

Necessity and sufficiency analysis

The necessity and sufficiency analysis (Table 2) for CEOs, scientists, and innovators shows that no individual condition achieves a necessity consistency greater than 0.80 (Schneider & Wagemann, 2012), indicating that no characteristic is strictly necessary for successful corporate science (Ragin, 2014). For CEOs, knowledge of the scientific process (0.74) and scientific approach (0.75) are essential but insufficient. Specialization (0.78) and scientific project management (0.69) presented high values but were also not necessary conditions. For innovators, empathy (0.83) comes closest to being necessary but is also insufficient.

When applying a sufficiency threshold of a consistency of 0.80, no individual CEO characteristic reached this level. Strategic vision, commitment, professional networks, entrepreneurship, and risk-taking show sufficient consistency of 0.72, indicating that these conditions can contribute to success in combination with others. Among scientists, organizational alignment, specialization, scientific project management, and temporal duality showed values close to the threshold, with the highest being 0.75 and 0.74. These conditions may be part of a sufficient causal configuration (Ragin, 2014).

Several innovator characteristics reached adequate sufficiency levels. Bidirectional coordination, opportunity orientation, market orientation, knowledge transformation, internal coordination, and empathy showed sufficient consistencies between 0.74 and 0.83. These conditions can contribute significantly to success (Schneider & Wagemann, 2012).

As combinations of conditions can provide a more complete picture of success, a counterfactual analysis using parsimonious and intermediate solutions is required (Schneider & Wagemann, 2012). This approach identifies simplified and balanced causal configurations, providing a better basis for understanding the underlying dynamics and designing strategies for developing corporate science in emerging contexts.

Complex solutions

In fsQCA, identifying complex configurations is fundamental for understanding the multiple paths that can lead to success in different contexts. The following section presents the complex solutions for CEOs, scientists, and innovators, highlighting combinations of sufficient conditions for corporate science success in Peru (see Appendix D). Robust configurations were selected, eliminating those with fewer than three cases, sufficient consistency of less than 0.80, and proportional inconsistency reduction of more than 0.75, as recommended by Misangyi and Acharya (2014).

For CEOs, 23 possible configurations were identified. The minimized complex solution for CEOs shows combinations of sufficient conditions for the success of corporate science in Peru. The identified configurations present the metrics of consistency, PRI, coverage, and several cases that support their relevance. The combination of all conditions (strategic vision, commitment, knowledge of the scientific process, professional networks, entrepreneurial capacity, scientific approach, motivation, and risk-taking) showed high consistency and adequate coverage. This suggests that a holistic approach in which the CEO leads innovation aligned with corporate strategy, understands the scientific process, utilizes professional networks, and innovates by taking informed risks is effective for the success of corporate science.

Another configuration with high consistency includes the absence of a strategic vision and commitment but with knowledge of the scientific process, professional networks, entrepreneurship, technological expertise, and motivation. This indicates that in some contexts, professional networks and motivation can compensate for the need for a clear vision and strategic commitment. The third configuration shows that professional networks, entrepreneurial ability, scientific focus, technological expertise, motivation, and risk taking can compensate for the absence of

Table 2
Need and sufficiency analysis.

Actor	Feature	Needs Analysis			Sufficiency Analysis			
		inclN	RoN	covN	inclS	PRI	covS	covU
CEO	stratV	0.69	0.78	0.72	0.72	0.57	0.69	0.00
	engage	0.72	0.77	0.72	0.72	0.56	0.72	0.01
	sciPro	0.74	0.72	0.69	0.69	0.54	0.74	0.00
	proNet	0.67	0.79	0.72	0.72	0.54	0.67	0.00
	entreT	0.74	0.76	0.72	0.72	0.55	0.74	0.02
	sciFoc	0.75	0.74	0.71	0.71	0.56	0.75	0.01
	techEx	0.71	0.72	0.68	0.68	0.50	0.71	0.00
	motiv	0.70	0.77	0.71	0.71	0.55	0.70	0.00
	riskTk	0.74	0.76	0.72	0.72	0.55	0.74	0.00
Scientist	orgAln	0.70	0.82	0.76	0.76	0.62	0.70	0.01
	specia	0.78	0.77	0.74	0.74	0.60	0.78	0.07
	manSci	0.69	0.78	0.71	0.71	0.55	0.69	0.02
	dualTe	0.68	0.81	0.74	0.74	0.59	0.68	0.01
Innovator	biCoor	0.75	0.79	0.75	0.75	0.59	0.75	0.02
	oppFoc	0.73	0.73	0.69	0.69	0.50	0.73	0.00
	markOr	0.75	0.79	0.75	0.75	0.58	0.75	0.01
	resAgn	0.77	0.79	0.76	0.76	0.60	0.77	0.00
	knTran	0.74	0.82	0.77	0.77	0.62	0.74	0.01
	intCoo	0.76	0.83	0.79	0.79	0.66	0.76	0.00
	empath	0.83	0.73	0.74	0.74	0.60	0.83	0.01

Note: inclN = consistency of need; RoN = relevance of need; covN = coverage of need; inclS = consistency of sufficiency; PRI = proportional reduction of inconsistency; covS = coverage of sufficiency; covU = single coverage.

strategic vision and commitment. CEOs can overcome their lack of vision and commitment through a solid professional network and scientific approach. Finally, another configuration with high consistency includes a scientific approach without a strategic vision, commitment, professional networks, entrepreneurship, technological expertise, motivation, or risk-taking. This highlights that in some contexts, a solid scientific approach may be sufficient, even without the multiple conditions generally associated with success.

The results of the scientists' analysis revealed multiple configurations that contributed to the success of corporate science, with 71% of cases included in the reported configurations. This allowed us to identify the trends and patterns that highlighted the importance of various conditions in different combinations. The combination of organizational alignment and science project management stands out, with high consistency and adequate coverage. This suggests that scientists who align their research with organizational goals and effectively manage their projects are more likely to achieve success. Organizational alignment facilitates the integration of science into corporate strategy, improving research impact, whereas effective project management improves the communication of findings and the application of management concepts.

Another relevant configuration is the combination of organizational alignment and the absence of temporal duality. This suggests that scientists who align their research with organizational goals but do not need to balance projects with different time horizons may still be successful. The absence of temporal duality may indicate a greater focus on short- or long-term projects, allowing for more in-depth research without the pressure to balance multiple temporal priorities. However, specialization combined with the absence of scientific project management capability shows high consistency and sufficient coverage. This indicates that specializing in a specific area may be more beneficial than managing multiple projects. Specialization allows for in-depth knowledge in a particular field, leading to higher-value innovations, which suggests that project management should fall to actors other than scientists. This facilitates a greater focus on research.

Another combination of specialization and temporal duality management suggests that scientists who balance projects with immediate results and long-term benefits may have an advantage. Managing temporal duality allows scientists to integrate continuous innovation with short-term results while pursuing more profound results when dealing with developments that require more R&D effort. Finally, the combination of a lack of specialization and the ability to manage temporal duality may be offset by a scientist's managerial capabilities. This suggests that some scientists can achieve success by effectively managing projects without the need for deep specialization and without the complexity of balancing projects with different time horizons. Thus, effective project management may be essential for scientists in more general environments, allowing for rapid adaptation to diverse demands and opportunities.

The analysis reveals that no single configuration of scientific characteristics guarantees success in corporate science. The diversity of successful combinations suggests that multiple routes can lead to success, depending on the context and strengths of the scientists. These configurations underscore the importance of organizational alignment, specialization, and project management, suggesting that different strategies may be equally valid.

The complex solution for innovators includes 79% of the cases, indicating better representativeness than for CEOs and scientists. Several combinations of conditions have been identified as determinants of success in corporate science. The first configuration highlights the importance of two-way coordination, orientation on the research agenda, internal coordination, empathy, and a lack of focus on opportunities. This suggests that efficient communication and collaboration among scientists, managers, and business leaders, aligned with organizational goals and empathy for scientists, is critical for success, even without proactivity focused on market opportunities.

The second configuration emphasizes opportunities, research agenda orientation, knowledge transformation, internal coordination, and empathy. Innovators who identify market problems and solutions, translate research into practical applications, and effectively collaborate with scientists tend to be successful. Another relevant configuration is a combination of market orientation, research agenda orientation, knowledge transformation, internal coordination, and empathy. Developing products with market potential and adapting scientific knowledge to relevant applications while collaborating internally and maintaining empathy for scientists is critical.

An additional configuration shows that empathy is sufficient for success, even without opportunity focus, market orientation, research agenda, knowledge transformation, or internal coordination. This indicates that scientists' empathy can compensate for a lack of other conditions. A final configuration, an alternative to the previous one, combines a focus on opportunities, market orientation, and research agenda orientation with the absence of knowledge transformation and internal coordination but with the presence of empathy. This suggests that a proactive focus on market opportunities aligned with research agenda orientation and empathy may be sufficient for success without needing knowledge transformation or internal coordination.

The analysis of complex solutions reveals multiple combinations of conditions that can lead to success in corporate science. The diversity of successful configurations underlines the importance of flexibility, adaptability, and a combination of different capabilities and approaches. However, analysis of the core and peripheral configurations is necessary for a deeper understanding. This approach allows the identification of simplified and balanced causal configurations, providing a better basis for understanding the dynamics underlying the development of corporate science in emerging contexts.

Central and peripheral conditions

The analysis of the core and peripheral conditions in corporate science projects allows us to identify the CEO characteristics that lead to success. Table 3 presents the results obtained.

Analysis of the seven identified solutions highlights the various combinations of conditions for success in corporate science. In Solution 1, the CEO's scientific orientation is central, while strategic vision is secondary, suggesting that a focus on science may be sufficient for project success. Solution 2 emphasizes CEO involvement supported by strategic vision and scientific knowledge as fundamental elements. Solution 3 emphasizes the importance of professional networks, technological expertise, and risk-taking, whereas strategic vision and scientific knowledge are less relevant. In Solution 4, professional networks, entrepreneurship, and risk-taking are central. Solution 5 emphasizes proactive leadership with a solid scientific and technological base. Solution 6 combines the willingness to take risks, a scientific approach, and an entrepreneurial attitude, highlighting the CEO's involvement. Finally, Solution 7 shows that professional networks, entrepreneurial skills, and technological expertise are essential, while motivation and scientific knowledge are secondary.

In summary, the evaluation of Hypothesis 1 indicates that not all proposed conditions are simultaneously required to achieve success in corporate science projects. Instead, success can be achieved through various partial combinations of sufficient conditions. CEO involvement, professional networks, entrepreneurial traits, technological expertise, and risk taking emerged as the most important and recurrent factors across configurations, whereas motivation appeared to be a complementary but not essential element. Therefore, this hypothesis is partially supported, as different combinations of some of the proposed conditions are sufficient for success without necessitating their simultaneous presence.

Regarding scientists' core and peripheral conditions (Table 4), the solutions reveal different combinations of success in corporate science. In Solution 1, organizational alignment and specialization are central conditions, suggesting that success depends on the alignment of research with organizational goals and a high level of specialization. Solution 2 highlights the centrality of specialization and the ability to manage temporal duality. At the same time, project management is peripheral, and organizational alignment is irrelevant, indicating that combining specialization with the ability to achieve both short- and long-term results is critical. In Solution 3, organizational alignment and the ability to manage temporal duality are sufficient for success, regardless of specialization or project management. Solution 4 emphasizes the importance of organizational alignment and management of temporal duality, complemented by project management skills, with specialization being irrelevant.

The evaluation of H2 shows that different configurations of conditions are sufficient for success in corporate science projects without requiring the simultaneous presence of all proposed conditions. Organizational alignment and temporal balancing capacity have emerged as the most important and recurrent conditions, suggesting that success largely depends on aligning research with organizational goals and effectively managing both short- and long-term objectives. Specialization and management skills are relevant in some configurations but are

Table 4
Central and Peripheral Conditions of Scientists.

Variable	Solution 1	Solution 2	Solution 3	Solution 4
orgAln	●		●	
manSci		•		•
dualTe		●	●	●
specia	●	●		
Consistency	0.85	0.81	0.80	0.80
PRI	0.64	0.47	0.66	0.58
Raw Coverage	0.38	0.32	0.60	0.45
Unique Coverage	0.01	0.02	0.02	0.07
Overall Solution Consistency	0.82			
Overall Solution Coverage	0.12			

Note: (●) Indicates that the condition is present and central to the configuration; (•) Indicates that the condition is present but not central to the configuration; (⊗) Indicates that the condition is absent and central to the configuration; (⊗) Indicates that the condition is lacking but not central to the configuration.

Table 3
Central and Peripheral Conditions of CEOs.

Feature	Solution 1	Solution 2	Solution 3	Solution 4	Solution 5	Solution 6	Solution 7
stratV	⊗	•	⊗	•			
engage		●			●	●	
sciPro		•	⊗	•	•	•	•
proNet			●	●			●
entreT				●	●	●	●
sciFoc	●				●	●	
techEx			●		●		●
motiv		•					•
riskTk			●	●		●	
Consistency	0.816	0.803	0.814	0.842	0.846	0.835	0.822
PRI	0.547	0.665	0.477	0.722	0.728	0.706	0.695
Raw Coverage	0.431	0.51	0.298	0.477	0.522	0.525	0.519
Unique Coverage	0.022	0.034	0.004	0.005	0.012	0.009	0
Overall Solution Consistency	0.825						
Overall Solution Coverage	0.469						

Note: (●) Indicates that the condition is present and central to the configuration; (•) Indicates that the condition is present but not central to the configuration; (⊗) Indicates that the condition is absent and central to the configuration; (⊗) Indicates that the condition is lacking but not central to the configuration.

not indispensable. Thus, the hypothesis is partially supported because various combinations of some of the proposed conditions are sufficient to achieve success.

For innovators, an analysis of central and peripheral conditions reveals specific configurations that lead to success in corporate science (Table 5). In Solution 1, a proactive approach to identifying opportunities and finding solutions is central. At the same time, two-way coordination is irrelevant, suggesting that proactivity may be sufficient to achieve success without intense collaboration. In Solution 2, knowledge transformation, internal coordination, and empathy are central. The presence of a focus on opportunities, although not central, indicates that the ability to adapt scientific knowledge and communicate it effectively, together with empathy and internal coordination, are decisive factors for success, as they facilitate collaboration and practical implementation of innovations.

In Solution 3, research agenda orientation and internal coordination are central conditions, whereas bidirectionality and empathy are irrelevant. This implies that aligning research projects with business needs and coordinating internally are sufficient to ensure success without requiring specialization or intensive project management. In Solution 4, knowledge transformation, internal coordination, and empathy are again central, while opportunity focus, market orientation, and a research agenda are present but not central. This suggests that the ability to identify market opportunities and target research complements project success along with the core capabilities of knowledge transformation and empathy.

The fsQCA analysis shows that while successful combinations of conditions vary, knowledge transformation, internal coordination, and empathy consistently emerge as central to success in innovation-driven corporate science. These conditions underscore the importance of adapting scientific knowledge to practical applications and fostering collaboration within organizations. In contrast, conditions such as market orientation and opportunity focus are context-dependent and not essential for every configuration. Thus, the evaluation of H3 indicates that the hypothesis is partially supported, as various combinations of some of the proposed conditions are sufficient for success without requiring their simultaneous presence.

General analysis of central and peripheral conditions

Analyzing the central and peripheral conditions for CEOs, scientists, and innovators reveals the critical factors that drive the success of corporate science projects when strategically combined. CEOs contribute through active involvement, entrepreneurial traits, and scientific focus, guiding the organization toward new opportunities and fostering evidence-based decision-making. Scientists, in turn, add value through organizational alignment and their capacity to manage temporal duality, ensuring that research initiatives are integrated with corporate strategy and balancing immediate outcomes with long-term impacts. In contrast, innovators excel in knowledge transformation, internal coordination, and empathy, facilitating effective collaboration and the practical application of scientific advances.

Together, these conditions create a cohesive environment that promotes innovation, aligns strategic objectives, and manages time effectively, allowing for the seamless implementation of new ideas through strong communication and collaboration. This systemic approach demonstrates that success in corporate science projects is not attributable to a single characteristic but, rather, to a dynamic interplay of conditions that vary depending on the context and unique contributions of each actor involved.

Furthermore, the analysis partially confirms the hypotheses regarding the combination of the personal characteristics of CEOs, scientists, and innovators. Although each hypothesis proposed that a specific combination of conditions is sufficient for success, the findings reveal that different partial combinations of these conditions can also be effective. This partial confirmation highlights the flexibility and adaptability required in corporate science projects, where success can be achieved through multiple pathways, depending on the context.

Table 5
Central and peripheral conditions of innovators.

Variable	Solution 1	Solution 2	Solution 3	Solution 4	Solution 5
biCoor	⊗		⊗		
oppFoc	●	•			
markOr				•	•
resAgn				•	
knTran			●		●
intCoo			●		●
empath		●		●	●
Consistency	0.76	0.80	0.83	0.81	0.83
PRI	0.47	0.64	0.62	0.66	0.70
Raw Coverage	0.39	0.42	0.36	0.69	0.65
Unique Coverage	0.04	0.04	0.01	0.02	0.01
Overall Solution Consistency	0.80				
Overall Solution Coverage	0.50				

Note: (●) Indicates that the condition is present and central to the configuration; (•) Indicates that the condition is present but not central to the configuration; (⊗) Indicates that the condition is absent and central to the configuration; (⊗) Indicates that the condition is lacking but not central to the configuration.

Discussion

The fsQCA results reveal a complex interplay of the characteristics that contribute to corporate science success. Existing literature highlights the traits of CEOs, scientists, and innovators that foster this success. Alvarez-Salazar and Bernal-Perez (2023) identify the attributes that scientists and managers value in cultivating an environment conducive to corporate science, directly linking these to positive outcomes. However, our analysis indicates that no single attribute guarantees success. Instead, success emerges from a combination of interconnected factors.

For CEOs, our findings align with transformational leadership theory. Bass (1999) posits that leaders induce change by aligning individual goals with broader organizational objectives. In our study, this alignment becomes evident as CEOs incorporate scientific knowledge into their corporate strategies, creating favorable environments for technology adoption and professional networks. These elements enhance the effectiveness of R&D projects and clarify decision-making under uncertain conditions (Loukil et al., 2020; Rao et al., 2024). Rather than relying on a singular trait, CEOs blend strategic vision, networks, and an entrepreneurial mindset to adapt to competitive contexts (Chen et al., 2014; Zuraik & Kelly, 2019). Their ability to integrate these factors rather than depending on one quality underpins their effectiveness.

For scientists, organizational alignment and collaboration are critical. Open innovation theory stresses how integrating internal and external knowledge strengthens strategic alliances and improves research outcomes (Ottonicar et al., 2020; Sá et al., 2023). Such collaboration aligns research with organizational goals (Carter et al., 2019) and facilitates continuous knowledge exchange, thus benefiting the organization. Our findings underscore the role of temporal duality—balancing short- and long-term projects—as a condition for success. Scientists who can deliver immediate outcomes while sustaining long-term research efforts enhance their value to organizations, echoing Wasowicz's (2021) conclusions.

Collaboration, alignment, and effective time management enable scientists to have immediate and long-term impacts. This approach, informed by open innovation principles, enhances companies' ability to leverage knowledge and ensure sustainable growth (Chesbrough & Appleyard, 2007).

Empathy and organizational alignment emerge as the central factors for innovators. Knowledge appropriation theory explains how innovators transform scientific knowledge into commercial applications. This transformation, as Boehm and Hogan (2013) describe, requires not only individual effort but also social integration within the organization, a process confirmed by our findings. As noted by Keusters et al. (2024), empathy fosters team cohesion and facilitates knowledge application. When combined with organizational alignment, empathy strengthens innovative capacities and amplifies their impact within the company.

Another essential feature of innovators is their effective coordination with scientists and other key actors. According to knowledge appropriation theory, innovators act as intermediaries between scientific discoveries and commercial applications, relying on their capacity to manage smooth, bidirectional coordination within the organization (Isaeva et al., 2024). Our findings indicate that successful configurations integrate both structured and informal coordination strategies, effectively applying the knowledge and skills necessary for innovation.

Variations in market focus, research agendas, and organizational alignment suggest that no single strategy guarantees success for innovators. In some cases, proactive market identification is the key, whereas research or market orientation may take precedence in others. This adaptability allows innovators to tailor their strategies to a company's needs and environment (Zahra et al., 2018).

Ultimately, innovators excel at transforming knowledge into commercial innovations, fostering empathy, ensuring coordination, and aligning themselves with organizational goals. This integrated approach, grounded in knowledge appropriation theory, creates an environment in which innovation can flourish. Our findings demonstrate that success does not hinge on any single trait but arises from a combination of coordination, empathy, and adaptability to corporate dynamics.

Theoretical implications

Our results show that success in corporate science does not depend on a single trait of key actors—CEOs, scientists, and innovators—but, rather, arises from the interaction of multiple factors. This approach aims to identify the predominant characteristics of each actor, suggesting that the ability to combine skills and adapt to the context is decisive.

Regarding CEOs, this research confirms the principles of transformational leadership (Bass, 1999), showing that these leaders bring about change by aligning organizational goals with individual interests and successfully integrating scientific knowledge into business strategies. In addition, our findings suggest that, particularly in an emerging context such as Peru, transformational leadership requires adaptability to local limitations, such as low R&D investment and limited collaboration with academic sectors. In a context such as Peru, where the science, technology, and innovation (STI) system is still developing and collaboration between academia and industry is limited (Borda-Rivera & Ortega-Paredes, 2021), the ability to create a favorable environment for technology adoption and the development of professional networks is particularly relevant.

Our study extends transformational leadership theory by indicating that effective CEOs in emerging economies must not only align goals but also build robust external networks and integrate scientific knowledge flexibly into business strategies. Despite low investment in R&D (Turpo-Gebera et al., 2021), CEOs who combine strategic vision with an entrepreneurial mindset and strong networks can drive corporate science projects, even in environments with institutional constraints and technological dependence, such as Peru. Thus, a transformational leader in these settings must possess strategic vision capable of inspiring teams and continuously adjusting to local institutional challenges, thereby broadening Bass's (1999) theory.

For scientists, open innovation theory provides a framework for understanding how collaboration and the integration of internal and external knowledge foster success in corporate science. Our findings confirm the core principle of open innovation: Collaboration between internal and external actors enhances strategic alliances and improves research outcomes (Chesbrough, 2003). However, the study reveals that scientists in resource-limited settings, such as Peru, must navigate a "temporal duality" to maximize both short-term and long-term impacts. This complexity goes beyond traditional open innovation principles and suggests that scientists must achieve short-term outcomes to meet immediate organizational demands while also pursuing long-term research goals for sustainable growth.

In still-developing STI systems, such as in Peru, in which public policies could be more effective and interactions between academia and business are scarce (Quispe et al., 2023), our findings highlight the importance of scientists managing temporal duality and balancing short- and long-term project demands. This adaptation challenges the theory's assumption that collaboration alone is sufficient, extending its application by illustrating that in contexts with limited resources, scientists must adapt open innovation principles to simultaneously drive immediate and sustainable results. This study offers empirical evidence of how, despite significant challenges, corporate science in Peru is beginning to establish itself as a driver of innovation (Sagasti, 2021).

The results expand knowledge appropriation theory for innovators (Boehm & Hogan, 2013), confirming that these actors serve as crucial translators of scientific knowledge into commercial applications. However, our study reveals that the appropriation process in a context such as Peru involves more than individual effort; it also requires empathy and organizational alignment to effectively integrate knowledge within the company. In addition to the technical capacity to adapt knowledge, our findings underscore empathy as essential for aligning scientific knowledge with organizational goals, especially in cases in which scientific advances may appear distant from immediate commercial objectives. This relational dimension of empathy and social integration was not deeply explored in the original knowledge appropriation theory but is central in emerging economies, in which resistance to new technology is common (Seclen-Luna & Alvarez-Salazar, 2021). In such environments, innovators benefit from the relational skills that enhance social cohesion and encourage the adoption of new knowledge.

In developing STI ecosystems, such as Peru, in which companies often resist adopting new technologies (Seclen-Luna & Alvarez-Salazar, 2021), empathy emerges as a key element in fostering team cohesion and facilitating the application of knowledge. Thus, this study expands the theory by indicating that empathy and alignment within organizational goals play pivotal roles in the knowledge appropriation process, especially in contexts in which scientific knowledge may appear distant from immediate commercial aims. The flexibility of innovators in adjusting their strategies to market demands or research priorities is crucial in this environment with technological and financial limitations.

In Peru, where financial and technological constraints are significant, innovators must manage social integration effectively in addition to the original theory of knowledge appropriation, which suggests that in emerging economies, relational and coordination skills are central to achieving successful outcomes. This study shows that innovators who coordinate effectively with other key actors and align their strategies with organizational goals can overcome barriers and generate successful innovations, even in challenging contexts such as Peru.

Practical implications

The findings of this study suggest practical steps to strengthen corporate science in emerging contexts. Managers should prioritize building leadership that actively integrates scientific knowledge into business strategy and fosters an environment in which technology adoption and collaboration are valued. In contexts such as Peru, where the STI system is in its early stages, training programs that improve empathy and collaboration among CEOs, scientists, and innovators are essential (Keusters et al., 2024). These programs should include rotations across departments so that leaders and scientists can better understand each other's goals and challenges, promote shared perspectives, and strengthen teamwork.

Companies should deepen their focus on market-oriented strategies to align their innovation efforts with real demand. Thus, innovation teams should regularly review market trends and adjust R&D projects to match their current needs and enhance their potential for commercial success (Zahra et al., 2018). Flexibility should also be built into STI project management to allow companies to quickly shift their priorities based on new opportunities or changing conditions (Rao et al., 2024).

Networking is another priority. Companies should actively support internal and external professional networks to strengthen their knowledge exchange, resource sharing, and access to technology. Collaborating with academic institutions, other companies, and government agencies is particularly useful in resource-limited settings because it keeps new ideas and technologies circulating (Faleye et al., 2014). Long-term partnerships with universities could bring academic researchers into strategic projects, and structured mentorship programs between managers and scientists could improve knowledge sharing and team cohesion.

For CEOs, continuous training in scientific methods is also key. Leaders require a firm grasp of the research and development (R&D) process, from early investment decisions to knowledge application. This will help them make strategic decisions that align with scientific progress and better integrate science-based projects into the company's overall goals (Loukil & Yousfi, 2022). Such training can encourage leaders to view R&D as a valuable long-term investment that moves beyond short-term priorities.

Policymakers also played a crucial role. To support smaller or newer companies in adopting corporate science, they should offer fiscal incentives tailored to these companies' realities. A tiered fiscal program can reward firms that show growth in their R&D capabilities, making public funding progressively accessible. Collaborative policies could also encourage STI consortia that connect companies, universities, and research centers, facilitating knowledge and technology exchange among these groups.

Executive leadership training programs can help CEOs manage scientific knowledge. Policies should include initiatives that teach CEOs about R&D project evaluation, open innovation strategies, and knowledge application, with content adapted to the context of STI in emerging markets.

Policymakers should promote international networking to broaden knowledge exchange. Creating international connections can support expert exchanges and the internationalization of R&D projects, ideally through specific funding for scientists and managers. This exposure can help local professionals gain valuable experience abroad, returning insight and knowledge for local application.

Finally, the robust monitoring and evaluation of corporate science support policies are essential. Policymakers should implement systems that regularly assess the impact of these policies, allowing for timely adjustments to meet the needs of science and technology companies.

Limitations

This study has limitations that should be considered when interpreting the results. The primary limitation is the small sample size of 56 respondents. While this size is adequate for the fsQCA methodology, it remains small compared with larger studies, which could limit the generalizability of the findings. Although stable configurations were identified up to an inclusion threshold of 0.80, the number of retained cases did not reach the recommended 80% (Misangyi & Acharya, 2014), suggesting that the results should be interpreted with caution and that further research with larger samples is needed to validate these findings.

In addition, the diversity of the samples was limited. Most participants were men (69.6%), and the concentration in specific age ranges may have introduced demographic or cultural biases. Furthermore, the study did not account for certain important contextual variables such as the macroeconomic environment, government policies, or industrial sectors, which could influence the success of corporate science (Alvarez-Salazar & Bernal-Perez, 2023).

Finally, the exploratory nature of this study limited the scope of the interpretation of the results. These findings should be viewed as a starting point, ideally complementing future research that employs more robust correlational methods to draw stronger conclusions (Hair et al., 2017).

Agenda for future research

This study opens up several lines of inquiry that can deepen our understanding of the factors that influence corporate science success, particularly in emerging economies. The first step is to expand the analysis to include a broader range of companies, industries, and geographical contexts. Comparing different sectors and regions would help in examining how cultural, economic, and institutional variations affect the adoption of scientific practices within the corporate environment. Longitudinal studies also offer a more detailed view of the evolution of corporate science projects by capturing how firms adjust their strategies over time in response to changing scenarios.

Another important area for future research is exploring how emerging technologies such as artificial intelligence and automation redefine the roles of CEOs, scientists, and innovators. As these technologies impact business practices, it is crucial to understand how they influence collaboration and decision making in corporate science. Such studies could focus on the shifting dynamics between key actors and how these changes affect innovation processes.

Additionally, future research should consider incorporating key contextual variables such as macroeconomic conditions, government support, and regulatory frameworks. These factors significantly influence leadership configuration, scientific expertise, and innovation capacity. Understanding how these external variables interact with internal practices will allow for a more nuanced analysis of the conditions that foster success in corporate science.

Finally, it would be valuable to delve into the role of organizational culture in supporting or hindering the adoption of scientific practices by companies. Exploring how cultural factors, such as risk tolerance, experimentation, and collaboration, impact corporate science success would help identify internal practices that better align organizational objectives with innovation. This perspective could provide useful recommendations for companies seeking to build a culture that supports corporate science, especially in contexts in which science and technology are still in the early stages of development.

Conclusion

This study shows that success in corporate science within an emerging national STI system such as Peru does not rely on a single characteristic of CEOs, scientists, or innovators but, rather, on the complex interaction of various factors. The fsQCA identified configurations that support positive outcomes in R&D projects, revealing that there is no one-size-fits-all formula for success but multiple pathways to achieve it.

These findings challenge reductionist approaches that focus on individual attributes and instead propose an integrated, contextualized perspective. The ability of key actors to adapt to the specific conditions of their environments and their effective interactions is essential in economies with developing science and technology systems. Therefore, strategies must be flexible and tailored to the constraints and opportunities in each context.

This broader, adaptable approach is particularly relevant in emerging economies, such as Peru, in which institutional and resource limitations demand innovative and collaborative solutions. In this sense, this study offers a more detailed understanding of how leaders, scientists, and innovators can leverage their integrative capacities to overcome challenges and have a real impact on environments that require adaptability and cooperation.

CRediT authorship contribution statement

Jubalt Rafael Alvarez-Salazar: Writing – review & editing, Writing – original draft, Visualization, Supervision, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Pedro Martín Bernal-Pérez:** Writing – review & editing, Writing – original draft, Validation, Supervision, Resources, Investigation, Funding acquisition, Formal analysis, Conceptualization.

Declaration of interests

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

Declaration of Generative AI in Scientific Writing

During the preparation of this work, the authors used Chat GPT and DeepL to facilitate the translation of the report into English and review the document's style and grammar. After using these services, the authors reviewed and edited the content as required, and they take full responsibility for the content of the publication.

Declaration of data availability

Data supporting the findings of this study are available upon request from the corresponding author. However, these data are not publicly available due to privacy and ethical restrictions.

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Supplementary materials

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References

Alderman, J., Forsyth, J., Griffy-Brown, C., & Walton, R. C. (2022). The benefits of hiring a STEM CEO: Decision making under innovation and real options. *Technology in Society, 71*. https://doi.org/10.1016/j.techsoc.2022.102064

Alvarez-Salazar, J., & Bernal-Pérez, P. (2023). Corporate science in emerging countries: a study of personal, organizational, and institutional dynamics in peru. Lima. doi:10.13140/RG.2.2.14785.16482.

Alsebai, M., Liu, P., & Nie, G. (2022). Causality between technological innovation and economic growth: Evidence from the economies of developing countries. *Sustainability, 14*(6), 1–39. https://doi.org/10.3390/su14063586

Alvarez-Salazar, J., & Bernal-Pérez, P. (2023). *Corporate science in emerging countries: a study of personal, organizational, and institutional dynamics in peru*. Lima. https://doi.org/10.13140/RG.2.2.14785.16482

Alvarez-Salazar, J., & Seclen-Luna, J. P. (2023). To survive or not to survive: Findings from pls-sem on the relationship between organizational resources and startups' survival. In H. Latan, J. Hair, & J. F. Noonan (Eds.), *Partial least squares path modeling* (pp. 329–374). Cham: Springer. https://doi.org/10.1007/978-3-031-37772-3_12.

Armstrong, J. S., & Green, K. C. (2022). *The scientific method. a guide to finding useful knowledge*. Cambridge: Cambridge University Press.

Bass, B. M. (1999). Two decades of research and development in transformational leadership. *European Journal of Work and Organizational Psychology, 8*(1), 9–32. https://doi.org/10.1080/135943299398410

BID Lab. (2021). *Emprendimientos tecnológicos peruanos: descentralizando el impacto social*. Lima. http://www.iadb.org.

Boehm, D. N., & Hogan, T. (2013). Science-to-business collaborations: A science-to-business marketing perspective on scientific knowledge commercialization. *Industrial Marketing Management, 42*(4), 564–579. https://doi.org/10.1016/j.indmarman.2012.12.001

Bolívar–Ramos, M. T (2023). The impact of corporate science on environmental innovations: The role of universities and research institutions. *R and D Management, 53*(3), 503–523. https://doi.org/10.1111/radm.12574

Borda-Rivera, E. A., & Ortega-Paredes, G. C. (2021). The role of the University in the university-business-government collaboration as a regional innovation system: The case of Arequipa, Peru. *Formacion Universitaria, 14*(6), 13–24. https://doi.org/10.4067/S0718-50062021000600013

Carter, D.R., Asencio, R., Trainer, H.M., DeChurch, L.A., Kanfer, R., & Zaccaro, S.J. (2019). *Best Practices for Researchers Working in Multiteam Systems. Strategies for Team Science Success: Handbook of Evidence-Based Principles for Cross-Disciplinary Science and Practical Lessons Learned from Health Researchers*. doi:10.1007/978-3-030-20992-6_29.

Chen, X., Mao, J., Ma, Y., & Li, G. (2024). The knowledge linkage between science and technology influences corporate technological innovation: Evidence from scientific publications and patents. *Technological Forecasting and Social Change, 198*. https://doi.org/10.1016/j.techfore.2023.122985

Chen, Y., Tang, G., Jin, J., Xie, Q., & Li, J. (2014). CEOs' transformational leadership and product innovation performance: The roles of corporate entrepreneurship and technology orientation. *Journal of Product Innovation Management, 31*(S1), 2–17. https://doi.org/10.1111/jpim.12188

Chesbrough, H. (2003). *Open innovation. the new imperative for creating and profiting from technology*. Massachusetts: HBS Press.

Chesbrough, H. W., & Appleyard, M. M. (2007). Open innovation and strategy. *California Management Review, 50*(1). https://doi.org/10.2307/41166416

Clayton, P., Feldman, M., & Lowe, N. (2018). Behind the scenes: Intermediary organizations that facilitate science commercialization through entrepreneurship. In *Academy of management perspectives, 32* pp. 104–124). Academy of Management. https://doi.org/10.5465/amp.2016.0133

CONCYTEC. (2022). *Informe de la ley N° 30309: beneficios tributarios por proyectos de I+D+i. resultados del 2016 al 2019*. Lima. www.concytec.gob.pe.

Creswell, J., & Creswell, D. (2018). *Research desing. qualitative, quantitative, and mixed methods approaches* (5th ed.). California: SAGE Publications, Inc.

Diaz Ruiz, C. A. (2022). The insights industry: Towards a Performativity turn in market research. *International Journal of Market Research, 64*(2), 169–186. https://doi.org/10.1177/14707853211039191

Ding, H. (2022). What kinds of countries have better innovation performance?–A country-level fsQCA and NCA study. *Journal of Innovation & Knowledge, 7*(4), Article 100215. https://doi.org/10.1016/j.jik.2022.100215

Duşa, A. (2018). *QCA with R: a comprehensive resource. qca with R: a comprehensive resource*. Springer.

Duşa, A. (2024). Package 'QCA'. *Journal of Business Research*. https://doi.org/10.1016/j.jbusres.2007.01.002

Faleye, O., Kovacs, T., & Venkateswaran, A. (2014). Do better-connected CEOs innovate more? *Journal of Financial and Quantitative Analysis, 49*(5–6), 1201–1225. https://doi.org/10.1017/S0022109014000714

Friedman, Y., Carmeli, A., & Tishler, A. (2016). How CEOs and TMTs build adaptive capacity in small entrepreneurial firms. *Journal of Management Studies, 53*(6), 996–1018. https://doi.org/10.1111/joms.12184

Hair, J., Hult, T., Ringle, C., & Sarstedt, M. (2017). A primer on partial least squares structural equation modeling (PLS-SEM). In *International journal of research & method in education* (2nd ed.,, *38*. Los Angeles: SAGE Publications, Inc. https://doi.org/10.1080/1743727x.2015.1005806

Hao, Z., Xu, Z., Zhao, H., & Su, Z. (2021). Optimized data manipulation methods for intensive hesitant fuzzy set with applications to decision making. *Information Sciences, 580*, 55–68. https://doi.org/10.1016/J.INS.2021.08.063

Hensmans, M. (2022). The innovation pyramid: Five approaches to strategic decision-making. *Journal of Business Strategy, 43*(4), 229–238. https://doi.org/10.1108/JBS-12-2020-0292

Herrera, L. (2020). Effect of corporate scientists on firms' innovation activity: A literature review. *Journal of Economic Surveys, 34*(1), 109–153. https://doi.org/10.1111/joes.12341

Hislop, D. (2003). Knowledge integration processes and the appropriation of innovations. *European Journal of Innovation Management, 6*(3), 159–172. https://doi.org/10.1108/14601060310486235

Huang, Z., Sindakis, S., Aggarwal, S., & Thomas, L. (2022). The role of leadership in collective creativity and innovation: Examining academic research and development environments. *Frontiers in Psychology, 13*. https://doi.org/10.3389/fpsyg.2022.1060412

Isaeva, I., Ooms, W., & Johansen, J. P. (2024). Aligning science-based partnerships: Attaining jointly beneficial outcomes in open innovation projects. *IEEE Transactions on Engineering Management, 71*, 5069–5087. https://doi.org/10.1109/TEM.2022.3209013

Jiang, Y., & Chen, C. C. (2018). Integrating knowledge activities for team innovation: Effects of transformational leadership. *Journal of Management, 44*(5), 1819–1847. https://doi.org/10.1177/0149206316628641

Jong, S., & Slavova, K. (2014). When publications lead to products: The open science conundrum in new product development. *Research Policy, 43*(4), 645–654. https://doi.org/10.1016/j.respol.2013.12.009

Keil, T., Maula, M., & Syrigos, E. (2017). CEO entrepreneurial orientation, entrenchment, and firm value creation. *Entrepreneurship: Theory and Practice, 41*(4), 475–504. https://doi.org/10.1111/etap.12213

Keusters, G., Hertogh, M., Bakker, H., & Houwing, E.-J. (2024). Empathic ability as a driver for project management. *International Journal of Project Management, 42*(4). https://doi.org/10.1016/j.ijproman.2024.102591

Khedhaouria, A., & Thurik, R. (2017). Configurational conditions of national innovation capability: A fuzzy set analysis approach. *Technological Forecasting and Social Change, 120*, 48–58. https://doi.org/10.1016/j.techfore.2017.04.005

Kolossa, A., & Kopp, B. (2018). Data quality over data quantity in computational cognitive neuroscience. *NeuroImage, 172*, 775–785. https://doi.org/10.1016/J.NEUROIMAGE.2018.01.005

Kopplin, C. (2023). A configurational view on technology acceptance: The example of highly integrated collaboration platforms. *Australasian Journal of Information Systems, 27*. https://doi.org/10.3127/ajis.v27i0.4043

Krieger, J. L., Schnitzer, M., & Watzinger, M. (2024). Standing on the shoulders of science. *Strategic Management Journal, 45*(9), 1670–1695. https://doi.org/10.1002/smj.3598

Leppänen, P., George, G., & Alexy, O. (2023). When do novel business models lead to high performance? A configurational approach to value drivers, competitive strategy, and firm environment. *Academy of Management Journal, 66*(1), 164–194. https://doi.org/10.5465/amj.2020.0969

Loukil, N., & Yousfi, O. (2022). Do CEO's traits matter in innovation outcomes? *Journal of International Entrepreneurship, 20*(3), 375–403. https://doi.org/10.1007/s10843-022-00309-y

Loukil, N., Yousfi, O., & Cheikh, S. B. E. N. (2020). Innovation effort and CEO's characteristics. *International Journal of Innovation Management, 24*(5). https://doi.org/10.1142/S1363919620500796

Luo, Y., Cui, R., Ma, J., Jin, Y., Li, M., & Lin, S. (2024). Impact of CEO's scientific research background on the enterprise digital level. *Humanities and Social Sciences Communications, 11*(1), 832. https://doi.org/10.1057/s41599-024-03283-z

Lust, J. (2016). Social struggle and the political economy of natural resource extraction in peru. *Critical Sociology, 42*(2), 195–210. https://doi.org/10.1177/0896920513501354

Makri, M., & Scandura, T. A. (2010). Exploring the effects of creative CEO leadership on innovation in high-technology firms. *Leadership Quarterly, 21*(1), 75–88. https://doi.org/10.1016/j.leaqua.2009.10.006

Misangyi, V. F., & Acharya, A. G. (2014). Substitutes or complements? A configurational examination of corporate governance mechanisms. *Academy of Management Journal*. https://doi.org/10.5465/amj.2012.0728. Academy of Management.

Moon, C., & Acquaah, M. (2020). Performance implications of combining creative and imitative innovation strategies. *European Journal of Innovation Management, 25*(1), 214–232. https://doi.org/10.1108/EJIM-06-2020-0213

Nguyen, T. A., & Nguyen, A. D. (2020). Applying Business Strategies to Establish Your Research Program. Current Protocols in Essential Laboratory Techniques, 20(1). doi:10.1002/cpet.41.

Nonaka, I. (1994). A Dynamic Theory of Organizational Knowledge Creation. *Organization Science, 5*(1), 14–37. https://doi.org/10.1287/orsc.5.1.14

Ottonicar, S. L. C., Arraiza, P. M., & Armellini, F. (2020). Opening science and innovation: Opportunities for emerging economies. *Foresight and STI Governance, 14* (4), 95–111. https://doi.org/10.17323/2500-2597.2020.4.95.111

Pavlačková, M., Pavlačka, O., & Horčičková, T. (2023). A fuzzy group decision-making model for measurement of companies' performance. *Economic Computation and Economic Cybernetics Studies and Research, 57*(2), 119–134. https://doi.org/10.24818/18423264/57.2.23.08

Pietraszek, J., & Skrzypczak-Pietraszek, E. (2014). The optimization of the technological process with the fuzzy regression. *Advanced Materials Research, 874*. https://doi.org/10.4028/www.scientific.net/AMR.874.151

Pisano, G. P. (2010). The evolution of science-based business: Innovating how we innovate. *Industrial and Corporate Change, 19*(2), 465–482. https://doi.org/10.1093/icc/dtq013

PRODUCE. (2021). *Impulsamos la innovación en el perú*. Lima.

Quispe, J., Diaz, F., Velasquez, O., Morán, Á., Rios, A., Moscoso, J., & Azabache, C. (2023). Evaluation and efficiency of public spending on R+D in science and technological innovation programs administered by Concytec of Peru. In *, 2023-July. Proceedings of the LACCEI international Multi-conference for Engineering, Education and Technology*. Latin American and Caribbean Consortium of Engineering Institutions. https://doi.org/10.18687/laccei2023.1.1.317.

Ragin, C. (2014). *The comparative method. moving beyond qualitative and quantitative strategies* (2nd ed.). California: University of California Press.

Ragin, C. (2023). *Analytic induction for social research*. California: University of California Press.

Randhawa, K., Wilden, R., & Hohberger, J. (2016). A bibliometric review of open innovation: Setting a research agenda. *Journal of Product Innovation Management, 33* (6), 750–772. https://doi.org/10.1111/jpim.12312

Rao, Y., Zhu, X., Sun, Y., & Qian, X. (2024). CEOs' knowledge integration, entrepreneurship, and corporate innovation: Evidence for China. *International Review of Financial Analysis, 91*, Article 102963. https://doi.org/10.1016/J.IRFA.2023.102963

Ricalde-Chahua, M., & Libaque-Saenz, C. (2023). The role of technology-transfer-oriented subsidies in building companies' absorptive capacity and innovation: Evidence from peruvian MSMEs. *Asia Pacific Journal of Information Systems, 33*(2), 444–467. https://doi.org/10.14329/apjis.2023.33.2.444

Rihoux, B., & Ragin, C. (2009). *Configurational comparative methods: qualitative comparative analysis (QCA) and related techniques, 1–51*. California: Sage. https://doi.org/10.4135/9781452226569

Rodríguez, A., Arias, G., Cabanillas, S., & García, H. (2024). Trade barriers and economic growth: Evidence from Peru. *Revista Venezolana de Gerencia, 29*(107), 1382–1399. https://doi.org/10.52080/rvgluz.29.107.26

Romero-Rodríguez, J.-M., Ramírez-Montoya, M.-S., Aznar-Díaz, I., & Hinojo-Lucena, F.-J. (2020). Social appropriation of knowledge as a key factor for local development and open innovation: A systematic review. *Journal of Open Innovation: Technology, Market, and Complexity, 6*(2). https://doi.org/10.3390/JOITMC6020044

Rosier, J. (2022). *The high-tech CEO: How to lead R&D When you're not the expert. The High-Tech CEO: How to Lead R&D When You're Not the Expert*. doi:10.4324/9781003142379.

Sá, T., Ferreira, J. J. M., & Jayantilal, S. (2023). Open innovation strategy: A systematic literature review. *European Journal of Innovation Management*. https://doi.org/10.1108/EJIM-11-2022-0638

Sagasti, F. (2021). *Estrategias de corto y mediano plazo para impulsar la ciencia y la tecnología en el perú para impulsar las empresas verdes*. Lima.

Sarstedt, M., Ringle, C., & Hair, J. (2017). Partial least squares structural equation modeling. In C. Homburg, M. Klarmann, & A. Vomberg (Eds.), *Handbook of market research* (pp. 1–40). Cham, Germany: Springer.

Schneider, C. Q., & Wagemann, C. (2012). Set-theoretic methods for the social sciences: A guide to qualitative comparative analysis. *Set-Theoretic methods for the social sciences: a guide to qualitative comparative analysis*. Cambridge: Caambridge University Press.

Seclen-Luna, J. P., & Alvarez-Salazar, J. (2021). Are Peruvian manufacturing firms product-based or service-based businesses? Effects of innovation activities, employee level of education and firm size. *Technology Analysis and Strategic Management*. https://doi.org/10.1080/09537325.2021.1987409

Serikov, P. Y., Sivolotsky, K. A., & Balakirev, A. A. (2020). R&D economic efficiency valuation methods and specifics of their application. *Science and Technologies: Oil and Oil Products Pipeline Transportation, 10*(6), 620–635. https://doi.org/10.28999/2541-9595-2020-10-6-620-635

Simeth, M., & Cincera, M. (2016). Corporate science, innovation, and firm value. *Management Science, 62*(7), 1970–1981. https://doi.org/10.1287/mnsc.2015.2220

Song, C., Nahm, A. Y., & Song, Z. (2023). Executive technical experience and corporate innovation quality: Evidence from Chinese listed manufacturing companies. *Asian Journal of Technology Innovation, 31*(1), 94–114. https://doi.org/10.1080/19761597.2021.2020137

Su, A., Cai, X., Liu, X.-S., Tao, X.-N., Chen, L., & Wang, R. (2023). Talk the walk: How corporate vision works for performance. *International Journal of Entrepreneurial Behaviour and Research*. https://doi.org/10.1108/IJEBR-04-2022-0355

Teece, D. J. (2006). Reflections on "Profiting from Innovation. *Research Policy, 35*(8), 1131–1146. https://doi.org/10.1016/j.respol.2006.09.009

Tho, N. D. (2018). Firm capabilities and performance: A necessary condition analysis. *Journal of Management Development, 37*(4), 322–332. https://doi.org/10.1108/JMD-06-2017-0204

Turpo-Gebera, O., Limaymanta, C. H., & Sanz-Casado, E. (2021). The scientific and technological production of peru in the south american context: A scientometric analysis. *Profesional de la Informacion, 30*(5). https://doi.org/10.3145/epi.2021.sep.15

Valantine, H. A., Beckerle, M. C., Reed, K. L., Towner, D., & Zahniser, N. R. (2014). Teaching corporate in college. *Science Translational Medicine, 6*(251). https://doi.org/10.1126/scitranslmed.3009450

van der Valk, W., Sumo, R., Dul, J., & Schroeder, R. G. (2016). When are contracts and trust necessary for innovation in buyer-supplier relationships? A Necessary Condition Analysis. *Journal of Purchasing and Supply Management, 22*(4), 266–277. https://doi.org/10.1016/j.pursup.2016.06.005

Van Norman, G. A., & Eisenkot, R. (2017). Technology transfer: From the research bench to commercialization: Part 1: Intellectual property rights—basics of patents and copyrights. *JACC: Basic to Translational Science, 2*(1), 85–97. https://doi.org/10.1016/j.jacbts.2017.01.003

Vekinis, G. (2023). *Can Everybody Be an Innovator? Studies on Entrepreneurship, Structural Change and Industrial Dynamics* (Vol. Part F1801). doi:10.1007/978-3-031-44369-5_4.

Vergne, J. P., & Depeyre, C. (2016). How do firms adapt? a fuzzy-set analysis of the role of cognition and capabilities in u.s. defense firms' responses to 9/11. *Academy of Management Journal, 59*(5), 1653–1680. https://doi.org/10.5465/amj.2013.1222

Vitale, P. (2017). Making science suburban: The suburbanization of industrial research and the invention of "research man. *Environment and Planning A, 49*(12), 2813–2834. https://doi.org/10.1177/0308518×17734855

Wang, H., & Chen, W.-R. (2010). Is firm-specific innovation associated with greater value appropriation? The roles of environmental dynamism and technological diversity. *Research Policy, 39*(1), 141–154. https://doi.org/10.1016/j.respol.2009.09.015

Wasowicz, M. (2021). Assessment of project success. Is sustainability is relevance? | Projekto sėkmės vertinimas. Ar tvarumas yra aktualus? *Transformations in Business and Economics, 20*(2), 939–953.

Yan, F., Chen, H.-Z., & Zhang, Z. (2023). Price and cooperation decisions in a cooperative R&D supply chain with different licensing models. *Kybernetes, 52*(12), 5776–5810. https://doi.org/10.1108/K-12-2021-1347

Yang, R., Wu, Q., & Xie, Y. (2023). Are scientific articles involving corporations associated with higher citations and views? an analysis of the top journals in business research. *Scientometrics, 128*(10), 5659–5685. https://doi.org/10.1007/s11192-023-04808-0

Zahra, S. A., Kaul, A., & Bolívar-Ramos, M. T. (2018). Why corporate science commercialization fails: Integrating diverse perspectives. In *Academy of management perspectives, 32* pp. 156–176). Academy of Management. https://doi.org/10.5465/amp.2016.0132

Zuraik, A., & Kelly, L. (2019). The role of CEO transformational leadership and innovation climate in exploration and exploitation. *European Journal of Innovation Management, 22*(1), 84–104. https://doi.org/10.1108/EJIM-10-2017-0142