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Enhancing Innovation in Technology-Based SMEs: The Role of Open Innovation and Strategic Orientation

Gabriel Silva-Atencio[1,*]

[1]*Engineering Department, Universidad Latinoamericana de Ciencia y Tecnología (ULACIT), Costa Rica*

Abstract: The capacity to innovate has grown to be a major obstacle in the corporate environment in the digital age. For technology-based small and medium-sized enterprises (SMEs), *open innovation* provides a strategic and cultural means to improve their innovation capacity by using internal and external ideas, resources, and technical knowledge-how. Although earlier studies have examined how *open innovation* affects big businesses, there is a great knowledge vacuum on how *open innovation* and *strategic orientation* affect *innovation performance* in SMEs, especially in underdeveloped countries. This research fills this need by investigating in Costa Rican technology-based SMEs the link between *open innovation, strategic orientation*, and *inventive performance* using a quantitative, cross-sectional methodology. The research supports the suggested hypotheses using Cronbach's alpha and statistical models, showing that *strategic orientation* and *open innovation* favorably affect *inventive performance*. The results add to the state of the art by giving empirical data from a developing economy setting and pragmatic advice for SMEs trying to improve their capacity for innovation in a fast-changing digital environment.

Keywords: open innovation, strategic orientation, innovative performance, innovative service, successful service, digital transformation.

1. Introduction

The ability of companies to innovate has become more important in deciding their survival and success in a global economy becoming more dynamic and competitive. *Open innovation* is a main weapon for improving business performance. According to this paradigm, companies might have to welcome both internal and outside ideas if they want to accelerate their innovation process [1]. This approach contrasts with the usual closed innovation paradigm, in which companies exclusively employ their resources and capabilities, in which case [2]. Although open innovation in big businesses has been the subject of many studies, its use and influence on small and medium-sized businesses (SMEs)—especially in developing countries—clearly remain unknown. This research aims to close this gap by investigating in Costa Rican technology-based SMEs the interactions between open innovation, strategic orientation, and inventive performance.

Previous research has mostly concentrated on the advantages of open innovation in big companies, often neglecting the distinct difficulties and possibilities that SMEs, particularly in emerging areas, experience. The capacity to absorb an *open innovation* model within an SME, according to Carrasco-Carvajal et al. [3], may enhance corporate performance and provide a durable competitive advantage. Still, the scholarly literature on this subject in the framework of SMEs is scant, especially in developing nations where market dynamics and resource limitations vary greatly from those in industrialized nations. This research seeks to add to the state of the art by presenting actual data from a developing country and thoughts on how SMEs may use *open innovation* and *strategic orientation* to improve their *inventive performance*.

The following research questions direct this project: (1) Can *open innovation* systems improve SMEs' performance in corporate innovation management? and (2) Can SMEs' firm innovation performance benefit from methods connected with *strategic orientation*? By answering these issues, this study not only confirms the relevance of *open innovation* in SMEs but also offers a theoretical foundation for future studies in this underdeveloped field.

Valdez-Juárez and Castillo-Vergara [4] highlight that *open innovation* can positively influence business processes, such as *strategic orientation* and *innovative performance*, allowing us to achieve the expected results in business objectives. Consequently, the objective of the proposed study is to verify the degree of positive influence of *open innovation* on business processes of *strategic orientation* and *innovative performance*, through the validation of a proposed model (hypothesis), by using statistical methods for its verification.

The findings obtained in the research will allow us to contribute to the state of the art with the validation of a theoretical model within a real environment, allowing us to certify the behavioral patterns of business processes within a changing environment.

Therefore, the proposed study seeks to contribute to the state of the art and the academy, with data that allow testing the validation of complex processes in business environments, within a sector with many opportunities for expansion (SMEs), offering validation of theoretical models with practical applications, which allow determining patterns of business behavior in a turbulent environment.

***Corresponding author:** Gabriel Silva-Atencio, Engineering Department, Universidad Latinoamericana de Ciencia y Tecnología (ULACIT), Costa Rica. Email: gsilvaa468@ulacit.ed.cr

2. Literature Review

The notion of *open innovation* is the creation of fresh ideas, both within and outside, enabling their application all around companies [5]. Unlike conventional, closed innovation models, this idea lets innovations be used without complete control over the processes, thus advancing goods, services, or processes [6, 7]. Particularly regarding environmental and commercial factors, recent research has underlined the significance that *open innovation* plays in promoting resilience and sustainability.

Dimitriadis et al. [8], for example, show how market asymmetries and environmentally friendly practices affect innovation results, implying that *open innovation* might be rather important in tackling these issues. This fits the increasing focus on sustainability in innovation initiatives, especially in SMEs, where limited resources call for group solutions to innovation.

The ability of the company to encourage innovation within will frequently determine how successful *open innovation* approaches are [9]. Due to challenges in maintaining control over research outputs, several academics point out the growing mobility of knowledge workers, therefore limiting the benefits of internal research and development (R&D) [10–12]. Still under investigation, however, is how *open innovation* could be used in SMEs—especially in developing nations. This research aims to close this gap by analyzing how *strategic orientation* and *open innovation* affect creative performance in Costa Rican technology-based SMEs, therefore providing fresh ideas with contextually relevant insights.

Open innovation is categorized into three primary types: outbound, inbound, and combined activities [13]. Table 1 shows that outbound activities leverage external knowledge from competitors, consultants, clients, suppliers, and academic institutions, enabling spin-offs or partnerships.

Table 1
Outbound open innovation (internal knowledge exploitation outside of the firm)

Type of application	Description
Licenses	Sale of rights of use or commercialization of an asset, usually intangible.
Revealed	Disclosure of knowledge, science, or technology outside the institution.
Sale of intellectual property	Sale of inventions, patents, trademarks, or authorships created within.
Sale of R&D services	Sale of research and development services.
Spin-off	Creation of an independent company derived from a parent company.

Table 2 shows that inbound activities integrate new ideas and resources into the firm [14].

Figure 1 shows that inbound *open innovation* includes applications such as the exploration of external scientific and technological trends, strategic alliances, and *crowdsourcing* to stimulate innovation [15].

Figure 1 shows the funnel of inbound *open innovation*, the process by which outside information and resources are incorporated into a company to inspire creativity. The funnel consists of many important phases:

1) *Exploration of external trends*: The first phase involves the exploration of external scientific and technological trends. This includes tracking developments in technology, consumer patterns, and new ideas coming from outside sources such as rivals, colleges, and research centers. This stage is crucial in seeing any creative ideas the company may use.
2) Making *strategic alliances* with outside partners—including suppliers, customers, or other businesses—is the second phase. These relationships let the company pool resources distribute risks and co-develop fresh ideas or goods and services. Strategic alliances are particularly important for SMEs as most of them lack the tools to grow on their own.
3) *Crowdsourcing*, in which the business asks numerous outside partners—such as customers, independent contractors, or the public—ideas, solutions, or opinions, comes third. Using *crowdsourcing*, the corporation may use a broad range of thoughts and expertise, thus promoting more original solutions.
4) The last step is the *internal integration* of outside expertise and resources into the corporate operations. This includes modifying current procedures, creating new goods or services, and matching outside ideas to the strategic objectives of the company. The degree to which this phase is beneficial will rely on the company's capacity to create an innovative and learning culture inside.

Table 2
Inbound open innovation (external knowledge input inside of firm)

Type of application	Description
Search	Exploration and analysis of information about technology, science, and innovation trends in outside sources.
Technological vigilance	When the search is organized, selective, and permanent.
Acquisition of intellectual property	Purchase of inventions or patents.
Outsourcing	Contracting of external research & development services.
Business association	Pooling of resources through a contract to obtain revenue.
Strategic alliances	Agreement between two or more institutions with a common goal.
Cooperation networks	Collaborative work between heterogeneous companies.

Figure 1
Funnel of inbound open innovation

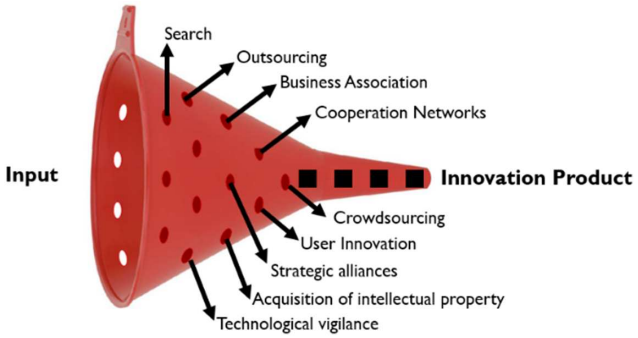


Figure 1 stresses the significance of outside collaboration in encouraging innovation, especially for SMEs that may lack the internal resources to grow on their own. Using outside knowledge and tools enables businesses to reduce costs and hasten their creative processes.

Figure 2 shows that outbound *open innovation* involves exploiting internal knowledge externally, through methods like licensing or selling intellectual property, or creating spin-offs [15]. This approach capitalizes on specialized knowledge not accessible internally, harnessing economies of scale and reducing development costs [16, 17].

Figure 2 displays the funnels of outward open innovation, therefore illustrating the way internal knowledge and resources are used outside. The funnel consists of the following phases:

1) *Licensing internal* knowledge or intellectual property (IP) to other companies comes first. Letting others use its patents, trademarks, or technology allows the business to earn from its ideas. Licensing is a common strategy used by many businesses seeking profit from their R&D work without immediately commercializing the products themselves.
2) Selling copyrights, trademarks, or patents, among other IP rights, to other companies comes second. This strategy is usually used when a corporation lacks the tools or expertise to promote the concept within.
3) Establishing spin-off companies to take advantage of internal discoveries comes in third. Spin-offs let the company concentrate on its main operation and yet profit from the commercialization of its ideas via another company. Companies with a strong R&D emphasis but limited ability to get new items to market would find this approach especially helpful.
4) The last stage is working with outside partners to help internal ideas be developed and commercialized. This covers alliances with other companies, academic institutions, or government organizations. Through outside cooperation, the company may use extra resources and knowledge, therefore lowering the risks and expenses related to innovation.

Figure 2 shows the use of firms' internal knowledge and resources in outward-facing activities. This strategy not only creates more income sources but also helps the company's standing as an industry pioneer to improve.

Table 3 shows that joint activities combine these strategies, benefiting from efficiency gains, cost-sharing, and improved control over spillovers [18, 19].

Open innovation empowers businesses to adapt to the evolving market landscape, introducing new leadership paradigms and phases of innovation, including idea generation, development, and commercialization [20–23]. Trust within and between organizations is pivotal in ensuring successful collaboration and innovation dissemination. Subsequently, *innovation performance* is measured by a company's success in achieving objectives related to new products or services [21, 22]. Employees and organizational learning capabilities are vital contributors to innovation, aligning it with strategic objectives and boosting market impact [24–26].

Figure 2
Funnel of outbound open innovation

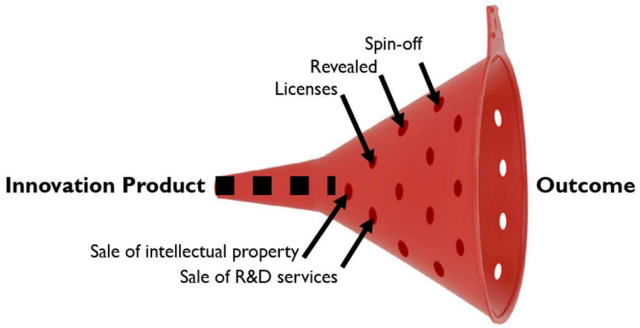


Table 3
Inbound/outbound open innovation (applied inbound and outbound open innovation)

Type of application	Description
Mix	When the firm applied both strategies of *open innovation*

The first hypothesis of the study assumes the positive influence of *open innovation* on *innovative performance*, regardless of the size of the organization and the scope of the business sector—an approach proposed by Hameed et al. [9], where it is proven that entrepreneurial behavior is not distinguished by size or sector, but the ability to innovate in the environment. Therefore, the study will understand this entrepreneurial behavior in technology-based companies in the SME sector, to verify that innovation models can be applied and valid throughout the business environment, regardless of size or sector.

In the digital era, organizations must seek new ways to compete to achieve strategic objectives, with strategy orientation being one of the ways to achieve this. Kindermann et al. [27] argue that this business approach seeks to understand organizational behaviors and environments to achieve business goals successfully in the short, medium, and long term, allowing us to change the paradigm of the organization toward a resilient approach to the context, changing the perception toward an approach from outside to inside in an agile, fast, and accurate way [28].

Cheng and Huizingh [29] state that the *strategic orientation* approach must be designed for a changing environment because the company is immersed in a globalized digital world that presents rapid and constant changes. Flamini et al. [30] emphasize that this model must be flexible and iterative to allow organizations to perform a risk assessment according to the needs of the environment, with the innovation processes being the tools to collect these requirements and promote innovative performance, thereby achieving a positive correlation between innovation and the company strategy for the achievement of the corporate vision. Cortes et al. [31] highlight a variant, known as market orientation, which aims to understand customer requirements in the environment and provide value for the company, taking into consideration factors such as competition, suppliers, tools, and inputs, as they drive or limit the results of *strategic orientation*. Bresciani et al. [32] in their findings highlight a positive link between innovative practices and market orientation, allowing for the optimization of business processes through innovation management.

Resource orientation involves a meticulous assessment and planning of an organization's internal resources, understanding the unique assets a company holds, irrespective of external competition. This orientation enhances a company's adaptability and initiative-taking capabilities, leading to better performance outcomes [29, 33]. Companies effectively managing internal resources, while recognizing and utilizing external resources, often achieve superior innovation management and performance [34].

Espina-Romero et al. [34] state that innovation processes in conjunction with a *strategic orientation* guarantee business sustainability through a differentiation strategy, achieving the expected

growth and returns on investment. Sikandar et al. [35] complement this approach by arguing that innovation enables the successful adoption and implementation of novel strategies in an efficient manner. Therefore, based on these studies, the second hypothesis to be tested in the study is proposed; *strategic orientation* positively influences business innovation performance, with the result obtained being a change in the business paradigm in a changing environment, as it enables organizations to be resilient and fast within a multifaceted context.

In the digital era, organizations must look for new business models that allow to boost creativity and innovation; where, *open innovation* becomes a mechanism to capture initiatives, both outbound and inbound, to boost competitive advantage, being its impact more profound and permanent when incorporating other business sectors such as education, business chambers, consulting firms and government, as they offer a systemic approach to the business context. However, in developing economies, the establishment of clear, precise, and concise procedures can be complex due to the lack of knowledge, experience, and expertise needed in these environments. This is a fundamental requirement of strategic business models in the digital era to ensure sustainability and the achievement of competitive advantage. However, the evolution of technology, such as the development of communications through the Internet, has made it possible to break down these barriers, fostering business cooperation for the achievement of strategic positioning of business models in this era.

While it is true that *open innovation* management can guarantee business success, organizations must have a roadmap for their business strategy, which allows them to make the necessary changes according to their environments; to achieve this improvement, it is necessary for companies to foster a culture of top-down learning, to encourage creativity through effective innovation models. Therefore, organizations must be willing to change their organizational paradigm toward an innovation approach, which allows a structural change in organizational processes. This will be necessary to promote knowledge, experience, and expertise in the collaborators, allowing them to generate disruptive inventions that provide a high barrier of entry for the company.

The successful implementation of an organizational transformation process in the digital era requires a balance between the traditional and innovation models, to ensure the exponential, sustained, and long-term growth of new business opportunities and the contribution of value to the customer.

Strategic orientation as a modulator of open innovation

Strategic orientation is the direction and concentration of a firm's strategies toward goal attainment. It covers many aspects like entrepreneurial orientation, technological orientation, and market orientation. Determining how businesses use outside knowledge and resources and engage in *open innovation* depends much on these factors.

1) *Open innovation* and market orientation are concepts wherein one understands and responds to consumer wants and industry trends. Strong market-oriented companies are more suited to spot useful outside expertise and use it in their creative process. This alignment guarantees that efforts at *open innovation* are tightly related to market needs, hence increasing the relevance and influence of creative results.
2) Technology orientation and *open innovation* center on using technology developments to inspire creativity. High-tech-oriented companies are more likely to participate in *open innovation* by working with outside partners such as colleges, labs, and technology companies. This cooperation speeds the creation of new goods and services and helps to acquire modern technology.
3) *Open innovation* and entrepreneurial attitude both stress proactive, risk-taking behavior. Strong entrepreneurial-oriented companies are more likely to investigate *open innovation* prospects including strategic alliance building and participation in innovation networks. This proactive strategy improves the firm's capacity to use outside expertise and resources, therefore promoting better performance of innovation.

Improving open innovation's results using strategic orientation

Strategy orientation not only helps to control but also enhances the outcomes of open innovation by providing a disciplined framework for merging outside knowledge with corresponding company strategy goals. There are several ways strategic orientation enhances open innovation:

1) Clear strategic direction helps businesses to correctly allocate resources and give *open innovation* initiatives supporting their strategic objectives a top priority. This ensures efficient use of outside knowledge and tools, therefore maximizing the impact on the performance of innovation.
2) *Strategic orientation* promotes within the business a creative and cooperative culture. Good use of *open innovation* approaches relies on this cultural alignment as it inspires staff members to embrace outside ideas and participate in cooperative initiatives with outside partners.
3) *Strategic orientation* provides a framework for assessing and managing the risks associated with *open innovation*. By connecting *open innovation* initiatives with strategic corporate goals, businesses may lower risks and ensure that outside alliances enhance the output of innovation.
4) Strategic direction allows businesses to create exact criteria for evaluating the success of *open innovation* programs. This performance assessment assures us that *open innovation* initiatives are continually under observation and constantly refined to provide desired outcomes.

Empirical proof and theoretical support

Research confirms the increasing importance of strategic direction in open innovation. For example, companies with a strong strategic orientation are more likely to gain from open innovation by properly combining external information and matching it with their strategic objectives, according to Cheng and Huizingh [29]. Likewise, Valdez-Juárez and Castillo-Vergara [4] underlined that *strategic orientation* improves the favorable effects of *open innovation* on corporate processes and *innovation performance*.

Given the circumstances, regulating and enhancing the outcomes of *open innovation* depends much on strategic direction. *Strategic orientation* provides a disciplined framework for integrating outside information, linking innovation efforts with strategic goals, and so promotes a culture of cooperation, thus considerably improving the innovation performance of firms. Especially concerning SMEs in developing countries, this cooperative relationship highlights the significance of adding strategic direction to the study of *open innovation*.

Especially in the context of SMEs, the literature research underlines the crucial necessity of *open innovation* and *strategic orientation* in raising the creative performance of businesses. Widely acknowledged as a strategic method to speed innovation processes and enhance corporate performance is *open innovation*—characterized by the integration of internal and outside ideas, resources, and knowledge—that combines. Although a lot of studies have been done on the advantages of *open innova-*

tion in big businesses, knowledge of its use and influence among SMEs—especially in developing nations—remains very lacking.

The study emphasizes three main forms of *open innovation*: integrated activities, inbound, and outbound ones. While outbound open innovation employs internal knowledge outside the company, inbound *open innovation* focuses on bringing other knowledge and resources into the company. Combining inbound and outward methods creates cost-sharing advantages and efficiency improvements. The use of this strategic model contributes to improving a company's competitive advantage by reducing development costs and enabling it to be resilient in a changing marketplace.

Furthermore, stressed in the literature is a need for *strategic orientation* in promoting creativity. *Strategic orientation* is matching organizational actions and resources with internal capabilities and market needs to accomplish corporate goals. Strong strategic direction has been demonstrated in studies to greatly improve the innovative performance of a company by encouraging a culture of ongoing education, market responsiveness, and operational efficiency.

Notwithstanding these revelations, the literature shows a clear study vacuum on the interaction between *open innovation* and *strategic orientation* in SMEs, especially in developing countries. Although earlier research mostly focuses on big companies in rich nations, there is little actual data on how these ideas affect innovation in SMEs running under restricted resources. In the framework of technology-based SMEs, where fast technical developments and market dynamics require quick and adaptable innovation methods, this gap is especially pertinent.

In essence, even while *open innovation* and *strategic orientation* are accepted ideas in the literature on innovation, their implementation and influence in SMEs—especially in developing nations—remain understudied. By examining the link between *open innovation, strategic orientation*, and *innovative performance* in Costa Rican technology-based SMEs, this study intends to close this gap and so contribute to the state of the art and offer useful advice for SMEs trying to improve their capacity for innovation in a fast-changing digital environment.

3. Methodology

The study employed a quantitative methodology, utilizing numerical measurements and statistical analyses to evaluate a theory, thereby affirming a scientific hypothesis [36]. This approach delved into the development of the object under study, aiming to unearth relationships and consistencies between various research elements [37]. Furthermore, a descriptive approach was incorporated to identify the specific characteristics and attributes of the phenomena under investigation, particularly examining the influence of *open innovation* and *strategic orientation* on the *innovative performance* of SMEs [38]. An exploratory subcategory was also adopted to meticulously detail each factor of the deployment of the said technologies in the business context [38]. Additionally, the cross-sectional design was selected to represent the diversity of participants at a singular point in time [39].

In complement to the quantitative approach, the qualitative methodology referenced by Cheng and Huizingh [29] was applied to assess the conceptual model depicted in Figure 3.

For the study's 2023 era, the selected sample matched 70 Costa Rican technology-based SMEs that gave honest, trustworthy, and genuine answers. To accomplish this goal, the sampling strategy was purposefully designed to minimize bias distortion throughout the sampling process and provide an impartial portrayal of the phenomena under study. To ensure knowledge and competence in the sector, participants were chosen in 2023 from the online database that the SME promoter in Costa Rica (PROPYME) made accessible [40].

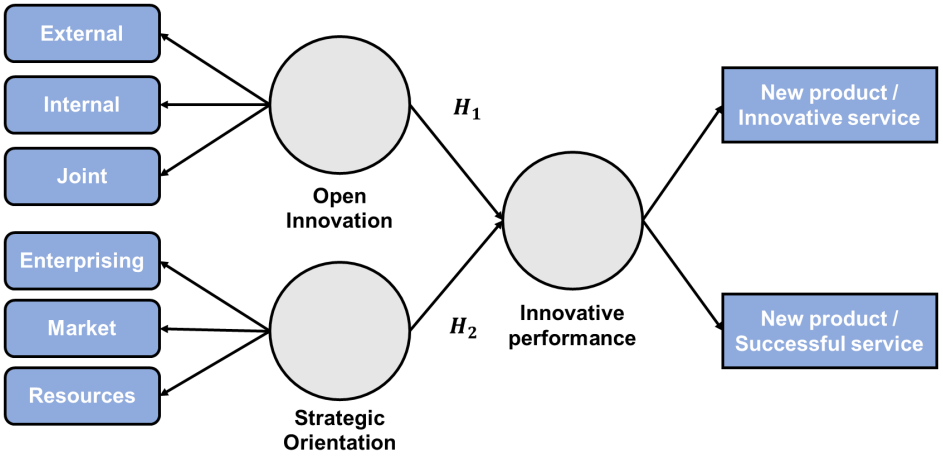
The sample was chosen from a final population model to minimize sampling bias in the study; confirm the integrity, validity, and reliability of the data; and ensure that the information was accurate with the phenomena under study. This allowed for a 95% effectiveness rate in the results obtained [41].

An electronic questionnaire with a defined format was used to gather data. To guarantee alignment and consistency with the research topic, the scale was based on the variables Cheng and Huizingh [29] suggested in their study.

Throughout the process of data analysis, the following tasks were completed:

1) Because it works well with small sample sizes, a partial least squares (PLS) model was used. The analysis correctly evaluated the hypotheses put forward and validated their applicability within the parameters of the study. According to Zeng et al. [42], its significance stems from its capacity to manage data including a response variable and many predictor factors—even when these are correlated—particularly in situations when there are fewer observations than variables.
2) Convergent validity and reliability were then assessed using Cronbach's alpha and composite reliability as the models used in the constructions. According to Stadler et al. [43], the instrument's

Figure 3
Conceptual model



consistent measurement of the construct validates its ability to assess phenomena of interest.

3) The HeteroTrait-MonoTrait matrix (HTMT), construct cross-loadings, and the Fornell-Larcker criteria were used to assess discriminant validity. According to Batra [44], both are necessary to guarantee that constructs are measured precisely and uniquely; they are also necessary to evaluate discriminant validity in structural equation models, guaranteeing that constructs are different from one another.
4) A cross-factor loading assessment was used to conduct discriminant validity, with each construct aiming to show the loadings with its associated variable on other variables in the model. According to Tiwari et al. [45], this strategy, when paired with discriminant validity, ensures that the construct being assessed is unique and that the variance of other constructs is not being gathered.
5) Lastly, the visceral test was used as a supplementary model to validate the model for the robustness test. According to Ismaiel et al. [46], the method's use enables the Cronbach test result to be validated.

The investigation covers the following hypotheses: (1) *open innovation* positively affects SME innovation, (2) *strategic orientation* boosts innovative performance, and (3) their interaction further enhances innovation, driving SME growth. The analysis has a Cronbach's alpha higher than 0.7 and a visceral value of 0.7 for all hypotheses proposed, allowing the acceptance of both the null hypothesis and the alternative hypothesis.

4. Results

The research using the PLS method demonstrated that *inventive performance* in Costa Rican technology-based SMEs is favorably influenced by both *open innovation* and *strategic orientation*. The findings demonstrate a somewhat positive association between both factors; *strategic orientation* has a route coefficient of 0.398, while *open innovation* has a path coefficient of 0.369. These results imply that SMEs that follow *open innovation* strategies and match them with a *strategic orientation* are more likely to reach better degrees of *inventive performance*.

The R^2 value of 0.463 shows that *open innovation* and *strategic orientation* together account for 46.3% of the variation in *inventive performance*, therefore demonstrating a major impact of both elements on the creative output of SMEs. This outcome is consistent with earlier research [29], but it further broadens the results to fit SMEs in a developing country, where such empirical data is still scarce.

Reliability and validity of the model

Using Cronbach's alpha and composite reliability, the research evaluated the internal consistency of the model; both values were above the recommended criterion of 0.70 for all components (see Table 4).

Table 4
Convergent validity and reliability

Construct	Cronbach's alpha	Composite reliability
Innovative performance	0.741	0.884
Open innovation	0.768	0.864
Strategic orientation	0.794	0.877

This validates (Table 4) the accuracy of the utilized measuring scales for the research. Convergent validity was further assessed using the mean extracted variance, with all constructs over the minimal criterion of 0.50, therefore strengthening the validity of the model.

Discriminant validity

Discriminant validity was verified using construct cross-loadings, the HTMT matrix, and the Fornell-Larcker criteria. The findings showed that the variance of each construct with its indicators was higher than its variance with other variables, therefore guaranteeing that the constructs are unique and not overlapping (Tables 5 and 6).

Table 5
Convergent validity and reliability

Construct	Innovative performance	Open innovation	Strategic orientation
Innovative performance	0.890		
Open innovation	0.598	0.824	
Strategic orientation	0.610	0.575	0.839

Table 6
Cross factorial loads

Construct	Innovative performance	Open innovation	Strategic orientation
Product/ Innovative Service	0.859	0.460	0.460
New Product/- Successful Service	0.920	0.591	0.610
External	0.433	0.812	0.331
Internal	0.419	0.787	0.344
Joint	0.595	0.872	0.676

Further supporting discriminant validity, the HTMT ratios for *strategic orientation* and open innovation were also below 1 (see Table 7).

Table 7
HeteroTrait-MonoTrait Ratio (HTMT)

Construct	Innovative performance
Open innovation	0.762
Strategic orientation	0.750

Important conclusions

1) Strategic focus and *open innovation* greatly improve SMEs' *inventive performance*.
2) These elements taken together account for 46.3% of the variation in *inventive performance*.
3) Confirming the validity and dependability of the model helped to guarantee the strength of the findings.

These results strongly corroborate the assumptions of the research and underline the need for *open innovation* and *strategic orientation* in promoting innovation in SMEs, especially in emerging countries. The findings provide SMEs striving to improve their capacity for innovation and practical insights in a fast-changing digital environment.

5. Discussion

The analysis delineates *open innovation* and *strategic orientation* as pivotal principles in the evolution of contemporary business management, each exerting profound effects on an organization's innovative capabilities. As specified by Yin et al. [47], the advent of the new industrial revolution mandates the amalgamation of both internal and external ideas to propel product and service innovation, distinguishing itself from the closed innovation paradigm, which confines ideation and development internally. In support of this, Mota et al. [48] point out that *open innovation* improves cooperative interactions with a range of stakeholders, including clients, vendors, and rival businesses. According to Bertello et al. [49], *open innovation* speeds up the invention lifecycle while reducing costs by giving access to a wide range of outside resources and skills. Additionally, according to Radicic and Alkaraan [50], businesses that embrace *open innovation* are better able to adjust to changes in the market and technology.

As the study we go toward the fifth industrial revolution, there are a lot of opportunities for *open innovation's* beneficial effects on *inventive performance*. According to Oliveira et al. [51], *open innovation* may stimulate collaboration among a variety of stakeholders, leading to more creative and effective solutions. However, according to Sanabria-Z et al. [52], businesses that use this innovation model show a greater capacity to quickly adjust to changing market trends and technology advancements.

Conversely, intrinsic challenges exist: as per Sanabria-Z et al. [52], external collaboration could potentially complicate intellectual property protection, necessitating robust agreements and management frameworks; Yao et al. [53] remark on possible impediments within organizations adhering to conventional cultures that prioritize secrecy and competition. Further, Choi et al. [54] identify the intricate process of selecting appropriate partners as critical to the triumph of open innovation.

Reyes-Gómez et al. [33] posit that cultivating and executing innovation-centric strategies, embodying learning and *market orientation*, significantly enhances *innovative performance* outcomes, as evidenced by prevailing trends. Rautela [55] encourages a culture of perpetual learning and procedural enhancement, which substantially augments a company's innovative faculties. Wulandari and Wardani [56] discuss the importance of aligning with market demands and consumer expectations to bolster innovation efficacy and relevance, while Yang et al. [57] elucidate strategic innovation orientation as a conduit for augmenting an organization's intellectual capital, thereby optimizing overall performance.

Challenges remain in effectively implementing such strategies, as indicated by Chistov et al. [16], citing resistance to change and resource deficiencies as potential barriers. According to Lu and Chesbrough [58], evaluating *strategic orientation*'s impact on innovative performance demands intricate metrics and analytical apparatus. Finally, Aquilani et al. [59] highlight the arduous task of integrating innovations into pre-existing organizational structures and processes.

The speech confirms that, while requiring careful management of inherent difficulties, *open innovation* and *strategic orientation* are fundamental in enhancing the creative ability of a company. Companies that can effectively balance these concepts are probably going to have significant, long-lasting competitive advantages.

Political implications

Open innovation might transform how governments and companies handle economic and technical advancement. Still, it also poses major political issues requiring cautious control. Maximizing the advantages of this method depends on a well-balanced approach combining the encouragement of collaboration with the defense of national and business interests.

6. Conclusions

The findings of this research confirm the theory that *strategic orientation* favorably affects i*nnovation performance* (0.398) in Costa Rican technology-based SMEs and that *open innovation* has a minor positive impact on *inventive performance* (0.369). These results are important as they fill in a major research need in the literature by providing empirical data from a developing nation where the use of *open innovation* in SMEs has not been well investigated. Unlike earlier studies mostly focusing on big businesses, this study shows that *open innovation* and *strategic orientation* are equally important for SMEs, especially in the technology-based sector, where fast technological changes and market dynamics demand agile and flexible innovation strategies.

The results of the research add to the state of the art by verifying the theoretical model in an actual SME environment and providing useful advice for SMEs trying to improve their capacity for innovation. The findings imply that by using *open innovation* techniques and matching them with a *strategic orientation* stressing market responsiveness, operational efficiency, and product differentiation, SMEs may attain significant competitive advantages. This is especially pertinent in developing nations, where SMEs must negotiate challenging market conditions and perhaps have limited resources.

To see whether comparable tendencies develop, future studies should investigate the dynamics of *open innovation* and *strategic orientation* in other industries and areas. A further understanding of how SMEs could maximize their innovation strategies might come from looking at other elements impacting innovation like technology engagement, customer interactions, and university affiliations [60]. This research highlights the need for *open innovation* and *strategic orientation* in improving the *inventive performance* of SMEs, especially in emerging countries, thus laying the foundation for the next research [61].

Such explorations will significantly contribute to the technology-based sector's growth through *open innovation*, promoting creativity, competitiveness, and sustainable economic progression in Costa Rica. This study's outcomes signify a strategic change in thinking, emphasizing *open innovation* in the digital era. The insights propose a strategic framework for businesses, underscoring the importance of integrating data-driven decisions and recognizing the constructive interaction between *innovative performance*, *strategic orientation*, and *open innovation* in digital environments. The practical ramifications equip stakeholders with a comprehensive guide to leveraging technological progress and fostering *open innovation* strategies.

Theoretically, the results advocate for extensive academic exploration, analyzing *open innovation* trends and challenges within business strategies and highlighting resilient stakeholder importance in the dynamic digital age. Given the nascent nature of the field, this study paves the way for further inquiry and development.

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Ethical Statement

This study does not contain any studies with human or animal subjects performed by any of the authors.

Conflicts of Interest

The author declares that he has no conflicts of interest in this work.

Data Availability Statement

Data sharing is not applicable to this article as no new data were created or analyzed in this study.

Author Contribution Statement

Gabriel Silva-Atencio: Conceptualization, Methodology, Validation, Investigation, Resources, Data curation, Writing – original draft, Writing – review & editing, Visualization, Supervision, Project administration, Funding acquisition.

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