Limiting factors of open innovation organizations: A case of social product development and research agenda

Kaveh Abhari [*], Summer McGuckin

San Diego State University, United States

ARTICLE INFO

ABSTRACT

While open innovation organizations have grown in popularity, they hold a high failure rate. This paper identifies limiting factors that contribute to this high failure rate at three levels: strategy, process, and community. After validating and expanding these limits through a case study, the paper offers a framework identifying success factors for open innovation and their hierarchical relationships. We classified these success factors into six groups, design, implementation, technology, operation, community readiness, and community development, and their relationships into four groups, deployment, engagement, evaluation, and governance. This framework and the accompanying propositions offer a better theoretical understanding of open innovation models and provide practical recommendations toward their viability, survivability, scalability, and profitability. Lastly, the paper discusses possible research avenues for the further development of open innovation organizations.

1. Introduction

Open innovation (OI) is defined as a distributed innovation process based on purposively managed knowledge flows across organizational boundaries to accelerate internal innovation based on the use of external knowledge or support external innovation based on the use of internal knowledge. For a long time, the theoretical development of OI has been focused on the strategic benefits of OI in an attempt to position OI models as alternative solutions for innovation (Albats et al., 2021; Bogers et al., 2019; Chaudhary et al., 2022). While OI initiatives in tandem with digital platform technologies can potentially facilitate and enhance the innovation process and outcomes (Jesus and Jugend 2021; Nguyen et al., 2021), the downsides and the limits of this openness remain understudied (Kohler and Nickel 2017; Saura et al., 2022; Schlagwein and Bjørn-Andersen 2014; Schoder et al., 2019; Stefan et al., 2022).

Proponents of OI have long argued that the literature falls short in documenting obstacles hindering OI's successful implementation and governance (Bigliardi et al., 2020; Chesbrough and Brunswicker 2014; Kohler and Nickel 2017; West and Bogers 2017). Instead, previous studies have mainly articulated the general logic of OI, described the success of some well-known cases, and examined the benefits of engaging external actors in new product development (e.g. Chesbrough 2017; Corral de Zubielqui et al., 2019; Henttonen and Lehtimäki 2017;

Liem et al., 2019; Xie et al., 2016). However, these success stories have generally failed to acknowledge that OI can fade in its efficacy due to many technical and non-technical reasons (Bigliardi et al., 2020).

Accounting for these failures, recent studies call for a more thorough analysis of OI's limitations and the dark side of OI (Stefan et al., 2022). Among these limitations, researchers have emphasized the strategic challenges such as balancing the level of openness (Grimaldi et al., 2021), organizational challenges such as employee readiness (Natalicchio et al., 2018), operational challenges such as integration (Gurca et al., 2021), community challenges such as conflict risk and self-promotion (Malhotra et al., 2017), and individual challenges such as knowledge gaps (Torres de Oliveira et al., 2021). Likewise, difficulty in OI implementation, complexity in OI governance, and uncertainty in OI results stem from limitations of OI that are not well-documented in the literature (Beck et al., 2020; Chesbrough 2019; Saura et al., 2022; Ullrich and Vladova 2018).

From a practical perspective, further research on the limitations of OI is more necessary than ever since, in recent years, many companies have closed their customer innovation communities, OI marketplaces have been abandoned, and innovation intermediaries have filed for bankruptcy (von Briel and Recker 2017; Kohler and Nickel 2017). Even with generous incentives, the OI models sometimes cannot attain the most effective innovation results (Hofstetter et al., 2018). Practical evidence also shows that OI does not necessarily reduce the risk or failure rate of
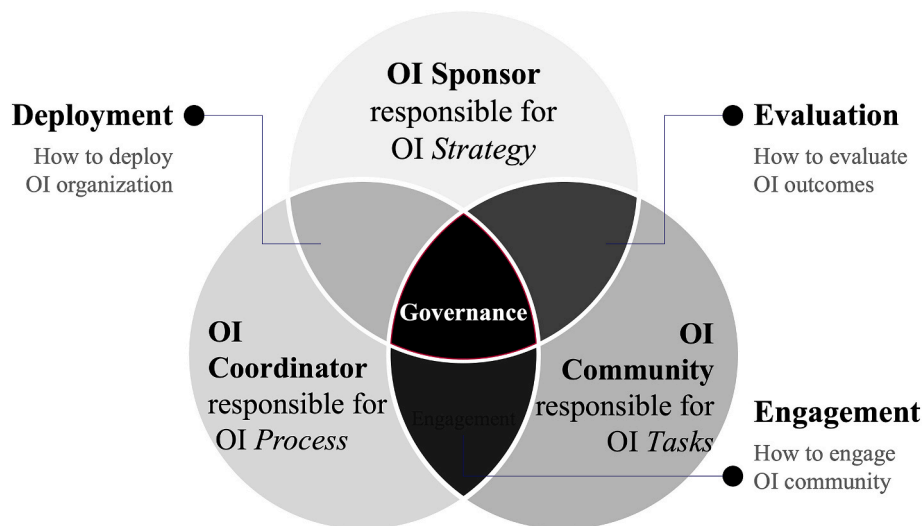

Fig. 1. OI organization: Key roles and functions in open innovation.

new products (Ehls 2017; Kohler and Nickel 2017). Besides, the cost of implementing and running an OI model sometimes does not justify its benefits (Bogers et al., 2018; Ovuakporie et al., 2021). Hence, understanding false negatives and false positives in the innovation process remains a central concern for the successful adoption of OI (Chesbrough and Bogers 2014; West and Bogers 2017).

Despite these challenges, there are a few models offering a holistic and generalizable explanation of these limitations. To this end, this study first discusses the key limiting factors of OI identified by recent studies under three categories: OI strategy, process, and community. We define 'limiting factors' as constraining variables that restrict the success of an OI system. After discussing the common limitations identified in recent studies, we analyze the manifestation of these limiting factors in the case of a once-popular Social Product Development (SPD) platform. SPD as an OI model uses social technologies and social mechanisms to mobilize community members to participate in new product or service development (Abhari et al., 2022a). SPD offers a rich context to study OI since it provides an end-to-end innovation cycle with a diverse range of OI qualities and functionalities. This richness allows us to develop a transferable understanding of the limiting factors while contextualizing our findings through the lens of SPD (cf. Bhimani et al., 2019; Greco et al., 2015; Hossain and Kauranen 2016; Ramírez-Montoya and García-Peñalvo 2018; West and Bogers 2014). Following the case review, we establish an integrated foundation and common language to understand factors threatening OI success, and we accordingly document OI success factors and their relationships through a framework and a set of propositions. This study contributes to the literature a theoretically grounded foundation for understanding and examining OI limitations. Our findings provide a systematic view of OI success factors in terms of design, implementation, technology, operation, community readiness, and community development and explain the possible hierarchical relationships between these factors. The findings also hold relevance for the conceptualizing OI organization with implications for OI viability, survivability (sustainability over time), scalability, and profitability. We conclude this study with a discussion of future research avenues to pave the way for more systematic investigations of OI organizations.

2. Background

The OI literature has mainly discussed the limiting factors of OI from three perspectives: strategy (e.g. Bagherzadeh et al., 2019), process (e.g. Gassmann and Enkel 2004), and community (von Briel and Recker 2017). These three levels of analysis are associated with three roles in an OI organization that include those who seek solutions through OI at the

organizational level (OI sponsor), those who implement and manage the OI process at the operational level (OI coordinator), and those who complete OI tasks at the partner level (OI community). These three levels and roles collectively represent an Open innovation organization and, therefore, they are used to systematically document the limits of OI in this paper. As illustrated in Fig. 1, in an OI organization, the OI sponsor and OI coordinator collaboratively define how the OI organization should be deployed. 'OI engagement' refers to the OI community's involvement in a set of OI projects or initiatives defined by the OI sponsor and facilitated by the OI coordinator. The OI sponsor is responsible for evaluating the contributions of the OI community before adopting the contributions as possible solutions. The OI sponsor, OI coordinator, and OI community directly or indirectly govern OI activities (i.e., they co-govern). Although these roles are not mutually exclusive, each must face a unique set of challenges to succeed.

OI sponsors are mainly challenged by the limitations that require strategic resources or strategic decisions (e.g., decisions concerning cost, structure, policies). These limitations are thus related to the inception and structure of the OI, independent from the OI model inbound/outbound orientation (Filiou 2021; Tang et al., 2021; Ullrich and Vladova 2018). Limitations related to OI coordinators are mainly associated with managing the OI, from incentivizing the community and performing quality control to implementing time management and coordination (Natalicchio et al., 2017). While OI sponsors mainly deal with the factors corresponding with the overall architecture of OI, OI coordinators are limited by the factors related to the operationalization of the OI process and its core activities and supporting technology (Durst and Ståhle 2013; Greco et al., 2015). Lastly, limitations related to the OI community are related to problem-solvers and innovation partners—the innovation community in general—participating in the OI and completing innovation activities or tasks (Chesbrough and Brunswicker 2014; Seo and Park 2022). Examples of these limitations include the lack of knowledge or counterproductive behavior of community members (Han and Yang 2020). However, innovation sponsors have partial control over these limitations due to their exteriority (Germonprez et al., 2020). Strategic, procedural, and communal limitations can be observed across OI models although they may manifest in different forms and intensities depending on the OI model in use.

2.1. Open innovation models

To better understand the limits of OI organizations, we need to recognize the different forms that OI organizations can assume—referred to as OI models in this paper. The benefit of accounting for

the differences between OI models is twofold. While it is necessary to better understand the limitations reported in the literature, it also helps us to offer a more generalizable explanation of the OI limitations. Common OI models include open-source community (OSC), innovation marketplace (innovation contest), user innovation (customer innovation), crowdsourcing, and social product development (SPD). Although the majority of OI models fall under one of these models, we should acknowledge the possible existence of other models including hybrid models.

OSCs are dedicated to developing and sharing non-proprietary software or hardware solutions (e.g., Mozilla Developer Community) (Vujovic and Ulhøi 2008). Innovation marketplaces are platforms managed by the third-party (intermediary) innovation brokers that connect innovation sponsors (problem-owners) to a large community of potential problem-solvers mainly through the organizing of innovation contests (e.g., InnoCentive) (Hossain 2018). However, ideations in innovation marketplaces are not necessarily competitive. For example, the idea marketplace is an example of innovation marketplaces with a focus on the exchange of knowledge, scientific expertise, and patents rather than competition (Natalicchio et al., 2014). User innovation refers to the participation of customers or end-users in R&D processes—typically in the initial phases of product development or improvement (Elia et al., 2020). User innovation could be direct, like in the case of customer innovation platforms such as LEGO Ideas, or indirect, like in user experience communities such as Microsoft Experience Dynamics 365. Crowdsourcing models solicit creative contributions from the community to a series of micro-tasks on a corporate or third-party platform (e.g., uTest) (Karachiwalla and Pinkow 2021). However, not all crowdsourcing platforms are qualified as OI platforms as not all micro-tasks are related to innovation. For example, Amazon Mechanical Turk is not qualified as an innovation community although it can be used to crowdsource innovative solutions (Johnson and Ryan 2020). Similarly, crowdfunding platforms are not OI innovation platforms despite their undeniable role in financing innovation projects and attracting investors (Messeni Petruzzelli et al., 2019; Roma et al., 2017). Lastly, SPD models use social mechanisms to mobilize individual inventors in support of collaborative new product development (e.g., Edison Nation) (Abhari et al., 2022a). We recognize SPD as a more comprehensive model of OI because of its end-to-end innovation process, variety of OI activities, diversity of contributors, and advanced platform technology. Appendix A summarizes the similarities and differences between these models in terms of strategy, processes (ideation and collaboration), and community structure. Making note of the similarities and differences between the main OI models allows us to account for both universal and context-specific limitations in this study and therefore, offer more generalizable recommendations. Toward this goal, in the next three sections, we examine the limiting factors of OI at the three levels of strategy, process, and community as identified by prior studies published in top-tier journals within the last two years to ensure currency.

2.2. Limiting strategic factors

The OI limitations at the strategy level are mainly related to how an OI sponsor formulates and implements OI strategies. The OI literature recognizes limitations that stem from a lack of clear vision, resource constraints, improper structure, unsystematic implementation, and compliance challenges.

Lack of Clear Vision. OI often develops from a need to address R&D challenges, meet customer demands, or seize market opportunities (Albats et al., 2021). Hence, the formation of an OI system within an organization (or as a newly formed organization) is often organic and lacks a clear vision (Bertello et al., 2021). This can prove to be an issue hindering OI organizations from surviving, much less thriving (von Briel and Recker 2017; Gentile-Lüdecke et al., 2020). Prior research argues that OI may be stalled in the absence of a unified strategy and

well-defined vision (Bertello et al., 2021). Defining clear goals and developing a clear plan for value creation are essential steps toward selecting the right OI business model (Chaudhary et al., 2022). OI goals should be not only clearly defined but also openly communicated. Falling short in communicating the goals with innovation partners may limit the OI organization in mobilizing the innovation community and thereby achieving its goals (Obradović et al., 2021; Ovuakporie et al., 2021). Articulating the OI's goals is also crucial to evaluating the outcomes of the OI—ensuring that organizations remain on track to reach their vision (Haim Faridian and Neubaum 2021; Ovuakporie et al., 2021).

Resource Constraints. The second most prevalent limiting factor of OI is resource constraints (von Briel and Recker 2017). For example, a survey on OI limitations reveals that 70% of firms cite a lack of financial resources as the root of their struggle to effectively adopt OI practices (Torres de Oliveira et al., 2021). Whether the issue was due to poor resource allocation or a lack of resources available to use, this was a common limitation throughout the OI literature. For instance, poor resource allocation is the root of OSC struggles in both value creation and value capture (Haim Faridian and Neubaum 2021; Urbinati et al., 2020). Similarly, OI models such as SPD platforms may face challenges in allocating resources to balance the exploration and exploitation of opportunities that originate across their boundaries (Annosi et al., 2020). From a broad strategic viewpoint, resource allocation is an issue of finding the right balance between competing innovation priorities. For example, OI practices come with a prohibitive cost (Filiou 2021) associated with extending a firm's resources and processes to external innovation partners (Ovuakporie et al., 2021). However, this cost is relative to the context. The high cost of OI implementation in some fields such as scientific research and the pharmaceutical industry may prompt organizations to redefine their OI goals or consider a different approach to strategizing for the OI's operation (Beck et al., 2020).

Improper Structure. The dynamic and open nature of OI should not be confused with a lack of structure. OI, similar to any complex system, requires a proper structure to maintain its efficiency and productivity (Germonprez et al., 2020). Informed by the OI model and its goals, the structure defines the intra- and inter-organization relationships, delimits functions and responsibilities, and facilitates implementation and evaluation (Barbosa et al., 2021; Pikkarainen et al., 2020). Lack of such structure can further exacerbate the issues associated with a lack of vision and resource allocation (Germonprez et al., 2020) and negatively affect the formalization of internal innovation processes (Gentile-Lüdecke et al., 2020; Torres de Oliveira et al., 2021). Without a clearly defined OI structure, external innovation partners struggle with determining how to contribute meaningfully to the OI process (Germonprez et al., 2020). For example, some OSCs have been created without a solid hierarchical structure and with no clearly defined authority. The organic form of these communities can result in complexity in governing these communities (Haim Faridian and Neubaum 2021). Similarly, a lack of structure within an organically formed innovation marketplace encourages an abundance of contributions, not all of which can be recognized, much less invested in. As a result, the OI sponsor may face the loss of many opportunities without the infrastructure necessary to give potential solutions a chance (Ovuakporie et al., 2021). Another potential problem related to the lack of a well-defined structure is the assumption of responsibilities among the internal and external members, especially in the B2B context (Cenamor and Frishammar 2021). This limitation may lead to inefficient cooperation within the organization that sponsored the OI (Martínez-Torres 2014; Torres de Oliveira et al., 2020, 2021).

Unsystematic Implementation. Subsequent to the decision on OI structure comes strategizing implementation, when the OI sponsor may face additional limitations (Bertello et al., 2021; von Briel and Recker 2017). Four implementation challenges stemming from OI's inherent limitations have been highlighted by recent studies. Firstly, strategic risks may arise if the adoption of OI practices does not fit organizational

norms and established practices (Cavallo et al., 2021). The alignment of OI's key functions with the OI sponsor's strategic objectives is key to the successful implementation of an OI organization (Cavallo et al., 2021; Chesbrough 2019). Secondly, the firms shifting the allocation of their resources may face additional challenges ranging from maintaining their R&D performance to meeting market demand (Filiou 2021; Srisathan et al., 2020). These risks can be decreased with proper planning and coordination but exist nevertheless (Ovuakporie et al., 2021; Roldán Bravo et al., 2021; Tang et al., 2021). Thirdly, the scope of OI implementation would limit the success of OI (Bertello et al., 2021; Diener et al., 2020). Firms are affected by varying degrees of scope constraints that they can be too big to manage or too small to be effective (Beck et al., 2020; Filiou 2021). Lastly, we must consider the effects of changing an organization's existing workflow to incorporate OI practices on the internal innovation teams in terms of roles and responsibilities (Gimenez-Fernandez et al., 2021). For example, firms may experience a decline in innovation performance due to the lack of willingness among employees to implement the new processes or employees' inability to manage the higher complexity (Srisathan et al., 2020).

Compliance Challenges. By extending opportunities to those outside the organization, firms also open themselves up to potential legal or regulatory trouble. At a strategy level, this can be a barrier to implementing an effective OI model. For example, governmental and local regulations can often become roadblocks for innovative practices (von Briel and Recker 2017). While they exist to protect intellectual property (IP) rights and prevent abuse of business know-how, such requirements, in some contexts, may be so restrictive that OI practices simply cannot succeed (Holgersson and Granstrand 2021). For example, the receipt of government subsidies or grants may do more harm than good if they come with conditions that do not support OI (Bertello et al., 2021). Constricting and ineffective public policies can also discourage organizations from implementing OI at scale or delay the OI implementation process (Patrucco et al., 2021). For example, security and licensing requirements present significant challenges to OSCs' ability to generate revenue (Bertello et al., 2021; Patrucco et al., 2021). Firms facing limitations by such policies at the strategic level will not be able to plan and implement OI in a way that best fits their needs and objectives (Bertello et al., 2021; von Briel and Recker 2017; Gold 2021).

2.3. Limiting process factors

After implementation, an OI organization may be limited by the OI coordinator's ability to manage decentralized innovation processes that involve a diverse range of external stakeholders outside the organization's operational boundaries (Gassmann et al., 2010). Prior studies have identified and categorized several challenges that can be classified into seven groups: namely, inefficient engagement mechanisms, coordination constraints, quality assurance tradeoffs, time pressure, technology affordances, and security concerns.

Engagement Mechanisms. At the operational level, recruiting qualified and productive innovation partners is critical to the success of the OI process. Hence, a lack of knowledge or resources to establish effective engagement mechanisms may limit OI operation. Targeting the wrong population, providing unclear directions, failing to provide feedback, having arbitrary reward systems, and offering inadequate compensation are only a few examples of ineffective engagement mechanisms (e.g. von Briel and Recker 2017; Dekkers et al., 2019; Kohler and Nickel 2017; Leckel et al., 2020; Ullrich and Vladova 2018; Yuan and Gasco-Hernandez 2021). Research has also shown the importance of both pecuniary and non-pecuniary rewards in attracting and motivating external actors in OI communities such as innovation marketplaces and SPD platforms (Abhari et al., 2022b; Suhada et al., 2021). For example, providing learning and networking opportunities can enhance engagement and collaborative participation (Abhari et al., 2019). Moreover, the importance of the engagement mechanism is not

limited to the ideation phase (Barham et al., 2020). For instance, a lack of fair compensation can lead to additional challenges in the closing phase due to the lack of commitment among the external innovation partners (Bertello et al., 2021).

Coordination Constraints. OI is not, by any means, a way to simplify the innovation process. Organizations face coordination constraints when adopting OI because of the need to integrate new actors through new activities and technologies (Cavallo et al., 2021; Maruping and Yang 2020; Mu and Wang 2020). As more actors, activities, and technologies get involved, there are more interactions to synchronize and expectations to manage (Gentile-Lüdecke et al., 2020). For example, in OSCs, the collaborative process can present a challenge for a centralized coordinator when there are too many individual contributors involved (Germonprez et al., 2020). OI coordinators who are unable to navigate this level of complexity may struggle to lead OI efforts effectively (Gentile-Lüdecke et al., 2020). Beyond effective integration, the OI literature has also noted challenges concerning monitoring the external actors' participation and evaluating their contributions (Marullo et al., 2021). Without strong leadership and centralized control, OI coordinators may struggle to coordinate the OI's strategy and overall direction (Roberts et al., 2021). Moreover, coordination constraints limit OI sponsors' ability to scale OI horizontally (including more partners who contribute to the same innovation domain) or vertically (including more partners who contribute to new innovation project domains) (Maruping and Yang 2020).

Quality Assurance Tradeoffs. An abundance of information can both help and hurt the OI process. In general, a fair number of qualified participants can bring an excellent selection of knowledge for an innovative project. However, information overload, among other factors, may prevent OI sponsors and coordinators from recognizing, assimilating, or exploiting high-quality ideas (Gentile-Lüdecke et al., 2020; Ovuakporie et al., 2021). For example, a study on complementary products found that those products developed with OI platforms are subject to unpredictable quality (Cenamor and Frishammar 2021). Balancing quality tradeoffs is challenging due to the nature of many OI platforms (Ovuakporie et al., 2021). For example, in the presence of OI co-governance (Abhari et al., 2022a), the innovation community is less restricted by the standard operating procedures required by the innovation sponsors (Elia et al., 2020). As a result, maintaining quality becomes difficult for the innovation sponsors unless they put restrictions on participation—for example by pre-screening ideas and ideators (Kohler and Nickel 2017; Souza et al., 2009). OI models such as SPD use social validation mechanisms, instead (Abhari et al., 2022a). While these mechanisms may improve the quality of contributions, they may also increase uncertainty in the viability of OI outcomes—at least, compared with the screening mechanisms used in innovation marketplaces.

Time Pressure. Even with flawless coordination and evaluation mechanisms, time constraints can stall the OI process (Bertello et al., 2021). Hence, researchers have cited lack of time as a barrier to the success of OI (Bertello et al., 2021; Nguyen et al., 2021), especially when the main goal of OI is reducing time to market (Capurro et al., 2021). OI takes time to plan, implement, and create value. Therefore, there is no guarantee that the OI process will reduce the duration of a new product or service development or commercialization. Delays at any level of the innovation process can be introduced by a multitude of factors, including poor resource allocation, ineffective implementation, and a lack of strategy (Bertello et al., 2021). Lack of realistic time estimates for OI projects may also create false expectations among the stakeholders and lead to resource depletion and project failure (Beck et al., 2020). Above all, OI projects may completely fail to meet their goals within a defined timeframe and discourage the OI sponsor from pursuing OI in the future (von Briel and Recker 2017).

Technological Affordances. Digital technologies allow organizations to implement OI processes and facilitate collaboration between internal and external stakeholders (Liu et al., 2020; Sun et al., 2020; Wu

and Hu 2018). Therefore, the importance of employing the right technology has frequently been cited in OI research (Abhari et al., 2022b; Nguyen et al., 2021; Wu et al., 2021). OI organizations with limited IT-related capabilities may suffer from limited absorptive capacity, which, in turn, may jeopardize the OI's performance (Wu et al., 2021). For example, excessive collaboration may lead to the problem of information overload and thus become a challenge when filtering valuable information and making economic decisions (Ovuakporie et al., 2021). With the right technology, the process of absorbing and synthesizing such extensive knowledge from various sources may become challenging (Gentile-Lüdecke et al., 2020; Torres de Oliveira et al., 2021), thus requiring highly compatible knowledge management with the innovation management system within the organization (Bogers et al., 2017; Wu et al., 2021; Zobel 2017). Additionally, OI platform technology plays a significant role in engaging its members and keeping them motivated, informed, and organized (Barlatier et al., 2020). Ideation, collaboration, communication, and coordination are key platform affordances noted in the literature (Abhari et al., 2017, 2022b; Wu et al., 2021). Platforms that fall short in offering these affordances or in their automation and integration may fail not only to coordinate the OI activities efficiently but also sustain a vibrant innovation community.

Security Concerns. The risk of a firm's knowledge base being mishandled or abused only increases as more external actors become involved in the OI process (Bogers et al., 2017; Dahlander et al., 2021). An environment that does not allow for the safe, efficient transfer of information is not one in which innovation can prosper. The innovation process, especially when coupled and integrated with external knowledge sources, requires extensive security measures—both technical and operational—to protect new ideas from unauthorized exploitations. A lack of security measures may discourage stakeholders from sharing their data, particularly in outbound OI, due to security concerns for commercial or industrial exploitation (Beck et al., 2020). The security requirements demand not only more resources from the firm, such as a reliable knowledge management system but also seamless integration and careful coordination of these resources. However, the cost of these requirements is negligible compared with the financial strain that a security breach may have on the OI sponsors (Gentile-Lüdecke et al., 2020; Torres de Oliveira et al., 2021). Moreover, OI initiatives may also fail if they do not open their processes enough to the external partners (Alam et al., 2019). Hence, maintaining the right balance between openness and safeguarding sensitive information can be challenging for many OI coordinators (Obradović et al., 2021).

2.4. Limiting community factors

Engaging the innovation community in the OI process is key to successfully and continuously generating value through the various OI models (Abhari et al., 2022a; Germonprez et al., 2020). At this level, OI literature discusses the limiting factors such as the idea competition effect, knowledge barriers, and individual risks, as well as identification limitations and internal community readiness. These limiting factors hinder the OI sponsors and coordinators from successfully implementing OI organizations. Focusing on the struggles facing those most directly involved in the OI process allows us to pinpoint where the OI strategy and processes can better support their powerhouses, namely, their communities. However, we should note that, among all possible factors, we focus on controllable limitations which can be managed, at least partially, by the OI sponsor or OI coordinator.

Idea Competition Effect. In OI communities such as innovation marketplaces, idea competition is often necessary to select the most viable solutions (Obradović et al., 2021). Likewise, for many OI sponsors, exposure to many competing ideas provides a higher chance of securing the best possible idea. However, competition among community members, if not closely monitored and managed, can destabilize the community and negatively affect the members' willingness to ideate (Abhari et al., 2022b). A high volume of new ideas submitted to a

platform for a single project increases the perceived constraints in participants' minds during the process, especially in innovation marketplaces. The idea competition effect can negatively affect individual competitors' perceptions of the task or even discourage ideation, thus constraining their ability to ideate (Hofstetter et al., 2021). Using social mechanisms and technologies in OI models such as SPD also increases the negative effect of idea competition (Fischer et al., 2021). While collaboration among or co-ideation by community members may mitigate this effect, only a limited number of OI platforms, mainly OSC, can currently accommodate meaningful collaboration.

Knowledge Barriers. Access to qualified external contributors is among the most common barriers to a successful OI project (Torres de Oliveira et al., 2021). In highly specialized sectors such as manufacturing (Lai-Yin Cheah et al., 2021), OI processes can be limited by the lack of external actors with adequate industry knowledge (Chaudhary et al., 2022). In the high-tech industry, implementing reliable procedures to recruit qualified individuals and evaluate their skills—to maintain the quality of contributions—poses significant operational challenges (Bertello et al., 2021). Knowledge barrier is the main underlying reason preventing OI sponsors and coordinators from establishing and sustaining a productive OI community (Bertello et al., 2021; Obradović et al., 2021). In addition to technical knowledge, many OI projects require a deep understanding of both industry and project context to advance (Obradović et al., 2021). Due to the need for such a deep understanding, OI coordinators face additional barriers when resorting to external sources for value co-creation and value capture (Bertello et al., 2021; Bogers et al., 2021). As a result, OI may fail to satisfy the OI sponsor's requirements, even during the ideation phase, thereby discouraging them from further investment in OI.

Risk Factors. OI processes are often associated with uncertainty because of the high level of risk involved not only for OI sponsors but also for OI community members (Abhari et al., 2018). OI risk is a multifaceted issue. We can assume OI sponsors understand and accept the risk of OI as part of their innovation strategy (Temel and Vanhaverbeke 2020). However, this does not mean that community members share the same goals for the venture or are able to incur the same level of risk. For example, due to IP rights concerns, the OI community members sometimes hesitate to share their contributions openly with other internal or external collaborators (Elia et al., 2020). Likewise, privacy concerns, even when not relevant or valid, may limit community participation. OI sponsors that do not have a strong knowledge management system in place may run into issues with the handling of community data, which could pose a risk for individual contributors. This, in turn, limits openness and collaboration (Beck et al., 2020). Individual risk factors, however, are not limited to IP rights or privacy but may also include financial, temporal, and even social (reputation-related) risks (Abhari et al., 2018; Chaudhary et al., 2022). For example, community members may have concerns about the time they need to invest in learning about the process or project even before participation. Similarly, community members may hesitate to openly contribute when there is a risk of losing their reputation in the community because of failure.

Identification Limitations. The abundance of individual innovators participating in an OI community may limit the OI coordinator's ability to keep track of each participant's contributions and responsibilities, thus losing control over some parts of the OI operation (Daniel et al., 2020). Anonymous contributions are often seen in online open communities such as Wikipedia. OI communities, such as OSC, are not an exception (Germonprez et al., 2020). These communities engage both identified (IPCs) and anonymous peripheral contributions (APCs) (Daniel et al., 2020). While the sponsoring organization can track IPCs, it cannot trace back to the actor of an APC for a specific project. This would be an issue when the OI coordinator needs to solicit further input from the APC in advancing the project beyond the ideation phase. Studies have shown that it is ideal for a sponsoring organization to maintain a uniform anonymity level and a good ratio between APCs and

Table 1
List of OI limitations identified.

CATEGORIES	LIMITATION	DEFINITION
Strategy	Lack of Clear Vision	Limitations in defining and communicating OI goals and objectives with internal/external stakeholders.
	Resource Constraints	Limitations in securing, allocating, and sustaining resources needed for OI operation and maintenance.
	Improper Structure	Limitations in designing viable OI structure with a clear definition of roles and responsibilities.
	Unsystematic Implementation	Limitations in establishing OI processes in support of both value creation and value capture.
	Compliance Challenges	Limitations stemmed from internal and external rules and regulations such as IP rights and public policy.
Process	Engagement Mechanisms	Limitations in miniating external actors' participation through pecuniary and non-pecuniary reward systems.
	Coordination Constraints	Limitations in coordaining OI activities and interactions between internal and external actors.
	Quality Assurance Tradeoffs	Limitations in evaluating the quality of community's contributions or controlling the outcome of ideation.
	Time Pressure	Limitations in OI project time management due to lack of enough time or inaccurate time estimate.
	Technological Affordances	Limitations in technological capabilities for managing the OI process and mobilizing the OI community.
	Security Concerns	Limitation in maintaining a safe and secure inbound and outbound knowledge flow and knowledge management.
Community	Idea Competition Effect	Limitation in keeping individual actors motivated and engaged in highly competitive OI communities.
	Knowledge Barriers	Limitations in recruiting qualified individual actors with adequate industry knowledge and required skills.
	Individual Risk Factors	Limitation in mitigating risks perceived by external actors from IP rights and privacy to financial and time risks.
	Identification Limitations	Limitations in monitoring, tracking, and integrating OI community members' anonymous contributions.
	Internal Community (Employee) Readiness	Limitations in internal community members' willingness, trust, or knowledge to participate in the OI process.

IPCs (Daniel et al., 2020).

Internal Community Readiness. OI can only thrive in environments that are well-supported by both internal and external OI community members (Bogers et al., 2018; Natalicchio et al., 2018; Suhada et al., 2021; Zhang et al., 2021). Without a highly engaged community and management support, OI performance may suffer at both strategic and operational levels (Barham et al., 2020). Those who contribute to OI are largely motivated by other community members and affected by the will (Verreynne et al., 2020). If the OIstructure does not support internal community participation and encourage knowledge sharing, OI cannot progress (Zynga et al., 2018). As much as it is necessary for external OI community partners, the willingness to participate in the OI process and contribute to OI activities is the key to effectively managing the timing and quality of OI projects (Bertello et al., 2021; Chaudhary et al., 2022). While the OIsponsors' and coordinators' ability to train their employees in OI can help (Natalicchio et al., 2018), the success of OI initiatives is dependent upon their active engagement with and trust in the OI process (Obradović et al., 2021; Torres de Oliveira et al., 2021).

2.5. Summary of literature review

Table 1 summarizes the limiting factors identified in the literature in three groups: strategy, process, and community. Strategic limitation refers to the limitations OI sponsors face in designing and implementing OI organizations. These limitations are mainly associated with why OI is needed in the first place, how the OI system should be structured, and what resources are available to implement such a system. Strategic limitations can affect the success of OI at any stage and thereby prevent the OI sponsor from realizing the full potential of OI. The second group of limitations are process-related and focus on the limitations that affect the processes and technologies enabling OI operation such as coordination, quality control, and engagement mechanisms. These limitations are concerned with how an OI system should be operated and why. The literature suggests that even well-thought-out OI implementation may simply fail due to improper operation. Lastly, the OI community may limit the success of any OI initiative. These factors range from recruiting qualified community members to managing their relationships. Therefore, these limitations are mainly associated with who should be engaged in the OI process and how.

3. Case review

As presented in the following discussion, we examined the manifestation of OI limitations discussed in the literature through a case review. The main goal of the case review is to complement our theoretical understanding and verify the impact of the observed limitations on an OI organization's viability, survivability, scalability, and profitability. We studied a case of OI platform failure and rebirth, how these limitations did or did not contribute to this platform's challenges, and how the platform reinvented itself despite the limitations. We conducted the case review in the context of SPD, an increasingly popular model of OI with both theoretical and practical significance (Abhari et al., 2022b; Annosi et al., 2020). SPD platforms engage community members in a broad range of innovation activities from early ideation to product development and commercialization (Forbes et al., 2019; Han and Yang 2020). The SPD process starts when individual community members submit their original product ideas. The ideation process continues as the members participate in initial idea screening and selection. Commenting and social voting are common activities during this phase. The OI sponsor selects promising ideas for further development after they are internally reviewed in consultation with the innovation partners. Selected ideas may go through the collaborative development phase in which the members can contribute to product design and development (e.g., feature selection). This phase may also include prototyping and user testing as well as consultation with experts in different areas such as intellectual property, consumer product safety, and market research. Innovation sponsors may also share successful prototypes with innovation partners such as retailers and manufacturers before commercialization. Community members may participate in product commercialization, as well. Finally, a fully developed product is manufactured and launched through indirect sales by the innovation partner or direct sales by the innovation sponsor. Revenues are distributed according to the platform's business rules, with the members who generated the idea receiving the largest community share and those who helped refine the product receiving lesser percentages.

Drawing on a broad range of actors with diverse goals and behaviors, SPD establishes a robust OI community in which actors not only compete in creative ideation but also connect and collaborate. Understanding this diversity is critical to a holistic portrayal of OI organizations (Coelho et al., 2016; Forbes et al., 2019). Additionally, SPD offers a rich context for the study of OI limitations for three reasons. Firstly, SPD platforms support end-to-end innovation processes; therefore, they can represent different OI scenarios supported by other OI models such as the sponsorship of innovation contests and the establishment of collaborative user innovation communities. Secondly, SPD platforms are established

to support the end-to-end OI cycle (from idea to market) and afford a broad range of innovation activities from early ideation to product development and commercialization (Forbes et al., 2019; Han and Yang 2020). Thirdly, SPD draws on a broad range of members with diverse goals, backgrounds, and behaviors and portrays a holistic picture of OI participation (Abhari et al., 2022b; Coelho et al., 2016; Forbes et al., 2019). On SPD platforms, inventors, investors, business professionals, freelancers, hobbyists, and students come together without any re-strictions and with different motivations to innovate (Abhari et al., 2022a). The diversity and autonomy of SPD members can represent different OI communities that attract only a specific group of partici-pants. Lastly, the inclusivity of SPD in terms of OI processes and activ-ities requires advanced digital technologies. Thus, SPD platforms represent a diverse range of features and affordances that are difficult to find on only one single OI platform. Altogether, we argue that, among different OI models, SPD represents the best context to study different OI activities, diverse OI contributors and technologies, and OI organiza-tions in their entirety.

3.1. Case selection

We selected the case of Quirky, an OI platform for consumer product development. The company was founded in 2009 in New York. Quirky's mission was to democratize new product development by making it accessible for all community members. Quirky allowed its community members to submit new consumer product ideas. If an idea was selected, it could go through different stages of new product development. This process encompassed a full cycle of OI that started with ideation and validation, continued with development and commercialization, and ended with distribution and monetization. Lead ideators and members ('influencers') received royalties (percentages of revenue) according to their level of contribution to the products launched in the market. The distribution of the royalties depended on how many members contrib-uted to the ideation phase and participated in the development activ-ities. By 2021, 1.3 million members had joined and contributed to the development of 321,000 product ideas on the Quirky platform. Quirky also worked with external business partners to develop, manufacture, and distribute new products from the ideas generated on the platform. The 170 products launched by Quirky ranged from toys and gadgets to appliances and connected devices.

Quirky's OI model showed promise early on, and, to our knowledge, it was able to raise over $170 million between 2009 and 2013 from investors. Despite the early success, the company filed for Chapter 11 bankruptcy in 2015. After a change in ownership and some operational adjustments, the Quirky platform was relaunched in 2017. The chal-lenges Quirky faced and the changes Quirky made are what makes this case a particularly good example to discuss OI limitations. The plat-form's downfall can offer valuable insights into what limits OIs' success at the strategy, process, and community levels. Although Quirky was relaunched with the same mission, there remains much to be discussed about the platform's initial failure and challenges (Hintz, 2019).

3.2. Case analysis

To gather a wide range of data to support this case review, we first evaluated Quirky's available materials (e.g., user guides, FAQs, forums) and other published works discussing Quirky between 2009 and 2021 (e.g., case studies, news, blog posts). Doing so allowed us to gain a better understanding of Quirky's position in the OI domain and the factors that contributed to its successes and failures. We also reviewed the Quirky platform design and OI processes and compared its structure in 2021 with its prior versions in 2010, 2013, and 2015. Comparing and con-trasting the platform features and functionalities gives us more insight into the Quirky process model and its evolution over time.

The information sets collected from different sources were initially summarized and openly coded and then they were categorized (Mills and Birks 2017). After the initial coding, we categorized our codes into three categories (strategy, process, and community) and 13 sub-categories in accordance with the results of our literature review. This allowed us to properly structure our data for further analysis. Then, we used the explanation building technique to describe the success and failure of Quirky at different points of time, related to each category (Yin 2018). For each category, we identified a series of events (patterns) that contributed to the rise, failure, and relaunch of Quirky. Then, we compared these results with the factors reported by previous studies to determine whether they matched and (if necessary) suggest new ex-planations or additional insights (Benbasat et al., 1987; Yin 2018). The final categories and subcategories were synthesized into a theoretical framework, a list of OI success factors, and a set of propositions.

3.3. Case results

We were able to connect the key causes of Quirky's failure to various categories of OI limitations that were identified by prior research. The case of Quirky allowed us to further clarify these limitations and describe how they led to the downfall of this once-popular OI platform. It also explained when and why OI organizations such as Quirky may fail to sustain their success, yield profit, and grow at scale.

3.3.1. Strategy limitations

We were able to classify the strategic limitations of the Quirky model in five groups: (a) lack of focus that led to an identity crisis, (b) ambi-tious strategic positioning that led to heavy dependency on external actors for manufacturing and distribution, (c) lack of resources and structure to maintain growth and profitability, (d) chaotic imple-mentation of new initiatives and frequent experimentation with its end-to-end OI process at scale, and (e) a lack of alternative options to protect and manage IP rights.

From Lack of Focus to Dual Identity. Quirky seems like the 'per-fect' OI platform (Piller, 2010) due to its end-to-end OI process, advanced OI platform technology, large community of contributors, and openness to a diversity of new ideas. However, shortly after its launch, Quirky spread itself among too many ventures beyond its core compe-tencies and attempted to establish itself as a leading consumer product. While Quirky's vision remained the same over time, its leaders failed to maintain a clear mission due to its dual identity—as an OI platform and a consumer product brand. Quirky's limited resources, as a result, were dispersed across different ventures rather than being invested in its core potentials. This lack of focus also required Quirky to experiment with too many product categories without developing expertise in any cate-gory. Commercializing a diverse portfolio of consumer products under its own brand also became challenging due to high development costs, demand uncertainty, and manufacturing capacity.

Dependency on Manufacturers and Distributors. While Quirky was successful in establishing itself as a successful OI brand through several marketing campaigns, it was unsuccessful in positioning itself as a consumer product company. The Quirky brand was diluted throughout its many product endeavors ranging across a wide variety of categories. Therefore, it heavily relied on third-party manufacturers and distributor partners such as Amazon, Bed Bath & Beyond, and Target. This de-pendency reduced Quirky's bargaining power, negatively affected its margin, and ultimately led to financial distress and bankruptcy. SPD platforms that launched around the same time with the same vision differentiated themselves mainly as ideation or crowdfunding platforms without directly participating in development, manufacturing, or sales. This approach allowed them to focus on their core competencies while building profitable relationships with external OI sponsors that had immediate access to reliable supply chains and distribution infrastruc-ture. This approach turned out to be more sustainable, although it may not be as lucrative as Quirky's strategy in the short term.

Grow to Resource and Resource to Grow. The Quirky community doubled in size every year for the first five years after its launch.

Enjoying its rapid growth, Quirky was challenged to resource its newly launched initiatives. This was partly due to the absence of a sustainable revenue stream. Quirky did not charge members for submitting ideas, except for a very brief period in the beginning. This factor, plus its successful products such as PivotPower®, contributed to its exponential growth in the early years. Such products were part of what made Quirky so exciting to inventors and investors alike—at first. As the community grew, the number of ideas submitted and selected for development increased dramatically. As a result, the company had to invest its limited resources in the product development stage without realizing its investments. Without having enough products in the market, and facing a low profit margin due to high manufacturing costs, Quirky failed to secure additional investments, partnerships, or other necessary resources to speed up the development phase. Another reason behind Quirky's resource constraints was low customer demand due to the low quality of its products. The lack of a sustainable revenue stream and resourcing challenges led to a significant delay in launching new products and generating revenue and, in turn, an unsatisfactory waiting experience for the members with the selected idea (who faced delays in getting paid and recognized). This hindered Quirky's growth and damaged its reputation.

Chaotic Implementation and Excessive Experimentation. Quirky excessively experimented with different implementation scenarios to overcome resource constraints, coordinate its dispersed activities, and maintain its organic growth. As a result, Quirky restructured itself, redesigned its technology platform, reformulate its royalty calculation, and redefined its relationships with its business partners a couple of times before filing for bankruptcy. However, none of these changes saved Quirky from itself due to poor implementation. For example, Quirky attempted to expand its business domain through a partnership with GE and by establishing a subsidiary, Wink, for connected products. At the time, despite access to GE's IPs, the extension of company resources to this new venture did not account for the costs associated with the royalties of this new product category. Besides, partnering with external companies necessitated additional structural changes and operational adjustments with cost, time, and performance implications that Quirky could not afford. Moreover, Quirky aimed to encourage community engagement by providing royalties to those who had contributed to the ideation and development of products that were successfully launched, but Quirky lacked the structure necessary to regulate such a process at scale. Therefore, the company had to redefine the selection process, collaboration options, and revenue distribution several times without finding an optimized solution.

IP Rights and IP Protection. Due to its end-to-end OI model, Quirky went beyond competitive ideation and offered various options for community members to participate in new product development. The new layer of complexity created various challenges for managing IP rights and copyrights. For example, the platform did not prevent members from copying and redistributing ideas submitted to the platform. Quirky only protected the IPs that had already been transferred to Quirky after the idea selection phase. There was also no mechanism to protect fully developed ideas from being copied by competitors in other countries. As a result, members expressed several privacy and copyright concerns regarding their ideas' unauthorized reuse. Concerns regarding IP rights did not discourage Quirky's members from collaboration; however, it negatively affected the quality of ideas submitted. Although Quirky addressed this issue later by allowing members to submit new ideas as 'private' (hidden from other members), the platform could not fully restore its members' trust regarding IP protection.

3.3.2. Process limitations

Quirky faced several challenges in operating its models. Focused on the OI process, we identified five groups of limiting factors that challenged Quirky: (a) indecisive OI governance and financial management, (b) compromising on quality for fame, (c) lack of diverse engagement mechanisms, (d) ineffective vetting process, and (e) frequent changes to the digital platform.

Governance and Financial Management. Poor coordination and resource mismanagement played roles in jeopardizing Quirky's initial success. As a result, in many cases, the cost of developing ideas submitted to Quirky failed to justify the benefits. For example, failure to conduct market research to determine a need for products and inform resource allocation was the main reason behind many products' failures. Also, in the absence of a Chief Financial Officer and without a system of checks and balances in place, there was no formula to limit the amount of money being put into each selected product. As a result, the company had spent its critical resources on developing the products that never made it to store shelves. Putting resources into products that were exciting but not useful or in demand left little for those that could potentially have a high rate of return. Financial challenges were also intensified by Quirky's direct involvement in production. The resources necessary to launch successful products were hard to secure and manage due to Quirky's limited manufacturing experience and access to qualified suppliers. Potential investors that could have saved Quirky were not attracted to this unsustainable process model and were unwilling to provide additional capital.

Compromising on Quality for Fame. Quirky's business model intended to generate revenue not from ideation but from production. That means that Quirky's success solely depended on its product success, not on its community size or diversity of promising product ideas. Unfortunately, out of 150+ products that reached production, Quirky only introduced a handful of successful products. While Quirky was using these success stories as enticements to attract more members and encourage quality contributions, it compromised on the quality of their products. The low quality of some products due to the expedited development process disappointed Quirky's customers. More complex products were inundated with negative feedback, reflecting poorly on Quirky as a brand. Quirky thus failed to gain enough traction in the market for certain products. Failed products brought a large financial burden on Quirky to the extent that the company could not invest in several promising products. Those that had to be recalled for simply 'not working as advertised' put a financial strain on the company, since Quirky had to handle customer requests while simultaneously removing products from store shelves. This expensive and time-consuming process was one that Quirky could not afford. Not only did recalls strain Quirky's budget, but they also damaged the company's reputation, and the company lost its appeal to potential investors. While the community members experienced the negative effect of resource constraints first-hand, the ripple effect on Quirky's bottom line was even more profound.

Lack of Diverse Engagement Mechanisms. As Quirky began to run into financial trouble, royalties for inventors had to be decreased significantly, as well. These cuts were necessary to keep Quirky alive but were a drawback for potential new ideators. Many committed inventors who joined Quirky to launch their products in partnership with Quirky either left the community or limited their activities to networking and brainstorming with other members. To address this challenge and maintain the engagement level, Quirky tried to redesign its engagement mechanisms with an emphasis on the educational and social aspects of its processes (e.g., social validation, networking, social sales) and even with gamification (e.g., a pricing game). While the new mechanism helped members to achieve goals such as learning, helping others, and socializing, they did not significantly contribute to Quirky's community vitality or its profitability beyond the initial excitement. Beyond community, Quirky was relatively successful in engaging media and community experts, mainly as part of its marketing efforts. Nevertheless, it failed to engage business partners in meaningful ways after a relatively unsuccessful attempt with GE over Wink products. Later, Quirky expanded its network of partners beyond its distribution network. However, these partnerships came late and did not save the company from bankruptcy.

Ineffective Vetting Process. Despite Quirky's commitment to transparency, the process complexity inevitably did not allow the

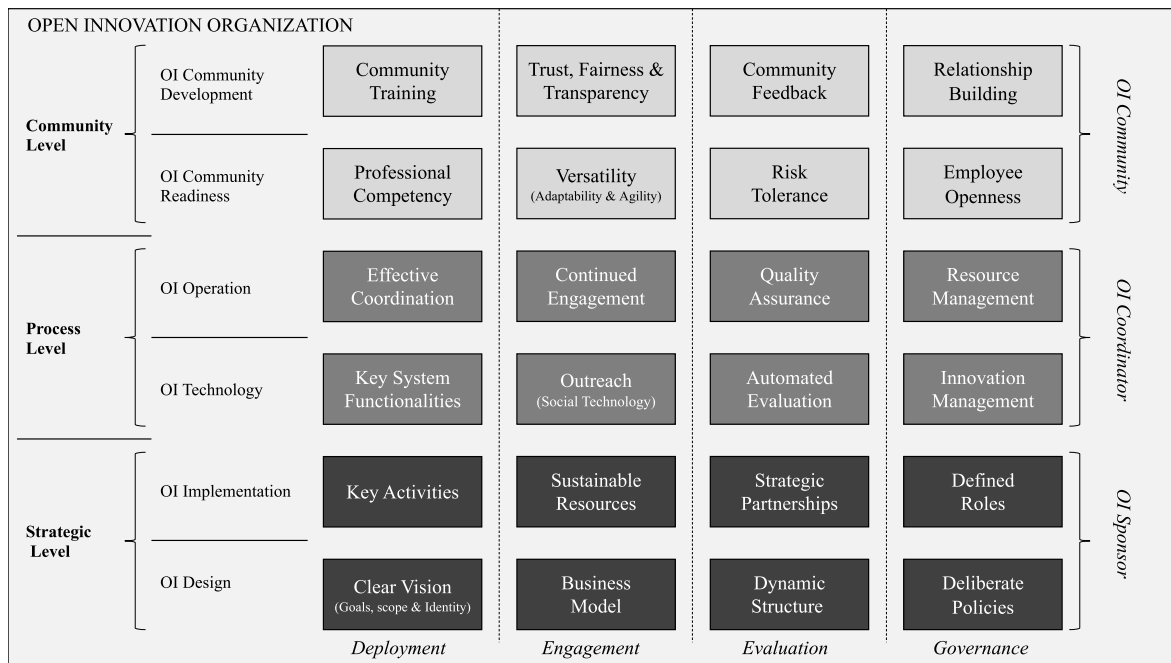| OPEN INNOVATION ORGANIZATION						
Community Level	OI Community Development	Community Training	Trust, Fairness & Transparency	Community Feedback	Relationship Building	*OI Community*
	OI Community Readiness	Professional Competency	Versatility (Adaptability & Agility)	Risk Tolerance	Employee Openness	
Process Level	OI Operation	Effective Coordination	Continued Engagement	Quality Assurance	Resource Management	*OI Coordinator*
	OI Technology	Key System Functionalities	Outreach (Social Technology)	Automated Evaluation	Innovation Management	
Strategic Level	OI Implementation	Key Activities	Sustainable Resources	Strategic Partnerships	Defined Roles	*OI Sponsor*
	OI Design	Clear Vision (Goals, scope & Identity)	Business Model	Dynamic Structure	Deliberate Policies	
		Deployment	*Engagement*	*Evaluation*	*Governance*	

Fig. 2. Critical success factors of open innovation.

company to maintain fairness. The platform used a social validation mechanism through which the members could vote on the ideas they liked. This model was not an effective substitute for market research, and it allowed products that were popular to pass through the community screening even if there was a nonexistent need for such an idea. There were no concrete selection criteria, and, therefore, some ideas were initially supported by the community regardless of feasibility and marketability. Besides, Quirky's attempt to encourage members to report on similar existing products was helpful but not sufficient. Consequently, the ideas selected by the community for development were not necessarily the best. In this situation, some well-developed ideas supported by strong research and prototyping may not be discovered while other ideas with more votes will move forward. While this process was not problematic per se, it put an extra burden on the Quirky team to filter ideas, plan additional community evaluations, and implement supplementary assessments. Due to the lack of resources, it became difficult for Quirky to thoroughly evaluate community contributions. As a result, unfortunately, only a few good ideas succeeded out of the many that were submitted.

Frequent Changes of the Digital Platform. Quirky's platform was one of the most elaborate OI environments with a collection of functionalities affording ideation, collaboration, and networking possibilities. Quirky frequently redesigned its platform to accommodate its new processes (e.g., changed member profile, more complex ideation form, removal of live brainstorming). The company also launched a mobile app to mirror its website. However, frequent changes in the platform and the expensive-to-maintain mobile app were not appreciated by the community. These changes did not help maintain the members' engagement due to their emphasis on completing tasks rather than meaningful participation. Additionally, Quirky's platform features lacked a strong set of direct collaboration tools or tracking tools that were necessary for complex project categories such as electronics. These shortcomings could be attributed to Quirky's prioritization of ideation over collaboration. More importantly, while the platform focused on adding new features to the platform, community members insisted on simplification (removing features) or the inclusion of simple features such as filtering and sorting to streamline the process.

3.3.3. Community limitations

The analysis of Quirky's community features helped us to recognize four groups of limiting factors: (a) incentives' impracticality and avaricious members, (b) implicit emphasis on competition over collaboration, (c) lack of trust and hope, and (d) information overload.

Incentives' Impracticality and Avaricious Members. Quirky was initially successful in building a community of inventors who not only freely ideated but also eagerly participated in improving other members' ideas. For example, 1,005 members contributed to the development of the PivotPower® product family. Quirky was simply established on the promise of sharing revenue—all contributors to a successful product ('influencers') expected a cut from the revenue. As the community grew, the number of influencers grew. As a result, only the lead ideators who submitted the product concept enjoyed the significant monetary compensation. An abundance of ideas within the platform also meant that only a few ideators could be selected for development and even fewer were eligible for the cash prize. Therefore, the royalty-based reward system became impractical to maintain members' active engagement. Quirky's emphasis on monetary reward—for example, as part of promotion activities—did not allow the members to enjoy the non-monetary benefits of the community such as learning from and networking with like-minded people. Extrinsically motivated members not only stopped contributing to the community but also discouraged the rest of the community from taking the process seriously. Unfortunately, these members had been the pillars of the community and were typically experienced and skillful members; before facing financial disappointment, they had been highly committed to quality and were spending significant time on the platform. The quality of the community contributions significantly suffered in their absence.

Implicit Emphasis on Competition over Collaboration. To manage a large community of ideators, Quirky prioritized competitive ideation or collaboration. The members thus invested their time and effort in the search for the next best product idea with limited attention to collaboration opportunities including the evaluation of ideas proposed by other members. This made Quirky sacrifice the quality of new ideas for the number of new ideas. When Quirky later introduced collaborative ideation, it was too late to change the community culture and promote direct collaboration between the members. Collective tasks such as surveys for CFM (Color, Finish, and Material) and Pricing Game

also did not change the level of collaboration since they were not collaborative in nature. Events with a collaborative essence such as Live Evaluation and Live Brainstorming were also stopped as the community grew.

Lack of Trust and Hope. The level of complexity in the process as well as the introduction of a new formula for royalty calculation reduced confidence in Quirky's operation and inevitably hurt community members' trust in other members. While many members were initially motivated by altruistic goals (e.g., a desire to solve a pressing consumer problem or share the experience with younger inventors), the lack of trust simply set them back. As a result, active participation declined, and members demanded more transparency in idea selection and development as well as revenue calculation and distribution. All the excitement among the community members as well as Quirky employees also faded away as the product development and production backlogs grew. The members started questioning the legitimacy of the platform, or, at least, the company's future.

Information Overload. Information overload not only challenged Quirky in processing new ideas but also negatively affected the Quirky community due to the idea competition effect. Quirky members who joined to submit an idea of their own were also able to browse the ideas of others. While this could be helpful, for example, as an initial screening mechanism to avoid redundancy, the abundance of information discouraged many members from participation by strengthening the idea competition effect. Allowing members to see the ideas that had already been submitted could be a way of validating one's own idea, yet, at the same time, it could discourage some members from going beyond what had already been suggested. Additionally, the ratio of ideas selected (for development or commercialization) to new ideas submitted also implied a low success rate and thereby discouraged many members from meaningful participation. Quirky attempted to minimize the effect of idea competition and self-rejection by compartmentalizing the process and allowing members to focus on a specific group of activities such as review, development, or production. However, the Quirky community, after its relaunch in 2017, was not vibrant enough to fully embrace these changes.

4. Discussion

Opening up the innovation process to external knowledge exploration and exploitation remains a challenging task for many organizations (Chaudhary et al., 2022; Haim Faridian and Neubaum 2021; Naqshbandi et al., 2019; Saura et al., 2022). This study synthesized the limitations of OI highlighted in recent studies and further explained their effects through a case review. Our case review also offered new insight into the relationships between these limiting factors. By classifying the identified limiting factors at the strategy, process, and community levels, we developed a framework rendering the key OI success factors and their hierarchical relationships (Fig. 2). The case study allowed us to recognize two groups of strategic decisions that could make or break OI initiatives and their design and implementation decisions. At the process level, OI success depends on both operational and technological decisions. At the community level, community readiness and community development are two critical dimensions of OI success.

Our study revealed the importance of having a clear vision for OI initiatives. Otherwise, OI may face an identity crisis and fail to position itself in today's crowded OI market. Organizations implementing OI also face potential brand dilution if a clear vision is not in place. Uncertainty about why OI is needed may lead to aimless experimentation—for example, with different product categories or ideation procedures—without notable outcomes. Moreover, OI goals should inform the OI business model and its structural configurations, and not the other way around. For example, an OI marketplace established to reduce the cost of R&D requires different mechanisms and partners compared to a customer innovation community aimed at building a brand community. The OI business model also defines the role and responsibilities of OI

sponsors, coordinators, and community, and thereby it requires a specific structure to optimally function.

An OI organization is innovative in itself and therefore should not be solely structured after existing best practices. Since there are significant differences between organizational needs and contexts, an OI organization needs additional structural configuration before being ready for implementation. Poor design, if not recognized early in the process, can lead to an OI model that lacks potency, adaptability, dynamism, and agility. Further, a lack of dynamic structure may lead to ineffective implementation, which the present research identified as the root cause of many cases of OI failure. OI organizations also need strategic partners to survive and thrive in the market. Upstream partnerships could help OI organizations with OI sponsorship, coordination, and evaluation, whereas downstream partnerships could help with commercialization activities such as marketing, production, and distribution. The nature of these partnerships—their commitment level, roles, and expectations—can determine which OI business model is needed and how it should be implemented.

Even with a robust design, resource constraints may prevent the successful implementation of OI. The important concern about OI resources is the recognition of differences between OI business models in terms of how they create and capture value. For example, an OSC may fail because of an incapable central integrator, while an SPD may fail in SMEs because of limited manufacturing partners. Therefore, OI model selection (and the identification of the appropriate scope and scale) can help identify the resources needed to implement an OI system. The amount of resources necessary to attract and engage external talents should not be overlooked by OI organizations. In the same vein, planning for a sustainable revenue stream, especially beginning in the ideation process, may also help secure some resources to operate OI successfully.

Even if an organization eventually overcomes resource limitations, OI may still fail in the absence of coherent policies concerning OI partners' rights (e.g., privacy compliance, fair and equitable enforcement of IP rights). Well-thought-out policies help OI sponsors to plan for roles and rules that not only protect the OI organization but also maximize OI value for all parties involved. Without a set of clear expectations from OI organizations, it is also difficult to determine the OI implementation priorities and thus plan for key activities and required resources. That is why many OI marketplaces narrowed their business scope after a few years of unsuccessful experimentation. Similarly, OI key activities, ideation, collaboration, and networking cannot be properly implemented in the absence of well-defined but sufficiently flexible roles and responsibilities. Both excessive freedom and unnecessary restrictions can limit OI implementation by causing information overload and discouraging ideation, respectively.

Accordingly, we recognize two groups of strategic decisions contributing to OI success. The first group of decisions is related to the OI organization's design. These decisions are mainly informed by *why* OI is needed in the first place. The second group of decisions represents *how* the OI organization should be implemented. These decisions are mainly informed by the OI design-related questions. Therefore, we proposed:

> **P₁** The success of an OI organization at the strategic level depends on OI design and implementation.
> **P₁ₐ** The success of OI design depends on a clear vision (goals, scope, and identity), the right business model, a dynamic structure, and deliberate policies.
> **P₁ᵦ** The success of OI implementation depends on OI design as well as well-planned key activities, sustainable resources, strategic partnerships, and well-defined roles.

Even with a solid foundation, OI models may fail at the process level. Process limitations should be managed with technological capabilities as well as operational competencies. OI organizations are reliant on digital platforms with certain affordances to enable or facilitate secure

knowledge flow and management. These platforms should be optimized for the OI activities on hand—for example, features should be carefully selected to enable community members to complete OI tasks with a sense of control but without overwhelming them. While advanced technology is necessary, it is not sufficient, since many OI organizations have failed even with sophisticated digital platforms. Their failure stems from their operational limitations in coordinating the community's efforts, engaging and motivating external ideators, and tracking and evaluating their contributions in a timely manner. These factors are independent of the OI model in use. For example, an OSC may fail due to limitations in coordinating distributed teams, while a crowdsourcing model may fail due to inefficiency in coordinating micro-task assignments.

The crux of OI operation is the effective coordination of internal and external innovation activities and their integrations. Part of this coordination is the management of operant and operand innovation resources. Finding the right balance between ideation, collaboration, and networking among the community members is also vital to orchestrating an OI community. Moreover, OI organizations require outreach mechanisms to attract external actors to join the community and learn about OI opportunities. Reward systems with an emphasis on extrinsic motivation cannot guarantee that the organization will attract qualified ideators, much less sustainable ideation, mainly because of the comparable alternative platforms. Evidence suggests OI community engagement at scale is only possible through well-designed and well-implemented social technology that helps community building and facilitates socio-professional engagement. When well-implemented, OI platforms can also help reach and target a specific group of members and engage them in specific activities in order to improve OI outcomes. This could be as simple as forums supporting OSCs or as sophisticated as private social networks enabling SPD platforms.

Our study also confirmed that the quality of OI outcomes matters, not only to the OI organization's survivability but also to the OI community's productivity. Neither ideators nor OI partners want to invest their resources in OI organizations that cannot produce superior outcomes compared with traditional innovation. Prior research has linked poor-quality OI outcomes to information overload. Too many new ideas existing on any platform may prevent the community members from submitting other, potentially better, ideas. Information overload during ideation also limits the OI sponsors in evaluating and selecting the most promising ideas. The OI platform can facilitate pre-screening and automate the evaluation of ideas to minimize challenges related to information overload. OI organizations that fail to automate the evaluation process risk the quality of OI outcomes, for example, by missing promising ideas. Lastly, the innovation process is a time-sensitive and resource-intensive process; therefore, implementing OI initiatives without proper management would not be more than costly R&D 'experimentations'. OI organizations thus need the tools and also the underlying processes that will allow them to track and monitor community activities and contributions in a timely manner. Otherwise, the complexity and multidimensionality of OI processes may overwhelm OI coordinators operationally and swamp OI sponsors informationally.

Accounting for these technological and operational necessities, the following propositions are suggested:

P_2 The success of an OI process depends on OI strategy as well as operational and technological enablers.

P_{2a} The success of OI technology depends on the implementation of a secure digital platform that enables key activities (e.g., ideation), outreach (e.g., social engagement), automated evaluation (e.g., a vetting system), and innovation management tools (e.g., OI task definitions, assignment, coordination, and monitoring).

P_{2b} The success of OI operation depends on OI technology as well as the effective coordination of OI efforts, continued engagement, quality assurance, and time management.

Lastly, the characteristics of the OI community manifested themselves as one of the main limiting factors of OI, especially within highly technical fields. In this study, we focused on the community factors that the OI sponsor or OI coordinator has control over. We recognized two control mechanisms. OI organizations can control *who* can participate in the OI process and *how* they can be supported. Accordingly, we recognize two groups of success factors: *community readiness* and *community development.*

Our study confirmed that the lack of access to external actors with the necessary knowledge, skills, and experiences may reduce the chance of success in OI regardless of how OI is implemented. Hence, professional competency is the most important dimension of OI community readiness. To ensure this readiness, and, in particular, to solicit qualified contributions, developing a training system that supports community members can be one of the defining factors of a successful OI organization. Besides, due to the dynamic nature of innovation, the OI community should be agile and flexible enough to respond to changes in both OI requirements and OI processes. Therefore, community versatility is the second determining factor of OI community readiness.

OI communities are also established on the promise of openness, transparency, and fairness. OI communities that fail to account for those key factors risk losing their most crucial members. Therefore, promoting trust among the members and between the member and the OI sponsor is necessary for community development, especially in the presence of monetary compensation. Trust can be established by transparency in processes such as idea selection as well as demonstrating fairness in activities such as reward distribution. Although OI organizations cannot please all their members, practicing transparency and fairness can establish a favorable brand image, attracting more qualified contributors. Another dimension of community readiness is risk tolerance. OI community members often ideate or collaborate under considerable uncertainty about outcomes. They also deal with various risk factors associated with the competition effect or individual reasons such as privacy and time. Considering this concern, and the fact that taking risks is needed for any creative endeavor, we argue the quality of members' contributions depends on their risk tolerance. Offering feedback to the community members can reduce OI risks and uncertainty and consequently help maintain the OI community participation level and participation quality.

Further, community readiness is not limited to external members. Internal actors, for example, R&D employees, are ultimately responsible for the integration and commercialization of OI outputs. Therefore, their readiness and openness to accept and process external ideas are essential to the project's overall success. Therefore, we argue that the absence of motivated and knowledgeable employees who trust in the OI process and its outcomes may jeopardize the success of any form of OI. R&D employees, for example, should perceive the OI organization not as an external resource but as an inherent constituent of their own organization. OI thrives in an organizational culture in which employees recognize OI community members as their coworkers, not temporary crowdworkers. Therefore, relationship building between internal and external members, to the extent possible, is as vital as building relationships between external community members.

We capture the importance of community readiness and community development and their critical success factors in the following propositions:

P_3 The success of an OI community depends on community readiness and community development.

P_{3a} The success of an OI community in terms of readiness depends on external actors' competency, versatility, and risk tolerance, as well as internal actors' openness.

P_{3b} The success of the OI community development depends on community readiness as well as offering community members meaningful training, sharing feedback on members' contributions,

and building relationships between the members, as well as promoting a culture of trust, fairness, and transparency.

4.1. Theoretical contributions

This study contributes to the OI literature by offering a more systematic analysis of OI limitations and synthesizing the findings in a new framework, as well as offering a series of propositions on OI success factors. This study also provides a new perspective to study and understand the viability, survivability, scalability, and profitability of OI organizations in light of their limitations. In particular, this study offers a more thorough theoretical understanding in the following four areas.

Firstly, this study contributes to the OI literature by identifying the main limiting factors concerning OI deployment and discussing their relevance to OI viability. Our study solidified the idea that, contrary to popular belief, OI deployment needs more structure and resources than classic innovation to succeed due to a higher level of complexity and uncertainty. This study also revealed that having sophisticated OI platform technologies does not necessarily lead to a viable OI organization; rather, platform design should follow the key OI activities and facilitate the coordination of those activities. We also argue that recruiting competent ideators and providing them with the necessary training and support should be considered a part of deploying a viable OI organization. However, initial success in launching successful platforms and establishing a vibrant OI community does not necessarily mean that OI can survive and scale past the barriers that restrict classic innovation models.

Secondly, this study contributes to the current debate on the survivability of OI organizations. We argue that OI survivability depends on how OI organizations continuously and consistently engage their communities. The engagement strategy is a function of the OI business model and sustainable resources. However, engagement concerns cannot be simply addressed by strategies such as licensing and IP transfer agreements or reward mechanisms. Relying solely on monetary rewards and cash incentives is not an effective engagement mechanism, especially to sustain growth and build trust when an OI platform needs to compete with other platforms to recruit qualified ideators. Hence, in theorizing OI survivability, researchers should consider engagement mechanisms centered around intrinsic motivations such as altruism, recognition, and learning. More importantly, recruiting qualified internal and external members and satisfying their motivations may not be sufficient to maintain their participation; once they join, trust, fairness, and transparency must be prioritized.

Thirdly, we postulate that the scalability of OI organizations depends not only on its structure and strategic partners but also on the quality of OI outcomes. Hence, we argue that quality assurance is an important part of OI scalability. Our study suggests that well-thought-out OI processes with a multilayered and automated vetting system are necessary to address common quality challenges and their root causes (e.g. the idea competition effect and information overload). Our study also reveals the theoretical significance of studying OI partners, especially those involved in the commercialization of OI outcomes because of their role in supporting the OI organization's scalability. At the community level, we recognize the importance of community risk tolerance as well as a proper feedback mechanism to enhance the quality of OI outcomes and ultimately support scalability.

Lastly, we theorize OI governance as a shared responsibility between OI sponsor, OI coordinator, and OI community, and we emphasize its impact on OI profitability. OI governance ushers in OI strategies when the OI sponsor determines policies based on the desired OI vision, business model, and structure and this governance is established when the OI sponsor articulates roles and responsibilities in accordance with key activities, available resources, and strategic partnerships. We assume two roles for the OI coordinator in governing OI organizations: managing the OI process using digital tools and managing the OI resources

(in particular, OI project timing). These two roles are directly related to the OI organization's profitability. Moreover, we highlight the relationship between OI productivity and OI community governance and recognize two critical success factors: internally engaging internal actors and externally fostering relationships between the community members.

4.2. Practical implications

This study can help practitioners better understand the limitations of OI organizations and classify OI success factors according to whether they are related to OI strategy, process, or community. Accordingly, we offer three groups of recommendations related to setting goals and strategizing, designing and managing processes, and maintaining community.

Setting Goals and Strategizing. We observed that OI goals are directly related to resource allocation, organizational structure, implementation strategies, and IP rights policies. These factors individually and synergistically contribute to the survivability of OI organizations. Firstly, there is no one-size-fits-all OI solution. Hence, OI models should be selected based on a clear vision for innovation and then adjusted based on the business goals and context. More importantly, the OI vision should be inspiring, challenging, and credible for all internal stakeholders, especially for employees as much as for external OI partners. Therefore, one of the best ways to develop a clear vision for OI is to include employees in developing, experimenting with, and validating such a vision before full-scale implementation. This participation is particularly important since employees' openness to work with the OI community plays an important role in maintaining OI productivity. Secondly, resources are the main constraint for all organizations, including OI. An OI project needs to secure, allocate, and sustain resources to survive in the market. We observed that managing resources is a matter of deciding between low-cost strategies to overcome resource limitations (e.g., hiring an intermediary coordinator) and low-risk strategies to circumvent the complexities of the innovation process (e. g., engaging existing users/customers). Furthermore, the lack of structure in integration is also exacerbated by the lack of adequate resource allocation. This may lead to the poor implementation of OI organizations. Nevertheless, OI sponsors can overcome the lack of resources with a well-coordinated partnership with successful OI coordinators or strategic partners.

After securing resources, selecting and implementing a proper organizational structure is key to the survivability of an OI. The structure of an OI organization is also determined by the OI sponsor's decision about the OI model that needs openness to explore and establish new or flexible structures and procedures. Also, as with any major business change, OI only thrives when its implementation fits the organization's core structure and practices. For example, OSCs cannot be supported by the implementation of an innovation marketplace; similarly, new drug initiatives cannot succeed by only building an OSC. Lastly, to implement and sustain a vital OI community, OI sponsors and OI coordinators need to collaboratively plan fair and transparent terms of operation in line with regulatory frameworks and then clearly communicate them to members of the OI community. Implementation decisions are also directly related to how the OI sponsor manages IP rights. For example, some organizational forms require additional legal protection for IP rights whereas some are better-protected by design. A lack of strategy concerning IP rights prevents many OI organizations from fully realizing the value of OI.

Designing and Managing Processes. The absence of a well-defined vision also leads to the poor design of OI processes. These factors are closely associated to the decision about the competitive or collaborative nature of the innovation community. Firstly, unfair compensation mechanisms could become a limiting factor for competitive OI communities. In these communities, research has shown a positive correlation between fair compensation and motivation to contribute meaningfully to the innovative process (Bertello et al., 2021; Suhada

et al., 2021). A lack of a robust reward system can lead to low commitment and additional challenges in the idea development phase.

An abundance of information can both help and hurt an OI. Hence, knowledge management—in terms of both operation and technology—is the next defining factor related to core activities. When there are too many innovation partners involved, OI coordinators may struggle to maintain a balance between quality and quantity. Not only is the process of absorbing such immersive knowledge challenging for coordinators, but also, excessive collaboration may lead to the problem of information overload among problem-solvers. Hence, in the absence of a highly suitable knowledge management system, filtering valuable information and making economic decisions become challenging.

OI success also depends on the quality of coordination activities. For example, OI coordinators may lose control over innovation operations when they attempt to manage several parallel projects, organize a large group of partners, and keep the innovation community motivated. OI coordinators who are unable to orchestrate this level of complexity will struggle to manage OI effectively. When ideation becomes an integral part of innovation, there becomes a greater need for coordination. This is where recruiting an experienced innovation coordinator becomes crucial. Furthermore, quality assurance is an integral part of OI coordination activities. Therefore, defining a set of clear expectations from both the OI coordinator and the OI community can play an important part in maintaining the OI project's productivity. Establishing these expectations early in the ideation process will help to ensure the sustainability of the model. Lastly, even in the presence of a strong coordinator, time constraints can still stall OI platforms. Delays at any level of the innovation process can be the result of a multitude of factors, including poor resource allocation, ineffective coordination, and a lack of defined roles and responsibilities. For example, under time pressure, OI sponsors are better off working with intermediary coordinators rather than establishing their own innovation platform or partnering with other supply chain management firms or managing their own production and distribution.

Maintaining Community. As more internal and external actors get involved in OI processes, there are more people and activities to manage and balance. OI sponsors' approach to this level of complexity could explain why some OI organizations have advanced and why some have failed. We capture these differences based on parties' decisions concerning size, idea competition, knowledge barriers, value chain access, and security. Firstly, engaging more members does not necessarily mean more success for the OI community. Innovation platforms with a growing member base may fail in the absence of effective strategies to orchestrate the members' efforts and harvest their potential. Admitting members without proper screening can also contribute to a lack of control over the quality of the OI process and outcome. Another problem associated with OI community growth is that responsibilities or expectations are not explicitly defined, especially in collaborative communities. In the same vein, large and competitive communities without proper screening may suffer from the idea competition effect. These forms of collaboration often require that OI coordinators select the most promising ideas for the OI sponsors to review. Although a plurality of competing ideas is desirable, when it exceeds a manageable level, this may limit engagement, complicate coordination, and puzzle the OI sponsor. In competitive ideation, community members may also lose their motivation when they realize their chance of success is extremely low due to the number of members involved. Hence, utilizing an intelligent vetting system with proper scaffolding can facilitate the process of idea screening and optimize the number of competing ideas proposed to the OI sponsor.

Engaging and training qualified community members with adequate knowledge or specialized skills about the industry (or specific products) are essential activities for OI success. The lack of qualified members or partners is one of the most common barriers to a successful OI project. In highly specialized industries such as the manufacturing industry, the boundaries of an organization can be limited by the failure to engage

and mobilize ideators with adequate industry knowledge. Lastly, without the proper mechanisms to engage qualified innovation partners, it is difficult to determine the potential of ideation activities and plan for further development and commercialization. Sometimes, the lack of partnership is a failure in not coordination but trust. Knowledge transfer is a process that involves valuable know-how, and it therefore requires security considerations and protection from commercial or industrial exploitation. Therefore, partnership decisions are under additional scrutiny for protecting IP. This may limit the OI organization's access to a broader range of innovation partners and, in turn, affect the survivability of the organizations in the long term.

4.3. Limitations and future research avenues

This study was limited in scope, and, thus, it is inevitably subject to limitations. Firstly, our findings are limited by the nature of our methodology despite our literature review and case review. There may be additional limitations beyond what we have identified in this study. Secondly, our classification of limitations is not the only way to interpret the findings; different researchers might categorize the limitations in different ways depending on the research objectives. Thirdly, further research is needed to identify possible limitations beyond the three levels introduced by this study. For example, we did not identify OI limitations at a higher level, such as the industry or regional levels. We encourage future researchers to consider OI limitations pertaining to industry development, inter-industry coordination, regional innovation systems, national norms, and public policies (e.g., see Chesbrough and Bogers 2014). The fourth point is that our review did not allow us to examine the relationships between the identified limiting factors beyond what was presented in the literature and confirmed by our case study. Future research may examine possible relationships in different contexts and for different OI models. Lastly, we acknowledge that differences between OI models exist; however, the exploratory nature of this study did not allow us to examine these differences in detail. Researchers can consider these differences in detail through comparative studies.

The motivations behind the inception of OI organizations also deserve additional investigation. There is limited research explaining why and when an organization needs to consider OI as an alternative innovation strategy. This line of research can yield more realistic expectations of OI as a strategic approach. Understanding OI organizations' needs in terms of resources and structure is the next research avenue worth noting. Future research can theorize different OI models and discuss their structures from different perspectives, such as financing and dynamic capability. Researchers can also examine the fluidity and dynamics of OI structure to inform OI model selection considering each model limitation.

While OI models have been well-documented in the literature, the implementation of OI models has received far less attention, except for OSC. Conducting longitudinal studies is recommended here since the OI implementation takes time to unfold and bear fruit. Furthermore, OI implementation is a resource-intensive process; therefore, identifying the strategic resources and the mechanisms for their optimum allocation would pave the way for more systematic implementations of OI models. OI implementation in SMEs with limited resources is also a promising research topic that can contribute to innovation democratization. Further investigation is also necessary on how organizations develop, implement, and enforce OI rules and policies. Examining internal and external policies concerning IP rights across OI models, industries, and countries is an example of such a research avenue. Future research may also explore the extent to which national and international laws and regulations can affect OI. OI can be limited or can thrive depending on the country or region in which it is implemented. Future studies, therefore, may include external factors such as culture (e.g., openness, sharing, transparency, and power distance) as well as social and economic factors (e.g., brand equity) in the examination of OI limitations.

The operational limitations of OI also deserve further investigation.

Table 2
List of possible research questions informing future studies on limiting factors of OI.

CAT.	POSSIBLE RESEARCH QUESTIONS
Strategy	- When, why, and how can an OI organization emerge as an alternative to classic innovation?
	- How can OIs set a clear vision for OI model selection and implementation?
	- What are the strategic resources needed to establish an OI organization and how can they be estimated and planned?
	- How can organizations manage resources in collaboration with their strategic partners?
	- What are the structural changes or barriers to consider when implementing OI?
	- How should OI organizations build and protect their brand identity?
	- How can OI organizations identify, plan, implement, and integrate key OI activities?
	- What are the dynamic capabilities necessary for OI organizations to manage implementation challenges?
	- How can organizations protect IP while allowing for dynamic knowledge exchange with external parties?
	- How can organizations best approach the division of labor, including partnerships, roles, and responsibilities, in OI teams?
Process	- How do OI operations unfold over time and how can OI organizations routinize OI processes?
	- How can digital technologies be developed and used to support OI?
	- What are the key privacy and security threats to OI platforms, and what measures are needed to identify and reduce them?
	- What are the best practices in OI network coordination and platform governance?
	- What bottlenecks must be considered before taking on the coordination of OI efforts?
	- How can OI organizations address the issue of information overload and maintain the quality of contributions?
	- How can organizations develop OI reward systems that encourage innovation and maintain participation?
	- How can automated and intelligent idea screening and selection tools be designed and tested?
	- How can OI organizations maintain participation and engagement through intrinsic rewards?
	- What are the best practices for managing and improving the quality of OI outcomes?
Community	- What are some knowledge barriers to consider when recruiting participants for OI?
	- What are the best strategies to support and train community members?
	- How can the OI community be supported and motivated through feedback?
	- How can OI organizations maintain a balance between anonymous and identified contributions?
	- How can organizations minimize the impact of the idea competition effect?
	- What roles OI organizations play in mitigating the individual risks of participating in OIs?
	- What practices should organizations utilize to manage individual actors' expectations?
	- How can OI organizations build and foster relationships between the community members?
	- How can an organization prepare and support its employees to participate in OI?

The research interests in this domain range from OI technologies to

community engagement and OI coordination. While there have been notable studies on technologies used in operationalizing OSC, the utilization of digital technologies in other OI models has remained understudied. Except for OI platform affordances, our knowledge of OI platform design is limited (e.g., integration with existing innovation management systems and tools). Further inquiry into the security of OI platforms is also necessary since openness may bring great privacy and security threats; therefore, it is important to identify the threats and mitigation strategies. Moreover, the engagement mechanisms and their effectiveness across OI models have not been fully understood yet. Developing a deeper understanding of the OI reward systems and their utility and limits is critical to the success of OI community planning. Finding the balance between quality and quantity of contribution as well as between anonymous and identified contributions is also a topic of interest in many forms of OI. Future research may also explore the various considerations and constraints associated with the coordination of such efforts. Research on OI coordination should go beyond OI activities (e.g., ideation/commercialization) and include topics such as community governance and development.

As for community-related limitations, future research can be centered on the role of OI sponsors in recruiting qualified members, maintaining their participation, addressing their evolving needs, and providing feedback and support as necessary. Future topics of interest may include external actor screening, community design, community auditing, competition design and optimization, individual risk identification and mitigation, and community development and retention. OI literature may also benefit from the comparison of community limitations and associated mitigation strategies across OI models. Table 2 provides a list of possible research questions guiding future investigations.

Financial disclosure

N/A.

Declaration of competing interest

N/A.

Appendix A

OI MODEL	STRATEGY	PROCESS		COMMUNITY
		Ideation Process	Collaboration Process	
Open-source community (OSC)	Dedicated to developing non-proprietary software or hardware solutions collaboratively and systematically.	New ideas submitted based on open but structured process to address existing needs or contribute to new development opportunities.	Collaborative and supportive in nature but specific in domain. Collaboration can be initiated by	Formal and informal innovation communities with some networking options focused on knowledge-sharing.
				(continued on next page)

(*continued*)

OI MODEL	STRATEGY	PROCESS		COMMUNITY
		Ideation Process	Collaboration Process	
			innovation sponsor or community members.	
Innovation marketplace (innovation contest)	Managed by innovation brokers that connects innovation seekers to a community of problems solvers mainly through organizing innovation contests/markets.	New ideas submitted individually, competitively and privately based on pre-identified problems sponsored or solicited by the innovation seekers.	Competitive in nature but collaboration can be initiated by innovation sponsors or innovation brokers by allowing joint submissions or partnerships.	Professional networks with no or limited networking options, structured within innovation contests or unstructured outside the innovation contests.
User innovation (customer innovation)	Engage customers or users in ideation for new/exciting product/service development/improvement—can be governed by innovation sponsors or third-party innovation coordinators.	New ideas are shared publicly in response to opportunities identified by either customers or by corporate innovation sponsor.	Collaborative in nature, limited to specific products or services and facilitated by innovation sponsors through forum-like structure.	Brand communities with networking options like posting, following and commenting but not necessarily linked to any innovation projects.
Crowdsourcing	Solicit creative ideas or contributions (micro-tasks) to complete or facilitate innovation tasks on a corporate or a third-party digital platform and later integrate them as part of an innovation project.	New ideas submitted, or creative tasks completed through a formally structured processed and pre-defined requirements and later be integrated	Independent in nature with no or limited collaboration opportunities that are not necessarily governed by the innovation sponsors.	Creative worker community with no or limited networking options that governed by innovation sponsors.
Social product development (SPD)	Use social technologies and social mechanisms to mobilize community members to participate in new product/service development.	New ideas are submitted individually or jointly to complete a broad range of innovation tasks from ideation to commercialization.	Both competitive and collaborative, not limited to pre-defined projects with both formal and informal collaboration opportunities.	Socio-professional network with various networking options that are not necessarily tied to innovation projects.

References

Abhari, K., Davidson, E.J., Xiao, B., 2017. Co-innovation platform affordances: developing a conceptual model and measurement instrument. Ind. Manag. Data Syst. 117 (5) https://doi.org/10.1108/IMDS-05-2016-0156.

Abhari, K., Davidson, E.J., Xiao, B., 2018. A risk worth taking? The effects of risk and prior experience on Co-innovation participation. Internet Res. 28 (3), 804–828. https://doi.org/10.1108/IntR-05-2017-0196.

Abhari, K., Davidson, E.J., Xiao, B., 2019. Collaborative innovation in the sharing economy: profiling social product development actors through classification modeling. Internet Res. 29 (5) https://doi.org/10.1108/INTR-03-2018-0129.

Abhari, K., Davidson, E.J., Xiao, B., 2022a. Modeling social product development process, technology, and governance. IEEE Trans. Eng. Manag. 69 (2), 409–422. https://doi.org/10.1109/TEM.2020.2973234.

Abhari, K., Davidson, E.J., Xiao, B., 2022b. Inventing together: the role of actor goals and platform affordances in open innovation. J. Assoc. Inf. Syst. Online 23 (1), 264–302. https://doi.org/10.17705/1jais.00716.

Alam, M.A., Rooney, D., Taylor, M., 2019. In: From 'EGO'' to Inclusive "ECO-Systems'': Theorizing the Process of Openness in Innovation, vol. 10510. Academy of Management Briarcliff Manor, NY, 10149. https://doi.org/10.5465/AMBPP.2019.10149ABSTRACT. Https://Doi.Org/10.5465/AMBPP.2019.10149abstract (2019:1.

Albats, E., Podmetina, D., Vanhaverbeke, W., 2021. Open innovation in SMEs: a process view towards business model innovation. J. Small Bus. Manag. 1–42. https://doi.org/10.1080/00472778.2021.1913595. Routledge.

Annosi, M.C., Marzi, G., Ciampi, F., Rialti, R., 2020. An Ambidextrous Approach to Practice-Based Innovation for Social Product Development: Lessons from A Dutch Company. IEEE Transactions on Engineering Management, IEEE, pp. 1–12. https://doi.org/10.1109/tem.2020.2977976.

Bagherzadeh, M., Markovic, S., Cheng, J., Vanhaverbeke, W., 2019. How does outside-in open innovation influence innovation performance? Analyzing the mediating roles of knowledge sharing and innovation strategy. IEEE Trans. Eng. Manag. 1–14. https://doi.org/10.1109/TEM.2018.2889538.

Barbosa, A.P.F.P.L., Salerno, M.S., Nascimento, P.T.de S., Albala, A., Maranzato, F.P., Tamoschus, D., 2021. Configurations of project management practices to enhance the performance of open innovation R&D projects. Int. J. Proj. Manag. 39 (2), 128–138. https://doi.org/10.1016/j.ijproman.2020.06.005. Pergamon.

Barham, H., Dabic, M., Daim, T., Shifrer, D., 2020. The role of management support for the implementation of open innovation practices in firms. June Technol. Soc. 63, 101282. https://doi.org/10.1016/j.techsoc.2020.101282. Elsevier Ltd.

Barlatier, P.-J., Mention, A.-L., Misra, A., 2020. The interplay of digital technologies and the open innovation process: benefits and challenges. In: Managing Digital Open Innovation, pp. 1–34. https://doi.org/10.1142/9789811219238_0001.

Beck, S., Bergenholtz, C., Bogers, M., Brasseur, T.-M., Conradsen, M.L., di Marco, D., Distel, A.P., Dobusch, L., Dörler, D., Effert, A., Fecher, B., Filiou, D., Frederiksen, L., Gillier, T., Grimpe, C., Gruber, M., Haeussler, C., Heigl, F., Hoisl, K., Hyslop, K., Kokshagina, O., LaFlamme, M., Lawson, C., Lifshitz-Assaf, H., Lukas, W., Nordberg, M., Norn, M.T., Poetz, M., Ponti, M., Pruschak, G., Pujol Priego, L., Radziwon, A., Rafner, J., Romanova, G., Ruser, A., Sauermann, H., Shah, S.K., Sherson, J.F., Suess-Reyes, J., Tucci, C.L., Tuertscher, P., Vedel, J.B., Velden, T., Verganti, R., Wareham, J., Wiggins, A., Xu, S.M., 2020. The Open Innovation in

Science Research Field: A Collaborative Conceptualisation Approach. Routledge, Industry and Innovation, pp. 1–50. https://doi.org/10.1080/13662716.2020.1792274.

Benbasat, I., Goldstein, D.K., Mead, M., 1987. The case research strategy in studies of information systems. MIS Q. 11 (3) https://doi.org/10.2307/248684. Management Information Systems.

Bertello, A., Ferraris, A., de Bernardi, P., Bertoldi, B., 2021. Challenges to open innovation in traditional SMEs: an analysis of pre-competitive projects in university-industry-government collaboration. Int. Enterpren. Manag. J. https://doi.org/10.1007/s11365-020-00727-1.

Bhimani, H., Mention, A.L., Barlatier, P.J., 2019. Social media and innovation: a systematic literature review and future research directions. Technol. Forecast. Soc. Change 144, 251–269. https://doi.org/10.1016/j.techfore.2018.10.007. October 2018.

Bigliardi, B., Ferraro, G., Filippelli, S., Galati, F., 2020. The past, present and future of open innovation. Eur. J. Innovat. Manag. 24 (4), 1130–1161. https://doi.org/10.1108/EJIM-10-2019-0296/FULL/PDF. Emerald Group Holdings Ltd.

Bogers, M., Burcharth, A.L.A., Chesbrough, H., 2021. Open Innovation in Brazil: Exploring Opportunities and Challenges. SSRN Electronic Journal. https://doi.org/10.2139/SSRN.3778361. Elsevier BV.

Bogers, M., Chesbrough, H., Heaton, S., Teece, D.J., 2019. Strategic Management of Open Innovation: A Dynamic Capabilities Perspective (62:1). SAGE PublicationsSage CA, Los Angeles, CA, pp. 77–94. https://doi.org/10.1177/0008125619885150.

Bogers, M., Chesbrough, H., Moedas, C., 2018a. Open innovation: research, practices, and policies. Calif. Manag. Rev. 60 (2), 5–16. https://doi.org/10.1177/0008125617745086. SAGE PublicationsSage CA: Los Angeles, CA.

Bogers, M., Foss, N.J., Lyngsie, J., 2018b. The 'human side' of open innovation: the role of employee diversity in firm-level openness. Res. Pol. 47 (1), 218–231. https://doi.org/10.1016/j.respol.2017.10.012. Elsevier.

Bogers, M., Zobel, A.-K., Afuah, A., Almirall, E., Brunswicker, S., Dahlander, L., Frederiksen, L., Gawer, A., Gruber, M., Haefliger, S., Hagedoorn, J., Hilgers, D., Laursen, K., Magnusson, M.G., Majchrzak, A., Mccarthy, I.P., Moeslein, K.M., Nambisan, S., Piller, F.T., Radziwon, A., Rossi-Lamastra, C., Sims, J., Wal, A. L. J. ter, 2017. The open innovation research landscape: established perspectives and emerging themes across different levels of analysis. Ind. Innovat. 24 (1), 8–40. https://doi.org/10.1080/13662716.2016.1240068.

von Briel, F., Recker, J., 2017. Lessons from a failed implementation of an online open innovation community in an innovative organization. MIS Q. Exec. 16 (1), 35–46. https://aisel.aisnet.org/misqeAvailableat:https://aisel.aisnet.org/misqe/vol16/iss1/3.

Capurro, R., Fiorentino, R., Garzella, S., Lombardi, R., 2021. The role of boundary management in open innovation: towards a 3D perspective. In: Business Process Management Journal, vol. 27. Emerald Publishing Limited, pp. 57–84. https://doi.org/10.1108/BPMJ-01-2021-0052, 8.

Cavallo, A., Burgers, H., Ghezzi, A., van de Vrande, V., 2021. The Evolving Nature of Open Innovation Governance: A Study of a Digital Platform Development in Collaboration with a Big Science Centre. Elsevier, Technovation, 102370. https://doi.org/10.1016/j.technovation.2021.102370.

Cenamor, J., Frishammar, J., 2021. Openness in platform ecosystems: innovation strategies for complementary products. Res. Pol. 50 (1), 104148. https://doi.org/10.1016/j.respol.2020.104148.

Chaudhary, S., Kaur, P., Talwar, S., Islam, N., Dhir, A., 2022. Way off the mark? Open innovation failures: decoding what really matters to chart the future course of action. J. Bus. Res. 142, 1010–1025. https://doi.org/10.1016/J.JBUSRES.2021.12.062. Elsevier.

Chesbrough, H., 2017. The future of open innovation. Res. Technol. Manag. 60 (1), 35–38. https://doi.org/10.1080/08956308.2017.1255054.

Chesbrough, H., 2019. Open Innovation Results: Going beyond the Hype and Getting Down to Business. Oxford University Press, Oxford University Press.

Chesbrough, H., Bogers, M., 2014. Explicating open innovation: clarifying an emerging paradigm for understanding innovation by henry Chesbrough, marcel Bogers :: SSRN. In: Chesbrough, H., Vanhaverbeke, W., West, J. (Eds.), New Frontiers in Open Innovation, pp. 3–28. Oxford. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2427233.

Chesbrough, H., Brunswicker, S., 2014. A Fad or a Phenomenon? the Adoption of Open Innovation Practices in Large Firms. Research Technology Management, Industrial Research Institute Inc., pp. 16–25. https://doi.org/10.5437/08956308X5702196

Coelho, D.A., Nunes, F., Vieira, F.L., 2016. The impact of crowdsourcing in product development: an exploratory study of Quirky based on the perspective of participants. Int. J. Des. Creat. Innovat. 6 (1–2), 1–15. https://doi.org/10.1080/21650349.2016.1216331.

Corral de Zubielqui, G., Fryges, H., Jones, J., 2019. Social media, open innovation & HRM: implications for performance. Technol. Forecast. Soc. Change 144, 334–347. https://doi.org/10.1016/j.techfore.2017.07.014. July 2017.

Dahlander, L., Gann, D.M., Wallin, M.W., 2021. How open is innovation? A retrospective and ideas forward. Res. Pol. 50 (4), 104218. https://doi.org/10.1016/j.respol.2021.104218.

Daniel, S.L., Chung, T.-T.R., Sharma, P.N., 2020. The impact of anonymous peripheral contributions on open source software development. AIS Trans. Hum.-Comput. Interact. 12 (3), 146–171.

Dekkers, R., Koukou, M.I., Mitchell, S., Sinclair, S., 2019. Engaging with open innovation: a scottish perspective on its opportunities, challenges and risks. J. Innovat. Econ. 28 (1), 193. https://doi.org/10.3917/jie.028.0187. CAIRN.

Diener, K., Luettgens, D., Piller, F.T., 2020. Intermediation for open innovation: comparing direct versus delegated search strategies of innovation intermediaries. Int. J. Innovat. Manag. 24 (4) https://doi.org/10.1142/S1363919620500371. World Scientific Publishing Company.

Durst, S., Ståhle, P., 2013. Success factors of open innovation-A literature review. J. Bus. Res. Manag. 4 (4), 111–131. http://www.cscjournals.org/manuscript/Journals/IJBRM/Volume4/Issue4/IJBRM-154.pdf.

Ehls, D., 2017. Open source project collapse-sources and patterns of failure. In: Proceedings of the 50th Hawaii International Conference on System Sciences, pp. 5327–5336. http://hdl.handle.net/10125/41807.

Elia, G., Messeni Petruzzelli, A., Urbinati, A., 2020. Implementing Open Innovation through Virtual Brand Communities: A Case Study Analysis in the Semiconductor Industry," Technological Forecasting And Social Change, vol. 155. Elsevier Inc. https://doi.org/10.1016/J.TECHFORE.2020.119994.

Filiou, D., 2021. A new perspective on open innovation: established and new technology firms in UK bio-pharmaceuticals. R&D Manag. 51 (1), 73–86. https://doi.org/10.1111/radm.12425. John Wiley & Sons, Ltd.

Fischer, D., Prasuhn, J., Strese, S., Brettel, M., 2021. The role of social media for radical innovation in the new digital age. In: International Journal of Innovation Management. World Scientific Publishing Company, 2150075. https://doi.org/10.1142/S1363919621500754.

Forbes, H., Schaefer, D., Panchal, J., Han, J., 2019. A Design Framework for Social Product Development. IEEE Transactions on Engineering Management (PP). IEEE, pp. 1–12. https://doi.org/10.1109/TEM.2019.2948996.

Gassmann, Oliver, Enkel, Ellen, 2004. Towards a Theory of Open Innovation: Three Core Process Archetypes. In: R&D Management Conference (RADMA) 2004. - Lissabon, pp. 1–18. In: http://www.researchgate.net/publication/36384702_Towards_a_Theory_of_Open_Innovation_Three_Core_Process_Archetypes/file/9c9605283ba47b0aa1.pdf.

Gassmann, O., Enkel, E., Chesbrough, H., 2010. The future of open innovation. R&D Manag. 40 (3), 213–221. https://doi.org/10.1111/j.1467-9310.2010.00605.x. John Wiley & Sons, Ltd.

Gentile-Lüdecke, S., Torres de Oliveira, R., Paul, J., 2020. Does organizational structure facilitate inbound and outbound open innovation in SMEs? Small Bus. Econ. 55 (4), 1091–1112. https://doi.org/10.1007/s11187-019-00175-4.

Germonprez, M., Levy, M., Kendall, J.E., Kendall, K.E., 2020. Tapestries of innovation: structures of contemporary open source project engagements. J. Assoc. Inf. Syst. Online 21 (3), 615–663. https://doi.org/10.17705/1jais.00615.

Gimenez-Fernandez, E., Abril, C., Breuer, H., Gudiksen, S., 2021. Gamification approaches for open innovation implementation: a conceptual framework. Creativ. Innovat. Manag. 30 (3), 455–474. https://doi.org/10.1111/CAIM.12452. John Wiley & Sons, Ltd.

Gold, E.R., 2021. The fall of the innovation empire and its possible rise through open science. Res. Pol. 50 (5), 104226 https://doi.org/10.1016/j.respol.2021.104226. North-Holland.

Greco, M., Grimaldi, M., Cricelli, L., 2015. Open innovation actions and innovation performance: a literature review of European empirical evidence. Eur. J. Innovat. Manag. 18 (2), 150–171. https://doi.org/10.1108/EJIM-07-2013-0074.

Grimaldi, M., Greco, M., Cricelli, L., 2021. A framework of intellectual property protection strategies and open innovation. J. Bus. Res. 123, 156–164. https://doi.org/10.1016/J.JBUSRES.2020.09.043. Elsevier Inc.

Gurca, A., Bagherzadeh, M., Markovic, S., Koporcic, N., 2021. Managing the challenges of business-to-business open innovation in complex projects: a multi-stage process

model. Ind. Market. Manag. 94, 202–215. https://doi.org/10.1016/J.INDMARMAN.2020.05.035. Elsevier Inc.

Haim Faridian, P., Neubaum, D.O., 2021. Ambidexterity in the age of asset sharing: development of dynamic capabilities in open source ecosystems. Technovation 99, 102125. https://doi.org/10.1016/j.technovation.2020.102125.

Han, C., Yang, M., 2020. Stimulating Innovation on Social Product Development: an Analysis of Social Behaviors in Online Innovation Communities. IEEE Transactions on Engineering Management, pp. 1–11. https://doi.org/10.1109/tem.2019.2955073. IEEE.

Henttonen, K., Lehtimäki, H., 2017. Open innovation in SMEs: collaboration modes and strategies for commercialization in technology-intensive companies in forestry industry. Eur. J. Innovat. Manag. 20 (2), 329–347. https://doi.org/10.1108/EJIM-06-2015-0047. Emerald Publishing Limited.

Hintz S, Eric, 2019. 10 Failed Inventor Initiatives, from the Franklin Institute to Quirky. In: Wisnioski, Matthew, Hintz S, Eric, Kleine Stettler, Marie (Eds.), Does America Need More Innovators? MIT Press.

Hofstetter, R., Dahl, D.W., Aryobsei, S., Herrmann, A., 2021. Constraining ideas: how seeing ideas of others harms creativity in open innovation. J. Market. Res. 58 (1), 95–114.

Hofstetter, R, Zhang Z, J, Herrmann, A, 2018. Successive open innovation contests and incentives: winner-take-all or multiple prizes? Journal of Product Innovation Management 35 (4), 492–517.

Holgersson, M., Granstrand, O., 2021. Value Capture in Open Innovation Markets: the Role of Patent Rights for Innovation Appropriation. European Journal of Innovation Management (ahead-of-print:ahead-of-print). Emerald Publishing Limited. https://doi.org/10.1108/EJIM-02-2021-0114.

Hossain, M., 2018. Motivations, challenges, and opportunities of successful solvers on an innovation intermediary platform. Technol. Forecast. Soc. Change 128, 67–73. https://doi.org/10.1016/J.TECHFORE.2017.10.018. North-Holland.

Hossain, M., Kauranen, I., 2016. Open innovation in SMEs: a systematic literature review. J. Strat. Manag. 58–73. https://doi.org/10.1108/JSMA-08-2014-0072.

Jesus, G.M.K., Jugend, D., 2021. How can open innovation contribute to circular economy adoption? Insights from a literature review. Eur. J. Innovat. Manag. https://doi.org/10.1108/EJIM-01-2021-0022.

Johnson, D., Ryan, J.B., 2020. Amazon mechanical Turk workers can provide consistent and economically meaningful data. South. Econ. J. 87 (1), 369–385. https://doi.org/10.1002/SOEJ.12451. John Wiley & Sons, Ltd.

Karachiwalla, R., Pinkow, F., 2021. Understanding crowdsourcing projects: a review on the key design elements of a crowdsourcing initiative. Creativ. Innovat. Manag. 30 (3), 563–584. https://doi.org/10.1111/CAIM.12454. John Wiley & Sons, Ltd.

Kohler, T., Nickel, M., 2017. Crowdsourcing business models that last. J. Bus. Strat. 38 (2), 25–32. https://doi.org/10.1108/JBS-10-2016-0120. Emerald Publishing Limited.

Lai-Yin Cheah, S., Ho, Y.-P., Li, S., 2021. Search strategy, innovation and financial performance of firms in process industries. Technovation, 102257. https://doi.org/10.1016/j.technovation.2021.102257.

Leckel, A., Veilleux, S., Dana, L.P., 2020. Local open innovation: a means for public policy to increase collaboration for innovation in SMEs. Technol. Forecast. Soc. Change 153, 119891. https://doi.org/10.1016/j.techfore.2019.119891. North-Holland.

Liem, N.T., Khuong, N.V., Khanh, T.H.T., 2019. Firm constraints on the link between proactive innovation, open innovation and firm performance. J. Open Innovat.: Technol. Market Complex. 5 (4) https://doi.org/10.3390/joitmc5040088.

Liu, Q., Du, Q., Hong, Y., Fan, W., Wu, S., 2020. User idea implementation in open innovation communities: evidence from a new product development crowdsourcing community. Inf. Syst. J. 30 (5), 899–927. https://doi.org/10.1111/isj.12286. John Wiley & Sons, Ltd.

Malhotra, A., Majchrzak, A., Niemiec, R.M., 2017. Using public crowds for open strategy formulation: mitigating the risks of knowledge gaps. Long. Range Plan. 50 (3), 397–410. https://doi.org/10.1016/j.lrp.2016.06.004.

Martínez-Torres, M.R., 2014. Analysis of open innovation communities from the perspective of social network analysis. Technol. Anal. Strat. Manag. 26 (4), 435–451.

Marullo, C., Ahn, J.M., Martelli, I., di Minin, A., 2021. Open for Innovation: an Improved Measurement Approach Using Item Response Theory. Elsevier, Technovation, 102338.

Maruping, L., Yang, Y., 2020. Governance in Digital Open Innovation Platforms. Oxford Research Encyclopedia of Business and Management. https://doi.org/10.1093/ACREFORE/9780190224851.013.267. Oxford University Press.

Messeni Petruzzelli, A., Natalicchio, A., Panniello, U., Roma, P., 2019. Understanding the crowdfunding phenomenon and its implications for sustainability. Technol. Forecast. Soc. Change 141, 138–148. https://doi.org/10.1016/J.TECHFORE.2018.10.002. Elsevier Inc.

Mills, J., Birks, M., 2017. Qualitative methodology: a practical guide. Qualitative Methodology: A Pract. Guide. https://doi.org/10.4135/9781473920163.

Mu, R., Wang, H., 2020. A systematic literature review of open innovation in the public sector: comparing barriers and governance strategies of digital and non-digital open innovation. Publ. Manag. Rev. 1–23. https://doi.org/10.1080/14719037.2020.1838787. Routledge.

Naqshbandi, M.M., Tabche, I., Choudhary, N., 2019. Managing open innovation: the roles of empowering leadership and employee involvement climate. Manag. Decis. 57 (3), 703–723.

Natalicchio, A., Messeni Petruzzelli, A., Cardinali, S., Savino, T., 2018. Open innovation and the human resource dimension: an investigation into the Italian manufacturing sector. Manag. Decis. 56 (6), 1271–1284. https://doi.org/10.1108/MD-03-2017-0268. Emerald Group Holdings Ltd.

Natalicchio, A., Messeni Petruzzelli, A., Garavelli, A.C., 2014. A literature review on markets for ideas: emerging characteristics and unanswered questions. Technovation 34 (2), 65–76. https://doi.org/10.1016/J.TECHNOVATION.2013.11.005. Elsevier Ltd.

Natalicchio, A., Messeni Petruzzelli, A., Garavelli, A.C., 2017. Innovation problems and search for solutions in crowdsourcing platforms – a simulation approach. Technovation 64–65, 28–42. https://doi.org/10.1016/J.TECHNOVATION.2017.05.002. Elsevier Ltd.

Nguyen, T.P.T., Huang, F., Tian, X., 2021. A Meta-Analysis of the Impact of Open Innovation on Performance. Journal of Management & Organization, pp. 1–18. https://doi.org/10.1017/jmo.2021.38. Cambridge University Press.

Obradović, T., Vlačić, B., Dabić, M., 2021. Open innovation in the manufacturing industry: a review and research agenda. Technovation 102, 102221. https://doi.org/10.1016/j.technovation.2021.102221. Elsevier.

Ovuakporie, O.D., Pillai, K.G., Wang, C., Wei, Y., 2021. Differential moderating effects of strategic and operational reconfiguration on the relationship between open innovation practices and innovation performance. Res. Pol. 50 (1), 104146. https://doi.org/10.1016/j.respol.2020.104146.

Patrucco, A.S., Trabucchi, D., Frattini, F., Lynch, J., 2021. The Impact of Covid-19 on Innovation Policies Promoting Open Innovation," *R&D Management*. John Wiley & Sons, Ltd. https://doi.org/10.1111/RADM.12495.

Pikkarainen, M., Hyrkäs, E., Martin, M., 2020. Success factors of demand-driven open innovation as a policy instrument in the case of the healthcare industry. J. Open Innovat.: Technol. Market Complex. 6 (2), 39. https://doi.org/10.3390/JOITMC6020039. Multidisciplinary Digital Publishing Institute.

Piller, F.T., 2010. Ten Reasons Why I Consider Quirky.com As Best in Crowdsourcing and Open Innovation. http://tinyurl.com/37boopb.

Ramírez-Montoya, M.S., García-Peñalvo, F.-J., 2018. Co-creation and open innovation: systematic literature review. Comunicar 26 (54), 9–18. https://doi.org/10.3916/C54-2018-01.

Roberts, Deborah L., Palmer, R., Hughes, M., 2021. Innovating the Product Innovation Process to Enable Co-creation," *R and D Management*. John Wiley & Sons, Ltd. https://doi.org/10.1111/radm.12492.

Roldán Bravo, M.I., Ruiz Moreno, A., Garcia Garcia, A., Huertas-Valdivia, I., 2021. How open innovation practices drive innovation performance: moderated-mediation in the interplay between overcoming syndromes and capabilities (ahead-of-print: ahead-of-print), Emerald Publishing Limited J. Bus. Ind. Market.. https://doi.org/10.1108/JBIM-02-2020-0106.

Roma, P., Messeni Petruzzelli, A., Perrone, G., 2017. From the crowd to the market: the role of reward-based crowdfunding performance in attracting professional investors. Res. Pol. 46 (9), 1606–1628. https://doi.org/10.1016/J.RESPOL.2017.07.012. Elsevier B.V.

Saura, J.R., Palacios-Marqués, D., Ribeiro-Soriano, D., 2022. Exploring the Boundaries of Open Innovation: Evidence from Social Media Mining. Elsevier, Technovation, 102447. https://doi.org/10.1016/J.TECHNOVATION.2021.102447.

Schlagwein, D., Bjørn-Andersen, N., 2014. Organizational learning with crowdsourcing : the revelatory case of LEGO. J. Assoc. Inf. Syst. Online 15 (11), 754–778.

Schoder, D., Schlagwein, D., Fischbach, K., 2019. Open Resource-Based View (ORBV): A Theory of Resource Openness, pp. 1–17, 40th International Conference on Information Systems, ICIS 2019 (Chesbrough 2003).

Seo, R., Park, J.-H., 2022. When is interorganizational learning beneficial for inbound open innovation of ventures? A contingent role of entrepreneurial orientation. Technovation 116, 102514. https://doi.org/10.1016/J.TECHNOVATION.2022.102514. Elsevier.

Souza, L., Ramos, I., Esteves, J., 2009. Crowdsourcing innovation: a risk management approach. In: Mediterranean Conference on Information Systems Proceedings, pp. 763–774. http://aisel.aisnet.org/mcis2009/67.

Srisathan, W.A., Ketkaew, C., Naruetharadhol, P., 2020. The intervention of organizational sustainability in the effect of organizational culture on open innovation performance: a case of Thai and Chinese SMEs. Cogent Busines. Manage. 7 (1) https://doi.org/10.1080/23311975.2020.1717408. Cogent.

Stefan, I., Hurmelinna-Laukkanen, P., Vanhaverbeke, W., Oikarinen, E.L., 2022. The dark side of open innovation: individual affective responses as hidden tolls of the paradox of openness. J. Bus. Res. 138, 360–373. https://doi.org/10.1016/J.JBUSRES.2021.09.028. Elsevier Inc.

Suhada, T.A., Ford, J.A., Verreynne, M.-L., Indulska, M., 2021. Motivating individuals to contribute to firms' non-pecuniary open innovation goals. Technovation (102), 102233. https://doi.org/10.1016/j.technovation.2021.102233.

Sun, Y., Liu, J., Ding, Y., 2020. Analysis of the relationship between open innovation, knowledge management capability and dual innovation. Technol. Anal. Strat. Manag. 32 (1), 15–28. https://doi.org/10.1080/09537325.2019.1632431. Routledge.

Tang, T (Ya), Fisher, G.J., Qualls, W.J., 2021. The effects of inbound open innovation, outbound open innovation, and team role diversity on open source software project performance. Ind. Market. Manag. 94, 216–228. https://doi.org/10.1016/j.indmarman.2021.02.013. Elsevier.

Temel, S., Vanhaverbeke, W., 2020. Knowledge Risk Management during Implementation of Open Innovation. Springer, Cham, pp. 207–227. https://doi.org/10.1007/978-3-030-35121-2_12.

Torres de Oliveira, R., Gentile-Lüdecke, S., Figueira, S., 2021. Barriers to innovation and innovation performance: the mediating role of external knowledge search in emerging economies. Small Bus. Econ. https://doi.org/10.1007/s11187-021-00491-8.

Torres de Oliveira, R., Verreynne, M.-L., Figueira, S., Indulska, M., Steen, J., 2020. How do institutional innovation systems affect open innovation? J. Small Bus. Manag. 1–45. https://doi.org/10.1080/00472778.2020.1775466. Routledge.

Ullrich, A., Vladova, G., 2018. Weighing the pros and cons of engaging in open innovation. Technol. Innovat. Manage. Rev. 6 (4), 34–40. https://doi.org/10.22215/timreview/980.

Urbinati, A., Chiaroni, D., Chiesa, V., Frattini, F., 2020. The role of digital technologies in open innovation processes: an exploratory multiple case study analysis. R D Manag. 50 (1), 136–160. https://doi.org/10.1111/radm.12313. John Wiley & Sons, Ltd 10.1111.

Verreynne, M.L., Torres de Oliveira, R., Steen, J., Indulska, M., Ford, J.A., 2020. What motivates 'free'' revealing? Measuring outbound non-pecuniary openness. *Scientometrics* (124:1). In: Innovation Types and Expectations of Future Profit Growth. Springer, pp. 271–301. https://doi.org/10.1007/s11192-020-03434-4.

Vujovic, S., Ulhøi, J.P., 2008. Online innovation: the case of open source software development. Eur. J. Innovat. Manag. 11 (1), 142–156. https://doi.org/10.1108/14601060810845268.

West, J., Bogers, M., 2014. Leveraging external sources of innovation: a review of research on open innovation. J. Prod. Innovat. Manag. 31 (4), 814–831. https://doi.org/10.1111/jpim.12125.

West, J., Bogers, M., 2017. Open innovation: current status and research opportunities. Innovat. Manag. Pol. Pract. 19 (1), 43–50. https://doi.org/10.1080/14479338.2016.1258995. Routledge.

Wu, I.L., Hu, Y.P., 2018. Open innovation based knowledge management implementation: a mediating role of knowledge management design. J. Knowl. Manag. 22 (8), 1736–1756. https://doi.org/10.1108/JKM-06-2016-0238. Emerald Publishing Limited.

Wu, S., Ding, X., Liu, R., Gao, H., 2021. How does IT capability affect open innovation performance? The mediating effect of absorptive capacity. Eur. J. Innovat. Manag. 24 (1), 43–65. https://doi.org/10.1108/EJIM-02-2019-0043. Emerald Publishing Limited.

Xie, X., Fang, L., Zeng, S., 2016. Collaborative innovation network and knowledge transfer performance: a FsQCA approach. J. Bus. Res. 69 (11), 5210–5215. https://doi.org/10.1016/j.jbusres.2016.04.114.

Yin, R.K., 2018. Case study research and applications. J. Hospit. Tourism Res. 53.

Yuan, Q., Gasco-Hernandez, M., 2021. Open innovation in the public sector: creating public value through civic hackathons. Publ. Manag. Rev. 23 (4), 523–544. https://doi.org/10.1080/14719037.2019.1695884. Routledge.

Zhang, Y., Xi, W., Xu, F.Z., 2021. Determinants of Employee Innovation: an Open Innovation Perspective. Journal of Hospitality Marketing & Management, Routledge, pp. 1–28. https://doi.org/10.1080/19368623.2021.1934933.

Zobel, A.K., 2017. Benefiting from open innovation: a multidimensional model of absorptive capacity. J. Prod. Innovat. Manag. 34 (3), 269–288. https://doi.org/10.1111/jpim.12361. John Wiley & Sons, Ltd.

Zynga, A., Diener, K., Ihl, C., Lüttgens, D., Piller, F., Scherb, B., 2018. Making open innovation stick: a study of open innovation implementation in 756 global organizations. Res. Technol. Manag. 61 (4), 16–25. https://doi.org/10.1080/08956308.2018.1471273. Taylor and Francis Inc.