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Risks and Challenges for SMEs in Open Innovation: A Systematic Literature Review

Daniel Ehls*

Fulda University of Applied Science,
Leipziger Straße 123, 36037 Fulda, Germany.
E-mail: Daniel.Ehls@w.hs-fulda.de

Abstract:

Small and medium-sized enterprises (SMEs) increasingly engage in open innovation (OI), yet the associated risks and challenges remain fragmented across the literature. This paper presents a systematic literature review of 34 peer-reviewed studies published between 2003 and 2024, synthesizing the risks and challenges SMEs face when implementing OI. Using a structured content analysis, we identify eight primary risk categories, with Process and Time, Partnerships, Team dynamics, and Knowledge Sharing/IP emerging as the most prominent. The findings reveal that these risks are fundamentally shaped by SMEs' distinctive structural characteristics — including resource constraints, limited absorptive capacity, and informal governance — and are not simply scaled-down versions of large-firm risks. We discuss the taxonomy's alignment with established theoretical frameworks and delineate critical boundary conditions. The study provides actionable guidance for SME managers and policy makers and advances a structured agenda for future research.

Keywords: open innovation; SME; risks; challenges; systematic literature review.

1 Introduction

Small and medium-sized enterprises (SMEs) constitute the backbone of modern economies. In the European Union alone, SMEs account for more than 20 million enterprises and employ over 75 million people (Wynarczyk et al., 2013; Klewitz & Hansen, 2014). In the United States, firms with fewer than 500 employees represent more than 99% of all businesses and generate nearly half of private-sector employment (U.S. Small Business Administration, 2023). Similar patterns are observable in Asia's emerging economies, where SMEs are central drivers of industrial development and employment (OECD, 2019). Many of these firms, sometimes called hidden champions (Simon, 1996), represent world leaders in specialized niches and are key drivers of innovation. In pursuing that innovation, firms no longer rely exclusively on internal resources; they

increasingly draw on both internal and external sources of knowledge to advance their business (Laursen & Salter, 2006) — a practice termed open innovation (OI) (Chesbrough, 2003).

OI has been found to enhance innovative performance across a wide range of empirical settings (West & Bogers, 2014 ; Sikandar & Abdul Kohar, 2022). For a long time, however, OI was predominantly practiced by large enterprises (Messer & Martin, 2019), and research into OI in SMEs emerged considerably later. Early scholarship on OI in SMEs was unequivocal: SMEs face specific risks and challenges when pursuing open innovation. These challenges span managerial and cultural dimensions (van de Vrande et al., 2009) as well as structural resource constraints that impede collaboration (Wynarczyk et al., 2013). Concurrently, literature reviews of OI pointed out that SMEs were underrepresented in OI research (West et al., 2014), a gap that was subsequently addressed through dedicated special issues and targeted empirical work (Bogers et al., 2018).

As a result, a larger body of research on OI in SMEs has emerged. Several reviews now offer topic-specific perspectives: Hossain and Kauranen (2016) concentrate on the benefits and adoption patterns of OI in SMEs; Brinkerink et al. (2016) examine the relevance of OI for family firms; Carrasco-Carvajal et al. (2023) address measurement approaches; and Fakhreddine and Castonguay (2024) analyze policy recommendations. While these reviews offer meaningful insights, none of them systematically addresses the risks and challenges associated with OI in SMEs. Yet this perspective is essential — both for building a stronger theoretical understanding and for guiding managers and policy makers in their innovation strategy decisions.

Three additional factors underscore the need for a dedicated, updated review. First, existing insights from large companies are not directly transferable to SMEs, which are structurally distinct from large firms (Brunswicker & Vanhaverbeke, 2015). Second, the business environment has changed dramatically: new risks related to digital transformation and global collaboration have emerged and require updated guidance (Dabic et al., 2023). Third, calls for deeper analysis of the managerial challenges SMEs face in adopting OI have gone largely unanswered (Bogers et al., 2018).

This study responds to these calls. It examines the specific challenges and risks faced by SMEs in implementing OI, drawing on a systematic literature review (SLR) of 34 peer-reviewed papers published between 2003 and 2024. The primary objectives are: (1) to identify and synthesize the main risks and challenges documented in the literature, (2) to assess their relative prominence within the SME context, and (3) to relate findings to established theoretical frameworks in order to offer structured guidance for researchers and practitioners. The paper proceeds as follows: Section 2 establishes the theoretical-conceptual framework; Section 3 describes the research design; Section 4 presents the findings; Section 5 discusses theoretical implications and boundary conditions; and Section 6 concludes with contributions and future research directions.

2 Theoretical-Conceptual Framework

Risks and Challenges of Open Innovation

For many decades, firms operated under a closed innovation logic: ideas were developed internally, intellectual property was closely guarded, and market pathways were proprietary (Chesbrough, 2003). This paradigm has shifted markedly. Today, companies deliberately steer "inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively" (Chesbrough, 2006, p. 1). While OI offers substantial opportunities to enhance innovative capabilities (Huizingh, 2011), it is not without risks. Research has identified various risk categories, particularly in the context of large firms.

Ullrich and Vladova (2016) propose a taxonomy encompassing organizational, knowledge management, and legal risks. Organizational risks include process coordination failures, implementation challenges, and workflow disruptions. Knowledge management risks involve the strategic handling of intellectual property and the potential for unintended knowledge spillover. Legal risks pertain to inadequate contractual frameworks and IP protection, which are especially acute for firms with limited legal experience. Building on this, Madanaguli et al. (2023) introduce further categories: data-related risks (privacy concerns, data distortion, technical vulnerabilities), people-related risks (uncertainties around contributor motivation and coordination), firm-level risks (resource deficits, limited managerial capacity), and outcome-related risks (market failure and IP issues). Additional categories include business environment challenges, free-riding, and identity and fit issues.

Beyond these taxonomies, Hewitt-Dundas and Roper (2018) highlight risks arising from incomplete information — including uncertainty about OI's potential benefits, the capabilities of potential partners, and the trustworthiness of those partners. Such information asymmetries can lead to suboptimal OI engagements, underinvestment in partnerships, and foregone benefits. Alexy and Reitzig (2013) draw attention to competitive threats related to intellectual property, particularly when OI exposes firms to clashes with proprietary rivals. Furthermore, the "not-invented-here" (NIH) and "not-shared-here" (NSH) syndromes can systematically impede the adoption and internal diffusion of externally sourced ideas (Dabic et al., 2023).

In summary, while OI offers significant advantages, it entails a wide and fragmented set of risks. Existing taxonomies, however, have been developed largely in the context of large firms, and no systematic synthesis of OI risks specifically for SMEs has yet emerged.

Open Innovation in SMEs: Structural Differences

Despite the popularity of OI as a research topic, its investigation within the specific context of SMEs emerged later and has distinct characteristics. SMEs constitute nearly 99% of all enterprises in the EU (Klewitz & Hansen, 2014), contribute disproportionately to employment, and play a critical role in regional innovation ecosystems (Wynarczyk et

al., 2013). However, the structural characteristics of SMEs make direct application of large-firm OI insights problematic.

SMEs typically operate under significant resource constraints: they employ fewer people, allocate less than half the financial resources to R&D compared to large firms (Henn & Sackmann, 2023), and pursue comparatively unstructured innovation processes (Hossain & Kauranen, 2016). At the same time, SMEs benefit from flatter, less bureaucratic organizational structures (Brunswicker & Vanhaverbeke, 2015), greater risk tolerance, and specialized niche expertise (Hossain & Kauranen, 2016). These characteristics enable faster decision-making and greater flexibility (Bigliardi & Galati, 2018), as well as a swifter response to market changes (Brunswicker & Vanhaverbeke, 2015). Interestingly, while large firms launch significantly more innovative products and services in absolute terms, SMEs generate a share of innovation-driven turnover nearly equal to large firms — highlighting the high impact of each individual innovation in an SME context (Spithoven et al., 2013). SMEs are also more research-intensive relative to their size and more active in knowledge-based service sectors, while large firms dominate manufacturing (Spithoven et al., 2013; Acs & Audretsch, 1987).

In terms of external collaboration — a core dimension of OI — SMEs exhibit a strong but concentrated network structure. They prefer low-cost, short-term partnerships due to financial constraints (Bigliardi & Galati, 2018; Lee et al., 2010), and a collaboration represents a strategic opportunity rather than routine activity (Hossain & Kauranen, 2016). Cross-national variation is notable: SMEs in some advanced economies, such as South Korea, display lower propensity to pursue externally sourced innovation ideas (Lee et al., 2010).

Open Innovation Practices of SMEs

The structural characteristics of SMEs fundamentally shape how they engage in OI. Empirical evidence confirms that SMEs primarily favor outside-in (inbound) OI (Brunswicker & Ehrenmann, 2013) — accessing external ideas and technologies while being more reluctant to externalize knowledge. In contrast, large firms employ about 78% OI adoption rates, with more than 50% having full-time dedicated OI staff (Brunswicker & Chesbrough, 2018). SMEs, by contrast, rely more heavily on their existing workforce — including non-R&D employees — to manage OI activities (van de Vrande et al., 2009; Santoro et al., 2018), resulting in informal internal and external work relationships (Dufour & Son, 2015).

A European study of over 1,500 SMEs shows that SMEs engage with a diverse range of external sources — including customers, suppliers, universities, and complementary long-term partners — but use fewer types of sources and engage in non-monetary activities more frequently than their larger counterparts (Santoro et al., 2018; Messer & Martin, 2019). Customers are the dominant external source for SME innovation, given their ability to deliver market-relevant signals and trajectory insights, whereas universities and public research centers feature less prominently (Santoro et al., 2018). Despite using fewer OI practices in absolute terms, SMEs are more dependent on OI proportionally, and the performance impact of OI is equally significant for both SMEs and large firms (Spithoven et al., 2013).

SMEs are also more selective in their appropriability strategies. Unlike large firms that routinely patent all inventions, SMEs apply for patents only when expected market potential is strong (Spithoven et al., 2013). This selectivity, combined with their general reluctance to share process-level information (Bigliardi & Galati, 2018), creates a particular tension: SMEs need openness to gain from OI, but their structural context incentivizes caution.

3 Research Design

Systematic Literature Review Approach

To provide an unbiased synthesis of the best available evidence, this study employs a systematic literature review (SLR) (Morrell, 2008). The term "systematic" denotes the use of an explicit, reproducible protocol for searching, selecting, and synthesizing literature (Okoli & Schabram, 2015). This protocol-based approach enhances reliability and enables coherent conclusions (Snyder, 2019). Specifically, this study follows the methodological guidelines proposed by Boell and Cecez-Kecmanovic (2015), who, after analyzing 14 SLR-claiming studies, found that most lacked a formal protocol and exhibited inconsistent quality standards. Their framework provides the structured, transparent approach required to maximize rigor and reproducibility.

Search Protocol and Study Selection

The objective of this review is to identify, categorize, and synthesize the risks and challenges that SMEs face in OI. The search string combines three well-established terms: "Open Innovation" AND "SME" AND "risk." These terms are widely used in the innovation management literature, appear in the titles of key influential papers in this domain (e.g., Hossain & Kauranen, 2016; Madanaguli et al., 2023), and are consistent with the terminology used in prior reviews on OI in SMEs (West et al., 2014 ; Bogers et al., 2018).

The search was conducted in three established databases: Business Source Premier (via EBSCOHost), ScienceDirect, and WISO Wirtschaftswissenschaften. Using three databases reduces the risk of publication blind spots while maintaining a high standard of publication quality. The observation period spans 2003 to 2024: 2003 marks Chesbrough's foundational publication defining OI, and 2024 represents the last complete year of coverage. Only English-language publications were included. The full inclusion and exclusion criteria are presented in Table 1.

Table 1 Inclusion and Exclusion Criteria for the Systematic Literature Review

Category	*Criterion*
Inclusion	I1: Three leading databases: Business Source Premier, ScienceDirect, WISO
	I2: Search string: "Open Innovation" AND "SME" AND "risk"
	I3: Publications from 2003 to 2024
	I4: Journal articles, books, and book chapters
	I5: Theoretical, conceptual, empirical, qualitative, quantitative, or review-based methodologies
Exclusion	E1: Non-English language publications
	E2: Pure theory papers with no empirical or practice-linked component; commentary papers
	E3: Papers focusing solely on OI without addressing SME context
	E4: Papers that do not independently develop insights on risks, barriers, or challenges

Source: own compilation

The study selection followed a multi-stage screening process. The initial database searches were conducted in April 2025 and yielded 1011 unique records. In the first screening stage, titles and abstracts were reviewed, resulting in the elimination of 865 papers — for example, papers that addressed open innovation exclusively in large-firm contexts or lacked any focus on risks, barriers, or challenges. The remaining 146 papers were read first via abstract and then in full. This process yielded a final sample of 34 focal papers. The complete study selection process is visualized in Figure 1 (PRISMA Flow Diagram). Table 2 lists all 34 focal papers.

Figure 1 PRISMA Flow Diagram of Study Selection

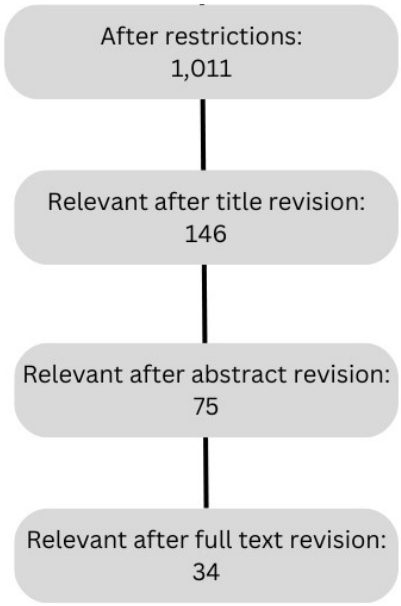


Table 2 Overview of the 34 Focal Paper

Authors	**Title**	**Journal**	**Year**
Alessandra Costa, Antonio Crupi, Chiara Eleonora De Marco, Alberto Di Minin	SMEs and open innovation: Challenges and costs of engagement	Technological Forecasting and Social Change	2023
Matthias Rudolf Guertler, Nathalie Sick	Exploring the enabling effects of project management for SMEs in adopting open innovation–A framework for partner search and selection in open innovation projects.	International Journal of Project Management	2021
Foroogh Farjam, Payam Shojaei, Kazem Askarifar	A conceptual model for open innovation risk management based on the capabilities of SMEs	Technovation	2023

Antonios D. Livieratos, George Tsekouras, Wim Vanhaverbeke, Antonios Angelakis	Open Innovation moves in SMEs: how European SMEs place their bets?	Technovation	2022
Carène Tchuinou Tchouwo, Sophie Veilleux, Diane Poulin	The limits to international open innovation within SMEs: the role of distance.	International Journal of Innovation Management	2022
Alberto Bertello, Alberto Ferraris, Paola De Bernardi, Bernardo Bertoldi	'Challenges to open innovation in traditional SMEs: An analysis of pre-competitive projects in university–industry–government collaboration'	International Entrepreneurship and Management Journal	2022
Fernando Almeida	Open-innovation practices: diversity in Portuguese SMEs.	Journal of Open Innovation: Technology, Market, and Complexity	2021
Sandra Dubouloz, Rachel Bocquet, Catherine Equey Balzli, Elodie Gardet, Romain Gandia	SMEs' open innovation: Applying a barrier approach	California Management Review	2021
Chiara Verbano, Maria Crema, Karen Venturini	The identification and characterization of open innovation profiles in Italian small and medium-sized enterprises.	Journal of Small Business Management	2015
Cristina Marullo, Alberto Di Minin, Chiara De Marco, Andrea Piccaluga	Is open innovation always the best for SMEs? An exploratory analysis at the project level.	Creativity and Innovation Management	2020

Barbara Bigliardi, Francesco Galati	An open innovation model for SMEs	Technology Analysis & Strategic Management	2016
Vareska van de Vrande, Jeroen P.J. de Jong, Wim Vanhaverbeke, Maurice de Rochemont	Open innovation in SMEs: Trends, motives and management challenges	Technovation	2009
Sungjoo Lee, Gw angman Park, By ungun Yoon, Jinw oo Park	Open innovation in SMEs—An intermediated network model.	Research Policy	2010
Margarida Cardoso, Isabel Ramos	Rvolta, a Case for Open Innovation: How can a SME be Innovative in a Competitive Industrial Environment?	Cases on SMEs and open innovation: applications and investigations	2012
Mokter Hossain, Ilkka Kauranen	Open innovation in SMEs: a systematic literature review.	Journal of strategy and management	2016
Emma L. Hitchen, Petra A. Nylund, Xavier Ferràs, Sergi Mussons	Social media: open innovation in SMEs finds new support.	Journal of Business Strategy	2017
Cristina Marullo, Alberto Di Minin, Chiara De Eleonora Marco and Andrea Piccaluga	The “hidden costs” of open innovation in SMEs: From theory to practice	Researching Open Innovation in SMEs	2018
Inga Haase	Open innovation: Challenges of integrating new forms of innovation in SMEs	Open Innovation and Entrepreneurship	2019
Simona Grama-Vigouroux, Sana Saidi, Anne Berthinier-Poncet, Wim	From closed to open: A comparative stakeholder approach for developing open innovation	Journal of Business Research	2020

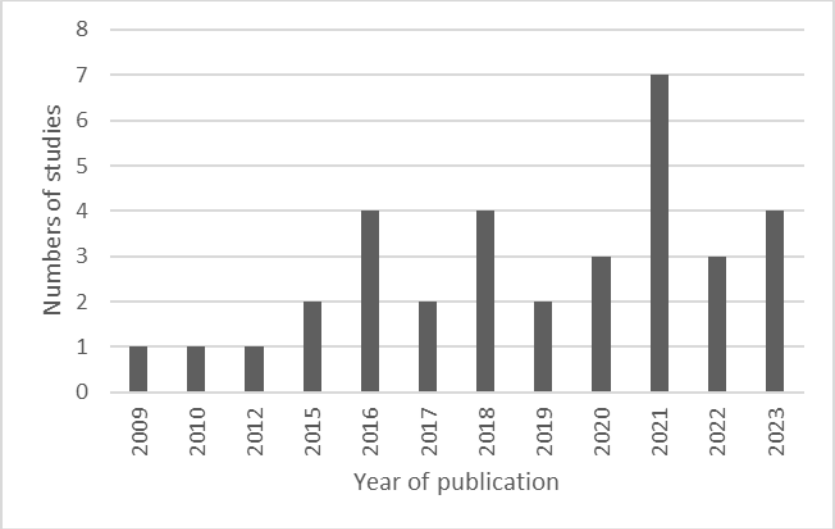
Vanhaverbeke, Allane Madanamoothoo	activities in SME		
Zoran Janevski, Elena Davitkovska, Vladimir Petkovski	BARRIERS OF IMPLEMENTING OPEN INNOVATIONS IN MACEDONIAN SMEs.	Journal of the Institute of Economics–Skopje	2015
Bo Li, Zeshu Xu, Hangyao Wu, Nan Hong	Open innovation: A research framework and case study of Huawei.	Technological & Economic Development of Economy	2023
André Ullrich, Gergana Vladova	Weighing the pros and cons of engaging in open innovation.	Technology Innovation Management Review	2016
Wissal Ben Arfi, Rickard Enström, Jean Michel Sahut, Lubica Hikkerova	The significance of knowledge sharing platforms for open innovation success	Journal of Organizational Change Management	2018
Franz Huber, Thomas Wainwright, Francesco Rentocchini	Open data for open innovation: managing absorptive capacity in SMEs	R&D Management	2020
Maria Isabel Rodriguez Ferradas, José A. Alfaro Tanco, Francesco Sandulli	Relevant factors of innovation contests for SMEs.	Business Process Management Journal	2017
Alenka Slavec Gomezel, Kaja Rangus	Open innovation: It starts with the leader's openness	Innovation: Organization and Management	2019
Anja Leckel, Sophie Veilleux, Leo Paul Dana	Local Open Innovation: A means for public policy to increase collaboration for innovation in SMEs.	Technological Forecasting and Social Change	2020

Gillian Barrett, Lawrence Dooley, Jow Bogue	Open innovation within high-tech SMEs	Technovation	2021
Alia Bihrajihant Raya, Riesma Andiani, Abi Pratiwa Siregar, Imade Yoga Prasada, Fairuz Indana, Theresia Gracia Yunindi Simbolon, Agustina Tri Kinasih, Agus Dwi Nugroho	Challenges, open innovation, and engagement theory at craft smes	Journal of Open Innovation: Technology, Market, and Complexity	2021
Stefan Markovic, Nikolina Koporcic, Maja Arslanagic-Kalajdzic, Selma Kadic-Maglajlic, Mehdi Bagherzadeh, Nazrul Islam	Business-to-business open innovation	Technological Forecasting and Social Change	2021
Nadia Zahoor, Samuel Adomako	Be open to failure: Open innovation failure in dynamic environments	Technological Forecasting and Social Change	2023
Kübra Şimşek, Nihan Yıldırım	Constraints to open innovation in science and technology parks.	Procedia - Social and Behavioral Sciences	2016

4 Findings

Descriptive Analysis

Our first analysis reveals the publication pattern of studies targeting risks of OI specifically in SMEs. While the concept of OI was coined in 2003, the first relevant publications appeared only in 2009. Roughly three to four publications appear per year — with a peak of seven in one year — reflecting consistent scholarly interest over time. The 34 studies are published across 26 journals and books; only three journals account for two or more publications: Technological Forecasting and Social Change (4 papers), Technovation (4 papers), and the Journal of Open Innovation (2 papers).



Content Analysis: A Taxonomy of OI Risks and Challenges in SMEs

Following the Gioia methodology (Gioia et al., 2013) and structured analytical coding (Reay et al., 2019), codes were developed inductively from the focal papers' themes and iteratively refined. Studies were not forced into a single category but were coded into all applicable categories to capture the full range of discussed themes. This process yielded **8 main risk categories**, each with four to six subcategories (Table 3 in the paper). Below is a summary of each category:

- **Financial Challenges** — captures funding difficulties, high innovation costs, and financial fragility that constrain sustained OI engagement (e.g., Lee et al., 2010; Huber et al., 2020).
- **Knowledge Sharing / IP** — encompasses the tension between openness and protection: fear of sharing, IP management processes, knowledge loss risk, and negotiation complexity. This is the category with the most subcategories (six), reflecting its historical centrality to OI theory (Chesbrough, 2003).
- **Partnerships** — addresses collaboration dynamics: misaligned partner objectives, lack of partner mapping (Bertello et al., 2022; Marullo et al., 2018), communication failures, and trust deficits.
- **Team** — reflects internal challenges: workload pressures, cultural resistance, commitment gaps, and skills deficits in the workforce supporting OI.
- **Process and Time** — covers procedural and temporal management challenges: bureaucracy, administrative burden, process complexity, and lack of dedicated OI management routines.
- **Resources** — captures non-financial resource gaps: material, informational, technological, and network-related resources required to sustain OI activities.
- **Expertise** — addresses capability gaps at management and employee level: strategic, technological, and methodological expertise deficits.
- **Stakeholders & Shareholders** — covers external pressure management: aligning customer requirements, shareholder expectations, and environmental factors with OI activities.

Table 3 Categories and Subcategories of the systematic literature review

Risk Category	Risk Subcategory
Financial Challenges	▪ Lack of Financial Resources (Sources,...) ▪ High Costs and Investments (Sources,...) ▪ Fund Difficulties (Sources,...) ▪ Risk and Uncertainty (Sources,...) ▪ Management and Constraints (Sources,...)
Knowledge Sharing / IP	▪ Management Challenges (Sources,...) ▪ Partner Selection and Collaboration ▪ Protection and Fear ▪ Loss and Risk ▪ Communication and Information Systems ▪ Negotiations and Exploitation
Partnerships	▪ Internal Team Dynamics ▪ Partner Selection and Characteristics ▪ Communication and Coordination ▪ Trust and Alignment ▪ Management and Organisational Challenges

Team	▪ Time and Workload Challenges ▪ Internal Culture ▪ Commitment and Misalignment ▪ Knowledge and Skills
Process and Time	▪ Time Challenges ▪ Bureaucracy and Administration ▪ Limitations and Complexity ▪ Management and Organisational Challenges
Resources	▪ Financial Resources ▪ Material and Information ▪ Development and Technology ▪ Market and Environment ▪ Organisation and Network
Expertise	▪ Language and Skills ▪ Strategic and Technological Expertise ▪ Management and Organisation ▪ Complexity and Methods ▪ Employees Expertise
Stakeholder & Shareholders	▪ Internal Interactions ▪ Customers' Needs and Requirements ▪ Expectations ▪ Environment ▪ Involvement and Assessment

Synthesis: Risks of OI in SMEs

Process and Time is the most frequently discussed category, addressed by 31 of 34 studies. Partnerships follows with 27 studies, and Resources with 26. Financial Challenges appear in 22 studies, while Stakeholders & Shareholders ranks last with 15 studies. A closer look at subcategories reveals that several sub-themes recur across multiple main categories. When aggregated across all categories: "Internal Organization Challenges" appears in 31 of 34 articles, "Management and Organizational Challenges" in 29 articles, and "Financial Challenges" in 11 articles — making them the three most cross-cutting sub-themes in the entire dataset. On a within-category normalized basis, the most prominent subcategory in Financial Challenges is "High Costs and Investments" (13 of 22 articles), and in Process and Time it is "Management and Organizational Challenges" (20 of 31 articles). Across all categories, three of the top within-category subcategories relate to management and organizational issues.

Rank	Category	Key Points
1	Process and Time	76
2	Partnerships	69
3	Team	55
4	Knowledge Sharing / IP	53
5	Financial Challenges	41

"Management and Organizational Challenges" (within Process and Time) leads all subcategories with 35 key points — more than 50% ahead of second place (22 points, "Internal Organisation"). Four of the five Partnership subcategories appear in the top-11 subcategory ranking, confirming inter-firm collaboration governance as the second dominant risk cluster. Moreover, cross-cutting risk levers exist. The most structurally significant finding of this synthesis is that certain sub-themes function as levers operating across multiple levels of the OI risk landscape simultaneously. "Management and Organizational Challenges" and "Internal Organization" each appear as subcategories in five of eight main categories. This means that strengthening OI-specific management competence and improving internal organizational structures does not merely address one risk category — it generates compounding risk mitigation effects across Process and Time, Partnerships, Team, Knowledge Sharing/IP, and Resources at once. For resource-constrained SMEs, this cross-leverage effect defines a clear prioritization logic: address the systemic organizational lever first, before tackling category-specific risks in isolation.

SME-Specific Risk Amplification

A central finding of this review is that the identified risk categories are not generic innovation management challenges that happen to be sampled from SME studies. Rather, the SME organizational context systematically amplifies each category in distinctive ways. Financial constraints do not merely affect the magnitude of investment in OI; they alter the feasibility calculus for OI participation altogether (van de Vrande et al., 2009). Team-level challenges in SMEs reflect key-person dependency and role concentration that are structurally absent in large-firm settings (Santoro et al., 2018). Knowledge governance risks are heightened in SMEs because the informal relationships that facilitate knowledge exchange also lack the contractual formalization that IP protection requires (Spithoven et al., 2013). Partnership risks are amplified by asymmetric power

relationships with larger collaboration partners that SMEs typically cannot offset through contractual sophistication or reputation capital.The cross-category recurrence of management and organizational challenges — appearing in Process and Time, Team, and Partnerships simultaneously — further suggests that a core management capability deficit underlies much of the observed risk landscape. This finding is consistent with the argument that SME-specific OI risks are not a subset of large-firm risks, but a qualitatively distinct risk configuration rooted in the organizational architecture of small and medium-sized enterprises.

Boundary Conditions

The applicability and severity of the identified risk categories are moderated by several boundary conditions that future research should examine more explicitly.

Type of OI. Inbound and outbound OI carry distinct risk profiles. Inbound OI (knowledge acquisition from external partners) is more susceptible to absorptive capacity failures, partner selection errors, and knowledge integration challenges — consistent with the dominance of Process and Time and Partnerships categories in this review. Outbound OI (knowledge commercialization through licensing or spinouts) exposes SMEs more acutely to IP leakage, contractual governance failures, and market valuation uncertainties (Alexy & Reitzig, 2013). Future research should examine whether and how the composition of the taxonomy shifts depending on OI directionality.

Industry Context. The relative prominence of specific risk categories likely varies across industries. Knowledge-intensive industries (e.g., biotechnology, software, advanced manufacturing) are more exposed to IP-related and knowledge governance risks, while traditional manufacturing or service sectors may face more acute partnership governance and financial challenges. The role of industry-specific regulatory frameworks and competitive intensity warrants dedicated investigation.

SME Size and Organizational Maturity. Within the SME category, micro-firms (fewer than 10 employees) face different risk configurations than small or medium-sized enterprises. Micro-firms are likely to be most acutely affected by team-level and financial challenges, while larger SMEs may face more complex organizational governance and strategic alignment issues. Similarly, young SMEs lack the relational capital and institutional experience to manage partnerships effectively, whereas established SMEs may encounter stronger NIH syndromes that impede openness to external ideas (Dabic et al., 2023).

Institutional Context. National innovation systems, legal frameworks, and cultural attitudes toward knowledge sharing significantly moderate OI risk exposure. SMEs in countries with strong IP protection regimes face different legal risk profiles than those in weaker institutional environments. The observed variation in OI engagement across countries — e.g., the comparatively lower OI propensity of Korean SMEs toward external knowledge sourcing (Lee et al., 2010) — points to the need for institutionally sensitive risk frameworks that account for cross-national heterogeneity.

5 Discussion and Conclusion

Theoretical Contributions

This paper contributes the first systematic, SME-specific taxonomy of OI risks — eight categories with 37 subcategories — to the innovation management literature. It reframes OI engagement in SMEs not merely as an opportunity but as a structured risk landscape that requires deliberate, prioritized navigation. Beyond the taxonomy itself, the identification of cross-cutting sub-themes as multi-level risk levers adds theoretical nuance: organizational capability deficits are not one risk among many, but a foundational vulnerability amplifying risk across the full breadth of OI engagement. This finding connects with the broader OI literature's emphasis on internal preparedness as a precondition for successful external knowledge integration (van de Vrande et al., 2009; Brunswicker & Vanhaverbeke, 2015), and specifies it empirically for the SME context.

Practical Implications

For SME managers, the taxonomy provides a structured risk checklist. The cross-leverage finding points to investment in OI-specific managerial competence and internal organizational clarity as the highest-priority risk mitigation strategy. Partnership risks — the second-largest category — suggest systematic partner mapping and governance frameworks are the next priority. For policy makers, the financial risk category, though moderate in key-point volume, represents a systemic constraint: without addressing financial fragility, SMEs cannot invest in the management and partnership infrastructure that mitigates the higher-ranked categories. Programs combining OI intermediary support, IP advisory services, and management development co-funding address multiple risk categories through a single entry point.

Limitations and Future Research

The search string may not capture all relevant studies using synonyms such as "barrier," "challenge," or "obstacle." Future reviews should broaden vocabulary to ensure coverage. Interaction effects between risk categories and concrete risk mitigation strategies remain underexplored and represent a priority for future research. Examining how risk profiles vary across OI types (inbound vs. outbound), industries, SME size classes, and institutional contexts will enrich the field's understanding considerably. Longitudinal perspectives on how risk exposure evolves as SMEs accumulate OI experience would complement the predominantly cross-sectional evidence synthesized here.

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