Orchestrating Crowdsourcing Platforms for Innovation: A Review of the Design and Governance Factors that Drive Value Creation

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Abstract :

In the search for innovative solutions, organizations are increasingly turning to innovation crowdsourcing platforms to access a large pool of diverse talent. This talent can provide solutions to complex problems that may be outside the organization's traditional scope of expertise. However, a challenge arises: designing mechanisms that foster trust and sustained participation without relying solely on guaranteed contracts, salaries, or rewards. In addition, the question arises as to whether it is more beneficial to integrate this crowd into the business model directly or whether it is preferable to use an intermediary to gain temporary access to this resource. In our research, we explore the design and governance factors that influence the value creation of these platforms. We do so through a systematic literature review, which allows us to identify the boundary resources that have been most frequently addressed in previous studies and discuss the opportunities and implications of their application.

Mots-clés : crowdsourcing, innovation, digital platforms, governance, design

Résumé :

Pour trouver des solutions innovantes, les organisations se tournent de plus en plus vers les plateformes de crowdsourcing d'innovation afin d'accéder à un large éventail de talents diversifiés. Ces talents peuvent apporter des solutions à des problèmes complexes qui ne relèvent pas du champ d'expertise traditionnel de l'organisation. Toutefois, un défi se pose : concevoir des mécanismes qui favorisent la confiance et la participation durable sans s'appuyer sur des contrats, des salaires ou des récompenses garantis. En plus, une autre question se pose : est-il plus avantageux d'intégrer directement cette foule dans le modèle économique ou est-il préférable de faire appel à un intermédiaire pour obtenir un accès temporaire à cette ressource ? Dans notre recherche, nous explorons les facteurs de design et de gouvernance qui influencent la création de valeur de ces plateformes. Pour ce faire, nous effectuons une revue systématique de la littérature, qui nous permet d'identifier les mécanismes de design et de gouvernance qui ont été le plus souvent abordés dans des études passées et d'examiner les opportunités et les enjeux de leur mise en œuvre.

Mots-clés : crowdsourcing, innovation, plateformes digitales, gouvernance, design

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1. INTRODUCTION

In markets where constant innovation is crucial for competitiveness, organizations need to leave their familiar environment where they make safe decisions, rooted in routines, knowledge and past experiences, to venture into new fields of knowledge that allow them to find optimal solutions to their problems (Afuah & Tucci, 2012). Internet technologies have made possible the emergence of digital platforms that connect geographically dispersed actors, which has facilitated the emergence of collaborative activities such as crowdsourcing, that occurs when an organization outsource the execution of a task to a heterogeneous crowd via the Internet (Howe, 2006). Innovation crowdsourcing platforms (hereinafter referred as ICS) are socio-technical structures that actively manage the interaction of heterogeneous groups of users for solving innovation problems. This study explores the challenges associated with their design and governance.

ICS represents an interesting alternative in the race for innovation, because it allows companies to temporarily access a broader and more diverse pool of talent, capable of contributing experiences and knowledge without the influence of organizational culture. In addition, they play a key role in facilitating transactions, reducing implementation costs, as rewards are based on performance, without any legal obligation to solvers. In addition, it represents an opportunity to create closer ties with potential customers by intentionally involving them in the value creation process.

Despite these benefits, reality shows that delivering on the value promise of crowdsourcing can be more complicated than anticipated. An illustrative example is the case of Netflix, which in 2006 took the decision to launch an open contest offering a prize of one million dollars to whoever improved its recommendation algorithm by 10%. Although the company managed to reach its goal after three years, this initiative provoked the exposure of strategic information and data from more than 500,000 customers. Therefore, Netflix had to

face challenges related to the leakage of private data, being flagged by the U.S. Federal Trade Commission (Singel, 2010).

Thus, strategically engaging the crowd in innovation processes is accompanied by numerous management challenges. There are difficulties in keeping innovation providers motivated as the remuneration model is often based on a "winners-take-all" relationship, leading to significant levels of attrition (Deng et al., 2016). Conditions of inequity in collaboration do not contribute to solving this problem. Previous research has observed that many platforms have implemented automated control systems without internal communication channels, leading to the dehumanization of work and placing participants at a structural disadvantage position.

From a technical point of view, there is a risk of losing control in operations involving globally distributed groups of people. Managing an uncontrollable number of contributions that exceeds the processing capacity of the platform represents a significant risk. The disparity in contributors' efforts implies that a large portion of contributions are of low quality. For example, it is estimated that on most platforms, 90% of users only consume information, 9% contribute occasionally, and only 1% contribute frequently (Oomen & Aroyo, 2011). In addition, leaks and abuses, such as mass spamming and identity theft, jeopardize intellectual property (IP) protection (Kittur et al., 2011). All these factors complicate stakeholders' value capture.

Governance plays a key role in addressing these challenges. Governance focuses on management's ability to control risks and implement strategic decisions (Gol et al., 2019). Past research in information systems has shown that platform governance is conducted through digital design elements or applications that act as an interface to regulate the relationship between the platform owner and users. These applications include, for example, registration systems, filtering tools, online contracts, reputation systems (e.g., points, badges, and leaderboards), and automated evaluation systems. Consistent with the information systems literature, in this study, we refer to these tools as boundary resources.

Consequently, in the present research, we are interested in answering the following question: *what are the design and governance factors that influence the value creation of ICS platforms*?

This question motivates us because there is a knowledge gap that we want to fill. Indeed, our review reveals that the design and governance dimensions have been explored in isolation, namely the influence of incentives (e.g. Brabham, 2010; Chandler & Kapelner, 2013), task management (e.g. Dissanayake et al., 2015; Zheng et al., 2011) and IP management (e.g.

Mazzola et al., 2018) Despite the valuable insights provided by past systematic reviews on crowdsourcing, these focused on defining it and exploring its process dimensions (e.g. Ghezzi et al., 2018). We also found reviews that cover the issue of governance but approach it from a global perspective of crowdwork platforms, which not only includes crowdsourcing but all forms of paid work on the Internet such as crowdlogistics and freelancing (Gol et al., 2019). However, there is a need for a systematic that provides an integrated view of the design and governance of these platforms from the perspective of the owners or managers and that focuses on crowdsourcing of innovation problems.

We are faced with a scattered literature, which makes it difficult to propose an interdisciplinary approach that combines both market (economics and strategic management) and technological (information systems) perspectives, necessary to study these socio-technical systems. Moreover, despite the constant differentiation in the literature between routine and innovation tasks (Pénin & Burger-Helmchen, 2012; Schenk & Guittard, 2011) there are few studies that clarify how these activities are designed and governed differently depending on the complexity of innovation tasks.

Our objective is to fill this gap by exploring the main factors associated with the design and governance of ICS platforms that may impact their ability to generate value for their stakeholders. We do this through a systematic literature review of 101 rigorously curated articles, which allows us to generate a repertory of the boundary resources that have been most frequently addressed by innovation crowdsourcing scholars. The coding of these articles allows us to obtain valuable information about the research context of these papers, which is essential for cross tabulations that provide a glimpse of the differences in the treatment of boundary resources according to the business models of ICS platforms.

Our research helps to clarify how these platforms are designed and governed differently depending on their business model. An integrative platform such as LEGO Ideas, which uses its own site to obtain new product ideas and then sells them directly to the client, does not have the same control and coordination structure, power distribution and profit sharing model as Tongal, a third-party platform that serves as an intermediary between a community of creatives in the audiovisual industry and multiple brands that demand content. We adopt a morphological approach in order to provide a reliable synthesis of the different design and governance strategies available and to address the opportunities and implications of their application.

The structure of this paper is organized as follows. First, we develop three fundamental theoretical considerations for conceptualizing the design and governance of ICS platforms.

Second, we present the methodology used for the selection of the sample of articles, which capture the current state of the literature. Third, we provide a synthesis of our systematic review.

2. THEORETICAL FOUNDATIONS

The concept of crowdsourcing denotes the strategic intent of a company to outsource challenges of varying complexity and modularity to distributed groups of individuals through the Internet (for a detailed review see Estellés-Arolas & González-Ladrón-De-Guevara, 2012). This definition highlights four essential aspects: (1) the existence of a problem by an organization, (2) the interest of individuals or groups in addressing that problem, (3) the facilitation of the process by means of a digital infrastructure, and (4) the acquisition of the solution by the seeking company in exchange for rewards. Among the numerous activities encompassed in this practice[1], we find crowdsourcing of routine tasks or microtasks, characterized by their rapid execution and reduced cognitive demand because they are qualitatively identical and standardized[2] . Examples of platforms offering such services include Amazon Mechanical Turk, CrowdFlower, ClickWorkers, Galaxy Zoo, and TaskMate.

However, in this paper we will focus exclusively on crowdsourcing of innovation problems, where users self-select complex problems that demand creative and inventive solutions in which they wish to make personal investments of time and effort, such as graphic design, multimedia production, new product creation, and patents.

The use of crowdsourcing in solving innovation problems emerges as a promising option for encouraging the participation of individuals with diverse backgrounds, expertise, and cultural perspectives, many of whom can contribute solutions to challenges that organizational entities have failed to solve internally, being especially beneficial for those organizations whose problems lie outside their field of expertise. This practice has led many companies to adopt crowdsourcing to take advantage of its potential in generating organizational value. For

[1] Our study does not cover other categories of online paid work such as crowdlogistics (e.g., Uber and Deliveroo), which involves activities linked to the distribution of physical goods or services; or freelancing, which consists of searching, evaluating and choosing an expert among numerous profiles of potential candidates (e.g., Fiverr and UpWork). Nor does it cover crowdfunding (e.g. Kickstarter and Ulule), which seeks funding from the crowd; or open source or free content platforms (e.g. Mozilla Firefox and Wikipedia), where users collaborate in the development of software applications.

[2] Within this category are evaluation tasks such as market surveys, feedback forms and organizational tasks such as text and image annotation and site rating. They are also called human intelligence tasks (HITs).

example, the My Starbucks Idea platform, conceived by the renowned coffeehouse chain, captured more than 160,000 ideas over a six-year period (between 2008 and 2013), resulting in the creation of iconic products such as the Hazelnut Machiatto, the Mocha Coconut Frappuccino and the Pumpkin Spice Latte (Livescault, 2022). Other notable companies such as LEGO Group (He et al., 2022), Threadless (Brabham, 2010; Kohler & Nickel, 2017) and Dell (Bayus, 2013) have also adopted this practice, demonstrating its potential to enrich the innovation process.

However, several factors can affect its process and jeopardize its strategic value, including the characteristics of the problem, the business model of the platforms that manage it, as well as the design and governance mechanisms for its organization. In this section, we outline the theoretical underpinnings of our research by addressing these issues in detail and highlighting their influence on the process of seeking new knowledge.

2.1. SEARCHING NEW KNOWLEDGE THROUGH CROWDSOURCING

We begin by clearly defining innovation problems, as the provision of an effective method for their resolution is the unit of value of innovation crowdsourcing platforms (Kohler & Chesbrough, 2019).

From a knowledge-based perspective, the main objective of organizations is to maintain competitive advantages by continuously seeking and assimilating new knowledge. Previous research supports the idea that a firm's knowledge and capabilities determine its ability to solve problems (Nelson & Winter, 1985; Nickerson & Zenger, 2004). However, a strategic question is what is the most efficient way to find this new knowledge? Our analysis assumes that the value of a solution is determined by the value of potential solutions and the cost of acquiring them.

From a problem-solving perspective, the effectiveness of the search for new knowledge is intrinsically linked to the nature of the problem. In this sense, companies tend to carefully select problems that, once solved, have the potential to generate unique and hard-to-replicate knowledge, before proceeding to plan where to conduct their searches (Nickerson & Zenger, 2004). This approach is largely justified because, on many occasions, the knowledge being sought does not yet exist.

The complexity of a problem can be evaluated from two fundamental dimensions: the level of interaction among the different knowledge components (Gatignon et al., 2002;

Nickerson & Zenger, 2004) and the number of components involved in the delimitation of the problem itself.

The level of interaction comprises the degree to which problems depend on the connection between different knowledge components. In low interaction problems, individuals can use their skills and experiences to propose solutions from their own local knowledge environment. Consider a software development project for a simple mobile application, such as a stopwatch. In this type of problem, each function of the application (start, stop, restart the stopwatch) can be performed independently by different developers and then easily integrated into the final product. In this case, the problem is decomposable, and the improvement of the solution comes from small modifications or additions that can be made individually without significantly affecting the system.

In contrast, high-interaction problems depend significantly on how different design decisions interact. These problems are more complex and require a deep understanding of multiple aspects to find an effective solution. Consider the creation of a movie. Here, each aspect of the project (script, direction, acting, production design, editing, visual effects, and music) interacts significantly with each other. For example, a change in the script may require adjustments in directing and acting, which in turn may affect editing and visual effects. Finding an effective solution involves each member of the team comprehensively understanding the overall vision of the film and working closely together to achieve cohesion and consistency in all creative and technical aspects of the project.

On the other hand, the clarity in problem delimitation is crucial for finding. However, this task is not simple, as it depends both on the tacit knowledge related to the problem and on the access to relevant information sources (Felin & Zenger, 2014). On the one hand, it is difficult to structure a problem without being influenced by biases associated with the company's local knowledge environment. On the other hand, sometimes managers do not know where to find the relevant information to solve a specific problem. Therefore, ill-defined problems are those whose knowledge components needed for their solution are hidden, either intentionally or by chance, which hinders the process of finding appropriate solutions (Natalicchio et al., 2017).

To find a solution to these problems, companies tend to start their exploration internally, relying on their own capabilities within their familiar environment, which encompasses their operating routines and accumulated experience. This local approach offers the advantage of considerable control over the process. However, these in-house solutions tend to be predictable

and incremental, as they rely on combining existing knowledge derived from past searches to improve a product or service in consistency with existing technical paths (Afuah & Tucci, 2012; Gatignon et al., 2002). However, the literature emphasizes that for a resource to become a sustainable competitive advantage, it must possess uniqueness and be difficult for competitors to replicate or imitate (Birkinshaw et al., 2016; Nooteboom et al., 2007; Wernerfelt, 1984). In this case how to overcome this incremental trap?

Environmental uncertainty and the difficulties related to the generation of new knowledge require organizations to interact more openly with their stakeholders. Through open innovation, firms can absorb knowledge flows "intentionally managed across organizational boundaries" (Chesbrough & Bogers, 2014). Despite the risks that this strategy composes, including the probable difficulties associated with knowledge appropriation (Katz & Allen, 1982) and potential opportunistic behaviors of other agents (West & Bogers, 2017); opening up this process may be necessary to unlock truly disruptive breakthroughs rather than simply iterating on what is already known. Radical innovation often requires a break from current competencies and trajectories, which involves taking greater risks and exploring unknown territories. This type of innovation has a deeper impact on the organization than incremental innovation, with a higher potential to generate significant returns (Chesbrough, 2003; Christensen, 2013). External searches are especially crucial when the problem demands unique competencies, involves user needs, or is unrelated to the organization's contextual knowledge (Bogers et al., 2017).

In this context, using crowdsourcing represents a viable alternative to escape this incremental trap. Crowdsourcing can be useful when the solution is beyond the company's field of expertise or when the knowledge sought simply does not yet exist. In this process, a company, known as a "searcher," poses the problem on its own platform or through an intermediary in the form of an online contest (Acar, 2019; Karachiwalla & Pinkow, 2021; Majchrzak & Malhotra, 2013), inviting a crowd of "solvers" to compete to achieve a specific goal. At the end of the process, the client company selects the best solution(s) and purchases them, offering a reward to the creator.

This format is especially beneficial when the problem is complex and difficult to delimit because the searcher does not necessarily know the location of the relevant knowledge, so it cannot simply be acquired (in the markets) or hired (designate an expert). In these cases, it is preferable to invite potential individuals who possess it or who are in a privileged position to find it to reveal themselves (Jeppesen & Lakhani, 2010; Malhotra & Majchrzak, 2014).

Crowdsourcing provides a crucial mechanism in this context, shifting the responsibility for identifying relevant knowledge to the solvers. These individuals can assess if the solution resides within their local knowledge environment and, if so, can find a solution more easily and at less cost. This solution can then be transferred to the organization, thus converting previously distant searches into local searches (Afuah & Tucci, 2012; Schenk et al., 2019).

Although in some cases self-selection is a more efficient mechanism than appointing an expert, there is still no certainty whether the agent capable of finding the optimal solution will self-reveal itself or even if it really exists. This makes the effective execution of the transaction conditional on the innovation seekers' satisfaction with the options presented on the table at the end of the process. In particular, when the task is complex and difficult to delimit, it is difficult to precisely codify ex ante contracts that make it possible to evaluate the performance of the parties once the exchange has been concluded and to ensure effective remuneration for their efforts. Sometimes even the client firm is not able to establish objective indicators to assess the value of a solution. These factors lead to high uncertainty between the parties, which can have a significant impact on transaction costs (Williamson, 1996).

On the other hand, being open to participation and offering mutual benefits, this format is especially useful for connecting companies with a larger number of geographically dispersed heterogeneous talents. Different dimensions of diversity, including cognitive diversity (Frey et al., 2011; Pénin & Burger-Helmchen, 2012) and cultural (Bockstedt et al., 2015; Chua et al., 2015) are especially relevant for effective innovation problem solving. In addition, more people performing independent searches (parallel effect) increases the probability of obtaining an optimal result (Boudreau et al., 2011) and, in turn, induces higher levels of competition (stimulation effect), so that participants must exert more effort if they want to increase their chances of winning .

However, scalability also entails difficulties linked to the increased resources required to process a large number of solutions (Patel et al., 2023; Piezunka & Dahlander, 2015) and excessive competition that deters the participation of competent competitors (Liu et al., 2014). These difficulties affect less crowdsourcing based on contests involving clearly delimited complex problems, where it is possible to establish objective evaluation criteria that make it easier to rank the best competitors or "superstars" (Felin & Zenger, 2014; Zhang et al., 2019). Indeed, when it comes to innovation, companies seek to identify the best proposition as opposed to scalability (Girotra et al., 2010; Terwiesch & Xu, 2008) as pointed out by Wooten & Ulrich

(2017): "in the field of innovation, extremes are crucial, while the average or the norm lacks relevance".

In summary, innovation crowdsourcing offers an alternative to search for new knowledge and overcome the incremental trap, providing new mechanisms such as self-selection and the transformation of distant searches into local ones, which distinguishes it from traditional methods such as internal search, marketplaces, or the appointment of experts. Innovation contests are the format of choice because they allow the distribution of mutual benefits and the emergence of the best-performing competitors. Although this activity is not free of limitations, in this research we defend the idea that the effective management of the process plays a fundamental role in mitigating the associated risks, a topic that will be discussed in depth later.

The complexity of innovation problems imposes difficulties that can affect the business model and the design and governance of these systems. For example, a problem that is difficult to delimit would require the specific competencies of an intermediary to establish objective evaluation parameters, which would allow the efficient classification of contributions. Likewise, a platform where communication between innovation providers is restricted would hardly be able to effectively solve problems that require a high interaction between knowledge components. The relationship between these dimensions will be analyzed in greater detail in the following sections.

2.2. INTEGRATED OR PROPRIETARY? CROWDSOURCING PLATFORM MODELS OF INNOVATION PROBLEMS.

A digital platform is defined as a technological environment that offers services and functionalities through the Internet, enabling interaction between users, applications and data (Tiwana, 2014). The prevalence of this model is attributed to the rapid development of information and communication technologies (ICTs), which have facilitated seamless interaction between geographically dispersed actors (Chen et al., 2022; Jacobides et al., 2019). By providing the socio-technical infrastructure that makes possible the encounter between seekers and solvers and the active management of their interactions, it has enabled the emergence and expansion of business models based on innovation crowdsourcing.

When a company decides to strategically involve the crowd in their innovation processes, their products or services become a platform (Boudreau & Lakhani, 2013). To

generate revenue from it, executives need to think about what kind of business model makes the most sense, being able to develop integrated platforms (company hosted) (Bayus, 2013) or intermediary platforms (Boudreau & Lakhani, 2009; Simula & Ahola, 2014). Integrated platforms use the solutions provided by their crowd[3] to sell products or services directly to their customers. For example, Threadless (https://www.threadless.com), has experienced remarkable success with a business model centered on their community (Brabham, 2010; Kavaliova et al., 2016; Kohler & Nickel, 2017). Rather than relying on its own team of designers, the value creation process occurs directly in the site's ongoing contests. Each week the company receives hundreds of submissions from experts and amateurs and acquires the 10 most innovative and attractive designs. Curation occurs through a voting system of its own community members, which in 2019 numbered more than 120,000 designers (Kohler & Nickel, 2017). Their revenue stream basically consists of the sale of T-shirts through their e-commerce site. Winners receive a gift card with a variable amount that can reach US$1,500 and other prizes such as merchandising. Note, however, that, in 2017, the company was selling about 1,000 T-shirts a day and earning about $450,000 (gross) in cash for each design (Kohler & Nickel, 2017). This gap forced the company to switch to a commission-based revenue sharing model.

An intermediary platform, or broker, is responsible for establishing the necessary connections between seeking companies and innovation providers. For example, Kaggle (https://www.kaggle.com) is a specialized platform that serves IT-intensive organizations such as Microsoft, Intel or Facebook to identify valuable machine learning problems and turn them into contests, providing them with temporary access to its base of expert and passionate data science users, which in 2020 reached more than 530,000 (Khasraghi et al., 2020). The platform's revenue streams consist mainly of commissions paid by innovation seeking companies for organizing contests for commercial purposes[4]. The minimum prize for running a competition in Kaggle is US$25,000, but it can reach millions of dollars. Kaggle provides consulting services that go beyond the mediation between the parties, but also provides technical assistance and support in launching, monitoring and evaluating the competition and other marketing services around its platform.

[3] This crowd can be made up of individuals within the organizational structure, which is called internal crowdsourcing (Beretta & Søndergaard, 2021; Lobova & Dolzhenko, 2015), or from individuals external to it, mainly customers who are fans of the brand.
[4] Kaggle offers free options for contests organized by members of its community, as well as reductions and grants for research-based contests from academic institutions and non-profit organizations.

These two models have their distinctive characteristics, summarized in Table 1, which, depending on the case, offer advantages and disadvantages. Organizations that opt for an integrated platform have as their main incentive to maintain a monopoly on the benefits of the process, so this infrastructure generally serves only one innovation seeker. In contrast, intermediary platforms have a legitimate interest in attracting more innovation seekers, as their primary incentive is to increase their return on investment (Schenk et al., 2019).

As a phenomenon involving internet and web technologies, innovation crowdsourcing platforms often exhibit network effects (Katz & Shapiro, 1994). In particular, intermediary platforms can be seen as a two-sided relationship. Innovation seekers want to benefit from a large diverse crowd, which increases their chances of the success of distant search (Jeppesen & Lakhani, 2010; Poetz & Schreier, 2012) and, at the same time, more contests attract more solvers. For example, the usefulness of 99Designs, a graphic design crowdsourcing platform, for a company looking to revamp its product packaging is directly dependent on the number of available designers, and vice versa. This creates a spiral of attraction where both parties mutually benefit from the increased participation of the other group. However, integrated platforms, typically owned by prominent firms such as IBM, SAP and Procter & Gamble, attract a large number of followers of their brands, but because they are focused on a single entity, they lack these network externalities that allow them to reach critical mass.

Integrated platforms excel at building close relationships with the crowd. While solvers who join an intermediary platform generally seek access to more contests without establishing lasting bonds with innovation seekers, members of integrated platforms participate with the intention of connecting with the brand due to their affinity and commitment to its values and goals (Blohm et al., 2018; Brabham, 2010). Therefore, the latter offer an obvious advantage, especially when problems are not strictly technical and require building strong relationships so that solvers can devote greater efforts to finding the best solutions (Kosonen et al., 2014)..

However, a model based on intermediation can be largely justified by transaction costs (Williamson, 1981). Given the bounded rationality and opportunistic nature of the parties involved, conducting crowdsourcing transactions involves significant costs, especially when information is uncertain. What ensures that innovation seekers will effectively and equitably pay innovation providers? The famous paradox of Arrow (1972) applies in these situations where the true value of a solution is only known once all possible solutions have been revealed. At the same time, what guarantees that solvers will not divulge strategic information or offer their solutions to competitors? Opportunism prevents actors from exchanging knowledge.

These costs are increased when innovation seekers and innovation providers do not regularly engage in crowdsourcing activities (Schenk et al., 2019). When a solver participates in a one-time competition, they may not care about their reputation, which increases the likelihood of engaging in opportunistic behavior. However, when they participate on a regular basis, reputation becomes crucial.

Table 1: Comparative between integrator and intermediary platforms

CHARACTERISTICS	INTEGRATOR	INTERMEDIARY
Number of seekers	Devoted to one single seeker	Devoted to many seekers
Incentives	Preserve exclusive benefits	Make profit by retaining fees for connecting both parts
Platform complexity	Two main actors: focus firm and solvers	Multiple sides: seekers, solvers, and a third-party firm
Size of the crowd	Dependent on firm size and investments (mostly clients and brand enthusiasts)	Large (unknown and more heterogeneous crowd)
Relationships	Closer to the firm	Less likely to share common values
Transaction costs	Dependent on the frequency of CS operations	Mitigated by the presence of the third party
Resources and competences	Skills in the CS process difficult to acquire	Specialized in the process
Nature of the crowd	Community	Fixed resource available on demand
Examples	Threadless, Lego Ideas, Dell IdeaStorm, MyStarbucks Idea, OSRAM LED	Innocentive, TopCoder, Kaggle, 99Designs, eYeka, Taskcn

Intermediaries capitalize on these risks and offer a value proposition based on reducing these costs by providing mechanisms to limit this type of behavior using their distinctive competencies. For example, Kaggle and TopCoder (https://www.topcoder.com) guarantee the effective delivery of prizes in some of their contests. While Wazoku Crowd (https://www.wazokucrowd.com) (formerly Innocentive) usually protects the identity of searchers, which prevents the leakage of strategic information. In many occasions, the presence of an intermediary is necessary to create the right stimuli for participation, absorbing these risk factors and improving user experience (Troll et al., 2019). Intermediaries develop the competencies and skills necessary for the successful management of these projects, including problem delineation, IP transfer, contract management, data management, establishment of key performance indicators (KPIs) and reputation systems. As integrated platforms are anchored in

their established organizational structures and innovation practices, they have difficulties sustaining the coordination efforts needed to ensure the success of these projects, especially when they do not frequently use crowdsourcing.

However, developing these types of skills is not only costly, but also requires considerable time and expertise (Prpić et al., 2015). Hence, the intermediation model represents a viable alternative for financing the considerable costs associated with maintaining an online community. Companies such as Google and Wazoku, which recently acquired Kaggle and Innocentive respectively, use this approach to launch their own contests on these platforms, while offering other companies a temporary access to their user base in exchange for a commission.

However, opening the platform to multiple organizations in search of innovation poses certain challenges. A major concern lies in the risk of eroding the value of the crowd as a sustainable source of competitive advantage (Birkinshaw et al., 2016; Nooteboom et al., 2007). By allowing temporary on-demand access to the user base, the organization would lose the monopoly on the benefits derived from exclusive control over the potential inputs of this strategic resource. Internal competition among multiple contests within the platform would result in owners no longer being able to guarantee their own access to the best competitors.

In short, the choice between an integrated or intermediary platform model depends on the organization's ability to control the potential benefits and costs of transactions. Many platforms such as eYeka (Kohler, 2015) and Travel2Change (Kohler & Chesbrough, 2019) have pivoted from an integrated to an intermediary-based model. While others such as Lego have successively reshaped their model until finding a formula that works for their purposes, moving from a platform, where fans could order customized products with high operational costs (Design byMe), to one based on an ideas forum that presented scaling problems (Lego Cuusoo), to finally stabilizing with Lego Ideas, characterized by a system based on reputation mechanisms and gamification (Kohler, 2015). These cases illustrate that managing a crowdsourcing platform for innovation problems is a considerable challenge. It involves addressing the complexity of managing ecosystems where relationships between diverse groups of users can generate conflicts due to their individual interests and motivations. In the following, we will discuss the implications related to the design and governance of these platforms.

2.3. CROWD OR COMMUNITY: ALTERNATIVES FOR THE DESIGN AND GOVERNANCE OF INNOVATION CROWDSOURCING PLATFORMS

Innovation crowdsourcing platforms operate under a different set of rules than traditional firms. First, participants are not formally employed by these platforms; rather, they contribute voluntarily and independently, choosing the problems they wish to address. As a result, owners lack the conventional tools of employee-employer engagement, such as wages and social security benefits (Simula & Ahola, 2014).

On the other hand, crowdsourcing regulations differ from conventional market arrangements. Here, it is not simply a matter of innovation buyers acquiring solutions from innovation sellers. There are no prior contracts or compensation guarantees for the solvers, which implies an inherent risk as only the best gets rewards. These particularities limit the authority of administrators and hinder the traditional governance of these systems.

Governance, understood as the system of rules and norms that an organization uses to manage risks and achieve its objectives (Bailey et al., 2003, p.27) faces particular challenges in this context. The literature on digital platforms has shown that they govern their users through technical structures embedded in their interface, from simple buttons to sophisticated predictive algorithms. For example, the research of Cui et al. (2017) show how a system based on supervised learning and reinforcement learning uses users' past behavior to efficiently assign complex tasks to solvers more likely to provide appropriate solutions.

The design of software tools plays a crucial role in regulating the interaction between the platform owner and users, especially in remote environments. In this research, we refer to these tools as "boundary resources" (adopted from Ghazawneh & Henfridsson, 2013). These resources have two main functions: to provide contributors with the means to perform tasks efficiently and autonomously (resourcing) and/or to exercise control functions (securing) to ensure that users' actions are aligned with behaviors deemed appropriate, optimizing and, in some cases, automating the monitoring of activities.

To illustrate this concept, let's consider boundary resources for gatekeeping (input control). If platforms lacked technologies such as Re-Captcha, QR codes, SMS, or email, it would be impossible to verify the identity of users. These technological resources are fundamental to prevent vulnerabilities in the site, from massive spam to more serious problems such as identity theft.

In choosing a design and governance model, managers face the critical question of how to organize the crowd to generate the knowledge sought by client firms. In the literature, two antagonistic governance models are recognized: centralized and decentralized. Table 2 summarizes the characteristics of these approaches based on key governance dimensions, including (1) decision making, (2) control and coordination, (3) the nature of relationships, and (3) incentives and value distribution.

Table 2: Centralized vs. decentralized governance

CHARACTERISTICS	CENTRALIZED GOVERNANCE	DECENTRALIZED GOVERNANCE
Decision making	Platform concentrates decision-making power and expects user compliance with pre-established policies. Lack of transparency in decision-making processes.	Distribution of decision-making among members.
Workflow control and coordination	**Control mechanisms:** Control mechanisms: formal control, the platform supervises strict compliance with the established rules. Rewards or sanctions based on behaviors that are considered desirable for achieving strategic objectives. **Performance assessment:** focused on mechanisms established by the platform, generally automated by using algorithms. **Rules and standards:** uniform for all members.	**Control mechanisms:** informal control, based on social norms (clan control) and self-control. The community rewards or sanctions based on behaviors that are aligned with common objectives and values. **Performance assessment:** implements self-assessment mechanisms and sometimes promotes crowdvoting to classify the best solutions. **Rules and standards:** more flexible and consensus based.
Nature of the relations	The relationship with the crowd is hierarchical in nature. Restricted communication channels. Characterized by competitive relationships among users.	Communication channels enable the exchange of resources among members. Their close collaboration allows the emergence of connected networks of different sizes (communities and teams) that develop shared values and objectives.
Incentives and value distribution	Mainly based on pecuniary incentives that trigger extrinsic economic motivations.	They combine monetary and non-monetary incentives, acting on intrinsic and extrinsic motivations.

In centralized models, management concentrates power, making the fundamental decisions and expecting user groups to conform to its policies, which are usually restrictive (Tiwana, 2014). This strategy ensures rigorous compliance with protocols and standards through the oversight of an accountable central body, which builds trust among customers (King, 1983). Trust in the system implies the assurance that the innovation process will be

developed in a transparent manner, with a mediator available in case of conflicts or opportunistic behavior by other economic agents.

However, overly restrictive policies can have counterintuitive effects, preventing organizations from tapping into the productive potential of the crowd. For example, some Kaggle contests impose restrictions or participation criteria based on geographic areas or experience levels. By being selective, managers take the risk of attracting users with homogeneous characteristics, which hinders the emergence of creativity and diversity of perspectives (Leonard-Barton & Swap, 1999). In addition, restrictive policies may cause negative effects related to procedural fairness, leading to a loss of trust in the platform (Fieseler et al., 1999). Users may perceive that they are being discriminated against or treated differently because of their origin or culture (Mazzola et al., 2020).

In contrast, decentralization implies the distribution of responsibilities and decision making based on openness and consensus. This strategy is characterized by imposing fewer restrictions, which eliminates hierarchical barriers with users, fosters agility and adaptability, and reduces the risk of abuse of power, improving equity (Gol et al., 2019). Despite these benefits, decentralization presents challenges, such as the lack of consensus due to the inherent difficulty in decision making when there is a great diversity of opinions. In addition, there is the risk of conflicts of interest and opportunistic behavior by economic agents. For example, on platforms such as Threadless, where users vote to decide which designs will be commercialized, many users try to influence each other's decision and may even create fake accounts to promote certain designs (Bauer et al., 2016).

Despite the associated risks, the decentralized strategy demonstrates that the platform trusts its users, which implies the conviction that their behaviors are aligned with the objectives and that the technological resources provided are used for that purpose. Platforms that trust users tend to grant them greater autonomy, which implies freedom and discretion in the use of their own methods and greater control over their actions, which has a positive impact on participation and performance (Ebner et al., 2009; Zheng et al., 2011). For example, in data modeling contests, the pursuit of new models and algorithms causes data scientists to develop a sense of self-efficacy and become more focused on the task, increasing their intrinsic desire to devote time and effort (Chen et al., 2020; Garcia Martinez, 2015).

Centralized models are also characterized by formal control and coordination, involving bureaucratic monitoring of compliance with standardized and non-negotiable rules. Control theory in management stresses the importance of formal organization to coordinate activities

that can hardly be regulated by flexible or consensus-based mechanisms (Adler & Chen, 2011). For example, input control systems such as registration forms, systems to detect automated program traffic (e.g., ReCaptcha), and authentication (identity verification) are critical to prevent site vulnerabilities such as mass spam, identity theft, and malicious data retrieval (phishing). Such formal arrangements contribute to the maintenance of order and cohesion of user groups, especially when they involve pre-established institutional rules and procedures that are non-negotiable and involve the protection of individual rights and the enforcement of contractual rules. However, monitoring behavior on platforms with hundreds or thousands of users is becoming increasingly complex. Therefore, most centralized platforms have introduced automated monitoring systems that recognize misbehavior and disqualify participants who do not comply with the established rules (Fieseler et al., 2019).

In addition to this tendency to adopt algorithmic evaluation (as opposed to direct feedback), there are other computerized control policies that lead to the dehumanization of work. In line with the discourse of protection and anonymity, on many platforms users have neither their photo nor their name, but rather an avatar and an identification number (ID) (Howcroft & Bergvall-Kåreborn, 2019). Moreover, lacking internal means of communication, these users are marginalized and structurally disadvantaged, which prevents the organization of a collective agency that would allow them to exert pressure, hindering any attempt to restore a balance of power. These measures have defined distant and hierarchical relations with managers and have turned centralized structures into spaces where competition between solvers is the rule.

In contrast, more decentralized models favor more collaborative spaces, with informal control methods based on individual (self-control) or social (clan control) norms. Self-control implies that each individual sets his or her own goals and monitors their fulfillment independently (Tiwana, 2014). For this purpose, gamification has been extended to monitoring functions, creating systems based on points, medals, and achievements that provide instant feedback and allow solvers to evaluate their own performance and progress on the platform (Koivisto & Hamari, 2019).

In contrast, clan control consists of conferring control and coordination functions to the community. In this paper, we define communities as interconnected networks of individuals who share common goals and values through interactions mediated or supported by platform technology (based on Porter, 2006). Decentralized platforms activate communication by facilitating the process of socialization, through which members establish ties, develop

practices and rituals, and consolidate common goals and values (Ouchi, 1979). Communication facilitates that, over time, community members develop from simple implicit rules to more sophisticated systems of sanctions that punish users who do not follow the rules. Once administrators are confident that the community is trying to achieve the right goals, many costly forms of auditing and monitoring can be eliminated. For example, specialized programming and data science platforms such as Kaggle and TopCoder have implemented collaborative spaces such as forums and solution sharing spaces that promote resource and knowledge sharing and even allow for the formation of self-organizing teams (Garcia Martinez, 2015). This allows decentralizing control, giving the power of moderation to these groups, which has been shown to have a positive effect on trust and sense of procedural justice (Franke et al., 2013).

Finally, one of the most important challenges posed by the governance of these platforms is to distribute the benefits in a way that harmonizes the interests of the different economic actors. This is achieved through incentives that act on intrinsic motivations, where individuals derive pleasure from performing a task because it is fun and challenging (Deci & Ryan, 1985), and extrinsic motivations, which depend on an external objective, ranging from economic motivations such as monetary rewards, product prizes and the assignment of intellectual property, to learning and professional development motivations, and even social motivations, such as status, recognition and hierarchy through a reputation system based on points, rankings or medals (Amabile, 1993). Thus, motivations are categorized according to the degree of relative autonomy, i.e., the freedom from external influences that individuals have when deciding to perform in a task.

Decentralized platforms have the advantage of greater flexibility to combine both types of incentives. In particular, having communication channels that allow collective organization and collaboration, they can satisfy social motivations aimed at improving their status, such as self-marketing, but even more noble ones such as altruism and reciprocity (Kosonen et al., 2013). They also have boundary resources such as reputation systems in the form of rankings, which provide them with a showcase to expose and be recognized for their achievements. Centralized platforms find it more difficult to create incentives that go beyond cash prizes; however, they can still come up with challenging problems and combine them with game-based experiences to appeal to intrinsic motivation (Morschheuser et al., 2019).

In summary, the design and governance of innovation crowdsourcing platforms require the implementation of boundary resources that allow the distribution of power, control and coordination of workflows, and the sharing of benefits among the various user groups. The

strategic combination of these mechanisms ensures that tangible operability is aligned with the platform's objectives. Although we have compared these two models antagonistically in this section, the reality is that many current platforms adopt a more flexible governance approach, with hybrid models that seek a balance between control and openness. Furthermore, based on our analysis in the previous sections of this paper, we recognize that choosing boundary resources depends on an organization's prospective goals for knowledge formation (Nickerson & Zenger, 2004). Thus, the choice between centralized or decentralized models depends on the type of problems the client firm is looking for and its business model.

Within the framework of the present research, we chose to conduct a systematic literature review to identify the design and governance factors that influence the ability of ICS platforms to create value for their stakeholders. In the next section, we will detail the method of our study, including the search parameters and data extraction, and provide a summary of the descriptive statistics of the studies selected for our analysis.

3. METHOD

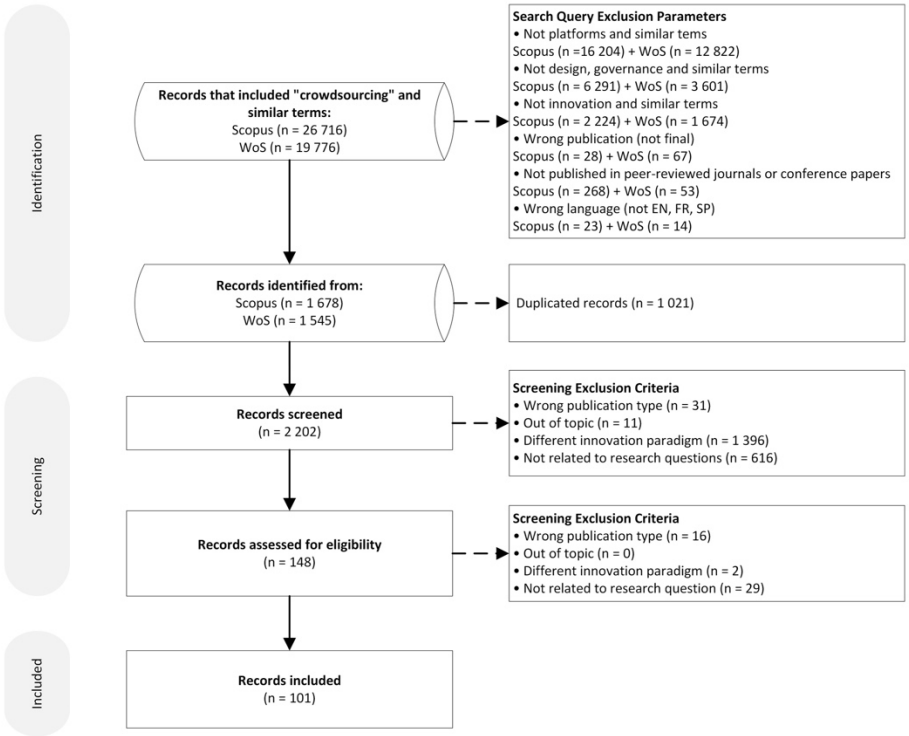
We conducted a systematic literature review with the objective of exploring the relationship between design and governance factors and the value creation of ICS platforms. This rigorous selection and coding process makes it a reliable, objective, and reproducible contribution to the advancement of the ICS platform design and governance literature. Below, we detail the steps for the selection of the 101 papers that were reviewed in this research.

3.1. SEARCH AND DATA EXTRACTION PARAMETERS

We began our review with a literature search following the recommendations of Boell & Cecez-Kecmanovic (2015); Tranfield et al., (2003). We simultaneously used Scopus and Web of Science (WoS) libraries, which host recognized scientific journals and have an efficient system to execute searches with a high level of precision and reproducibility (Gusenbauer & Haddaway, 2020). We adopted a multi-step process, with a chain of parameters with the purpose of identifying the most relevant works on design and governance of innovation crowdsourcing platforms from the appearance of the term "crowdsourcing" in June 2006 to November 2023 (see PRISMA diagram in Figure 1).

Search filters (see string search in Appendix 1): (1) we searched for articles containing the word "crowdsourcing" and similar terms such as "crowdwork" in the title, abstract or keywords. As our research focuses on analyzing the role of platforms as technical structures that facilitate the process, (2) we filtered studies containing "platform" or associated terms such as "ecosystem", "community" or "marketplace". Considering that contests are the format of choice for the organization of these projects, (3) we include synonyms for "contest". The scope of our research comprises crowdsourcing platforms for "innovation" activities, therefore, it is important to add a parameter that (4) includes similar terms such as "creativity", "inventiveness" and "macro-tasks". This also helps us to prevent the appearance of studies involving routine tasks. Finally, we established a parameter related to "design", "governance", "architecture" and "administration", which allows us to identify works that have been interested in the management of these platforms, without jeopardizing the interdisciplinarity of our research. Proof of the effectiveness of this strategy is that we obtained representative studies from more than 25 disciplines, including computing and information systems (34.7%), engineering (13.7%) and business, management and economics (10.8%).

Figure 1: PRISMA diagram with screening search results



Our semantic search revealed signs of a low representativeness of studies related to the design and governance of ICS platforms, which constitute less than 8% of our first search. The next step was to implement a filter to select exclusively articles from peer-reviewed scientific journals and conference proceedings with definitive publication status. This measure reduced our list to 1 678 articles from Scopus and 1 545 from WoS.

Exclusion criteria: we then proceeded to perform a detailed review of the titles and abstracts with the assistance of the Rayyan.ai tool. We checked that these papers did not fall into the exclusion criteria such as being under review, having been subject to retraction or dealing with innovation paradigms other than crowdsourcing (more details in Table 3). In total, 148 articles passed this stage. Subsequently, we conducted a second review through a cross-sectional reading to verify the relevance of each article in relation to our research objectives. As a result of this process, we obtained a final list of 101 selected articles. Subsequently, we carried out a thorough and comprehensive reading, coding the data in our extraction tables following the recommendations of (Webster & Watson, 2002).

Table 3: Screening specific exclusion criteria

Exclusion Criteria	Description
Wrong type of publication	Wrong type of publication: studies that are still under development, with a high similarity to other publications by the same authors, that did not generate results or that were subject to retraction.
Out of topic	Articles that were not related to the paradigms linked to innovation or crowdsourcing.
Different innovation paradigm or type of CS	Papers that addressed the innovation literature in a general way or that used CS as a data collection method, but focused on phenomena other than CS (e.g., algorithms, machine learning or large language models). This includes the study of other paradigms such as social networks (e.g., Twitter), open source, independent work or wikis (e.g., Wikipedia), as well as other types of CS such as collaborative logistics, spatial CS, microtasks (e.g., MTurk), or crowdfunding.
Not related to the research questions	Studies that dealt with the ICS phenomenon, but whose subject was outside the scope of our research, such as definitions, typologies and task assignment algorithms, as well as those that approached the phenomenon exclusively from the perspective of the solvers or companies providing the tasks.

3.2. MATRICES AND DATA OPERATIONALIZATION

Prior to the detailed reading and analysis of the selected articles, we constructed a matrix to extract the relevant characteristics of each study. We tabulated the fields describing each one (e.g. objectives, research questions, theories, method, study setting, results, originality, and limits). Table 4 presents other fields of interest included based on the research questions and

terms addressed in our theoretical framework. Initially, we opted for a flexible coding strategy, completing the corresponding fields with the terminology used by each author. This resulted, for example, in the boundary resources field, in similar entries such as "limits to entry", "participation restrictions" and "participation policies", which were later regrouped into a single category called "entry policies".

Table 4: Fields of interest included in the study's extraction matrix

FIELD	DESCRIPTION
Boundary Resources	Governance mechanisms used for control and coordination, distribution of decision-making power, regulation of relationships and distribution of benefits.
Design Applications	Subsystems and software applications that extend the functionality of the central system and allow user interaction with the platform.
Value Propositions	Expected benefits or solutions that the platform offers to its stakeholders.
Perspective Analysis	This field identifies the perspective of the study from the point of view of the stakeholders: searchers, solvers, platform owners or the community.
Platform Model	Level of integration of the crowd to the platform business model. Integrated or bi(multi)phased platforms.
Variables of Interests	Independent variables identified mainly in empirical studies.
Outcome Variables	Dependent variables identified mainly in empirical studies.

Once the tabulation process was completed, we proceeded to perform a statistical analysis of our database, making frequency tables and cross tables. This process allowed us to group the articles according to their coincidences, thus identifying the predominant themes and existing gaps in the literature. Below, we provide a summary of the descriptive statistics of our sample.

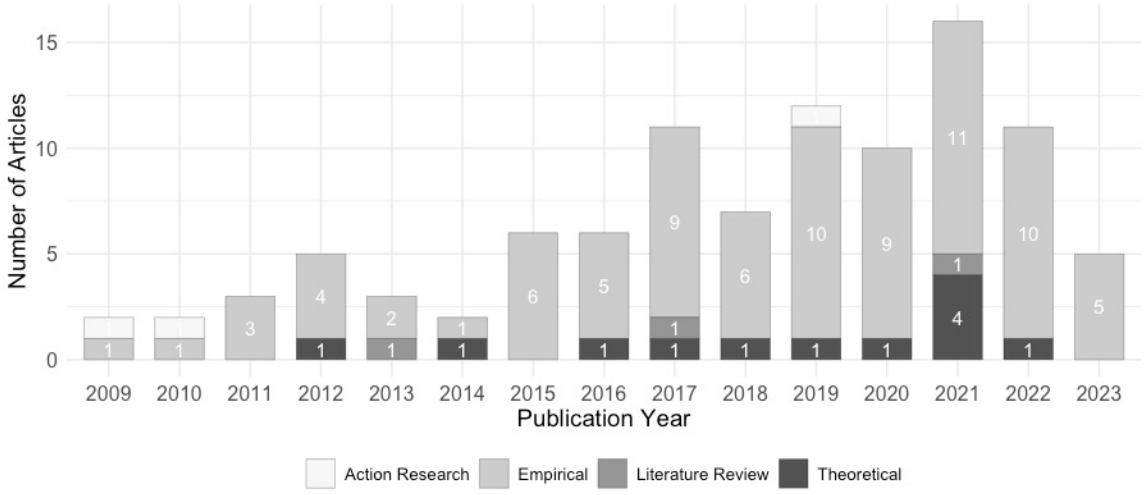
3.3. DESCRIPTIVE RESULTS

Our study comprises a representative sample, which allows us to infer the composition of the literature on innovation crowdsourcing design and governance. The following is a summary of our data analysis[5].

[5] It should be noted that the following variables can compose one or more options in each article: "Theories" and "Analysis Perspective". In the variable "Platform Model" we had 13 observations without data because it is a conceptual paper or because the document does not specify whether the context is in integrated or intermediary platforms.

- As we can see in Figure 2, most of the articles were published between the first half of our period between 2016 and 2023 (77.22%). This indicates that the interest in the design and governance dimensions of these platforms is recent, however, there seems to be a declining trend from 2022 onwards. Eighty-two percent of our articles are empirical, while there is less representation of conceptual research (12%), which establishes the theoretical definitions of the topic; literature reviews (3%) and action research (3%).

Figure 2: Distribution of selected articles by type and by year



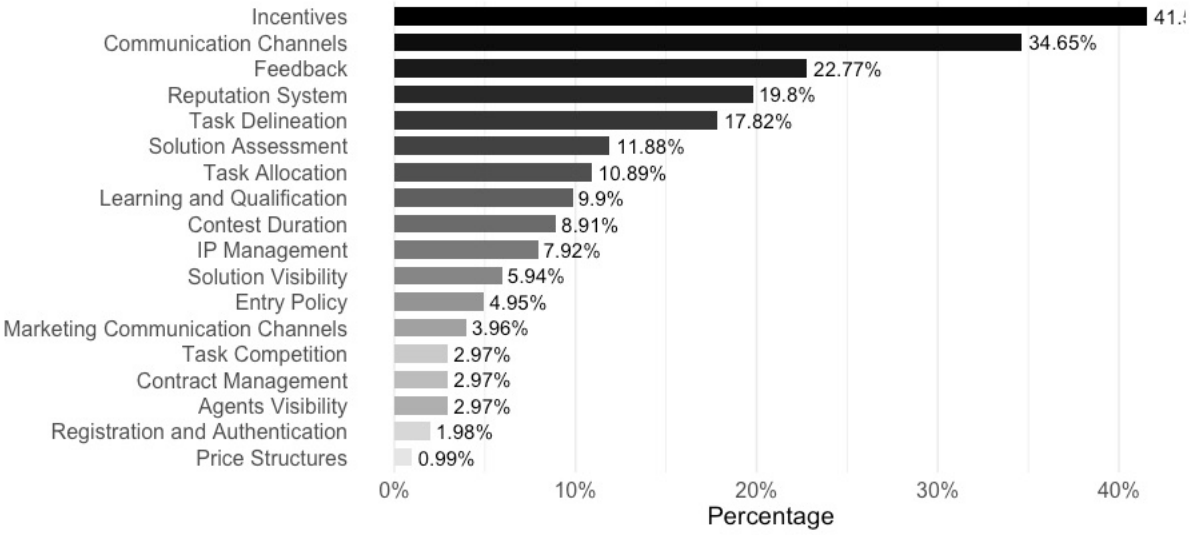
- A large proportion of articles were developed in the context of single-case (58%) and multiple-case (16%) studies. Studies with experimental methods were less representative: field experiments (10%), laboratory experiments (1%) and computer simulations (1%).
- The most frequently applied theories are self-determination theory, which appears in 18% of the papers, tournament theory in 11%, social network theory in 8% and auction theory in 5%.
- More than 58% of articles take solvers as the key unit of analysis, followed by the community approach with 13%; platform owners with 13% and requesting firms with 7% respectively. An estimated 28% of articles take a holistic view, focusing on two or more stakeholders at a time.

- In addition, 52% of these investigations focus on intermediary platforms, 24% on integrated platforms, and 12% compare the two models.

4. DESIGN AND GOVERNANCE OF ICS PLATFORMS THROUGH BOUNDARY RESOURCES

There is a perspective in the literature that task self-selection behavior and subsequent performance of innovation providers is highly dependent on individual traits, such as knowledge, competencies, experiences, and past performance (Blohm et al., 2018; Patel et al., 2023), in addition, to cultural and demographic traits (i.e., place of residence, age and income level, and risk aversion) . However, one idea that persists in the literature is that managers use different design and governance mechanisms to foster behaviors that lead to the achievement of strategic goals. In this section, we present the results of our exploration of the design and governance factors that influence value creation in the context of ICS platforms. We do so by offering a morphological approach, which allows us to identify interdependencies between boundary resources, problem type and platform business model. In addition, we point out existing gaps in the literature and offer suggestive insights for future research.

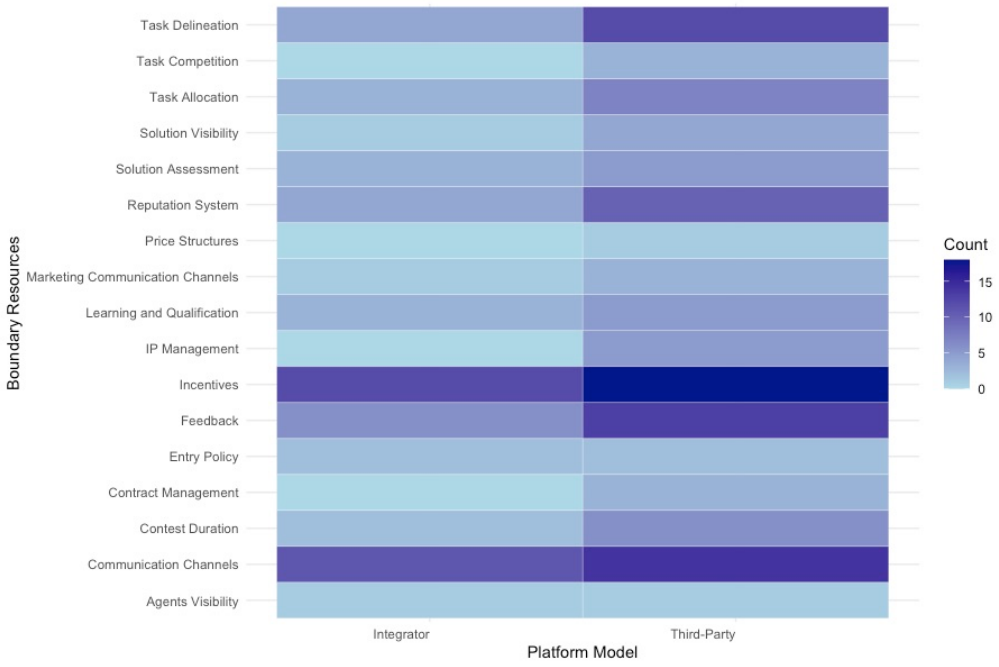
Figure 3: Proportion of items according to boundary resources



Our results suggest that ICS platforms have different boundary resources to regulate the remote relationship with their stakeholders and to control the potential risks inherent to this activity. Figure 4 shows the percentage of articles where the implications of each of these mechanisms have been explored.

However, flexibility in the use of these resources depends largely on their business model. Let us remember that integrated platforms have their own technological infrastructure, which allows them not only to have complete control of operations but also to concentrate the monopoly of the benefits of the crowd as a resource with the potential to add value. On the other hand, the presence of a new player complicates the management of the intermediary platforms, which must deal with the client firms' own interests, which entails greater interactions and risks to control. Our systematic review showed that the literature deals with the influence of these factors in different ways, depending on the context of the research. In Figure 4, we can see that some boundary resources such as IP management, contract management and marketing communication channels are major concerns in intermediation platforms, while they are addressed in less detail by research on integrated platforms.

Figure 4: Heatmap of Boundary Resources According to the Platform Business Model



In this context and based on our literature review we can classify boundary resources into (1) general purpose boundary resources, which apply to the two models we have explored

in this research and; (2) intermediation resources, which are specific to the facilitator role of intermediary platforms. Below, we outline each group of design and governance mechanisms, describing their influence on value creation processes.

4.1. GENERAL PURPOSE RESOURCES

The purpose boundary resources function as a support system that the platform makes available to provide resources or exercise control over its activities. Table 5 provides a summary of these mechanisms, which will be discussed in detail below.

Table 5: Non-Exhaustive List of General-Purpose Innovation Crowdsourcing Boundary Resources

Area	Boundary Resource	Description	Design Application	Relevant Research
Task management	Task delineation	Providing information and resources to execute the tasks. This includes providing rules and participation conditions (e.g. solution requirements, submission limits and evaluation conditions).	Guidelines and briefs, datasets, audio and video assets.	Gillier et al. (2018) Yin et al. (2022) Malhotra and Malhotra (2023)
	Task allocation	Process of assigning specific tasks to individuals, taking into account their skills, interests and qualifications.	Open task selection, dynamic task assignment, AI predictive task assignment.	Li et al. (2022)
	Task duration	Specific period during which a project takes place, encompassing the time frame for participants to submit entries or engage in it.	Short and long term contests, multi-stage contests.	Korpeoglu et al. (2021) Ayaburi et al. (2020)
Incentives	Monetary rewards	Financial incentives or compensation provided to individuals as a form of recognition for their success in a given task.	Cash prizes, research grants, royalties or licencing agreements and merchandising.	Leimeister et al. (2009) Zheng et al. (2011)
	Non-monetary rewards	Encompass forms of recognition, benefits, and incentives that do not involve direct financial compensation.	Reputation based rewards ingluding badges, points and medals. Learning, mentorship, media exposure and recruiting opportunities.	Feng et al. (2022) Füller et al. (2012)
Quality assessment	Evaluation systems	Systematic assessment of submitted solutions to determine their effectiveness, feasibility, and alignment with predefined criteria or objectives.	Automatic and real time scoring based on metrics, judging panels, peer reviewed or public voting (crowdvoting).	Lampel et al. (2012) Chen et al. (2020b)
	Feedback	Provide timely, supportive and corrective information about performance during the contest.	Real time leaderboards, detailed comments and responses on contest discussion spaces.	Wong et al. (2021) Wooten and Ulrich (2017)

Regulations	Terms and conditions	Legal agreement that establishes contract and intellectual property management policy, use of personal data and platform profit sharing scheme.	Banners, page disclaimer and conditions acceptance buttons.	Zhang and Du (2021)
	Conditions of eligibility	Entry conditions and specific criteria that individuals must meet in order to participate or gain access to a contest.	Conditions in terms of qualifications, experience (past success) and geographical areas.	Fu et al. (2022)
Communication Channels	For Collaboration	Tools that facilitate communication, information sharing, and teamwork.	Forums, blogs, solution sharing spaces and direct chat.	Dissanayake et al. (2015) Riedl and Woolley (2017)
	For marketing	Institutional information disclosure that provides permanent information on the operation, values and objectives of the platform.	Newsletters, FAQs. Landing, service and about pages.	Troll et al. (2019)

Task management

Task management refers to procedures that include delineate, allocate and setting a duration to find a solution to a problem. ICS platforms commonly include a page with a brief description detailing the requestor's requirements (e.g. scope, timing, KPIs, evaluation methods and IP policy). Some provide access to sample data or supplementary documents (e.g. Jovoto), short video tutorials (e.g. XPRIZE), a timeline (e.g. TopCoder), leaderboard (e.g. Kaggle) and/or user toolkits (e.g. Salesforce IdeaExchange).

Clarity in the delineation of the problem, in addition to the precision of the rules and conditions associated with entry, submission, evaluation and benefit sharing, is crucial to finding a solution (Ebner et al., 2009). A well-structured task, with a defined scope, realistic (solvable) and relevant to contributors, is more likely to find a satisfactory solution for innovation seekers (Feller et al., 2012; Zheng et al., 2011).

In addition, any CS operation must have a limited duration. Innovation tasks, commonly organized in the form of a contest, can have one or several stages that can last hours (very short term), days (short term), weeks (medium term) and even years (long term) (Boudreau et al., 2011, Bullinger et al., 2010). These last two periods are the most common.

Incentives

Benefit sharing through incentives for participation constitutes a central aspect in the governance of ICS platforms and is the most discussed topic in our database (41.5%). Empirical

studies in the context of contests with different levels of complexity (both logo design and data modeling and algorithms), found that intellectual satisfaction and passion in the performance of tasks is the most important factor to generate substantial contributions, as it happens in open-source software projects software (Acar, 2019; Battistella & Nonino, 2012; Frey et al., 2011; Garcia Martinez, 2017). For this type of intrinsic motivation to have an effect, it is key to design challenging tasks (emphasis on problem solving) with a high level of autonomy, leading to greater enjoyment and sense of competence. It has also been found that the solicitation to execute several different tasks (cognitive diversity) in the same contest causes it to be intrinsically interesting, increasing the desire to share and create knowledge (Garcia Martinez, 2015; Zheng et al., 2011).

ICS platforms can also trigger intrinsic motivations by creating playful experiences, such as completing challenging missions or even offering augmented reality elements, facilitating (quasi)direct interaction among virtual teams (Feng et al., 2022). Previous research has shown that this type of mechanisms has positive psychological effects, stimulating individual work and quality (Morschheuser et al., 2017). In addition, they can help reduce the likelihood of cheating by participants. This occurs in systems that detect misbehavior and where participants are afraid of losing their badges, medals, or points. It is imperative to continue to explore and evaluate the psychological and behavioral effects associated with these evolving technological tools, bearing in mind that personal characteristics play a crucial role in individual performance.

On the other hand, we have also found that incentives that activate extrinsic motivations have a positive impact on the intention to participate[6] . Similar to the motivations identified in sport science studies, we found that participants of ICS platforms are motivated by obtaining direct rewards, either financial, through salaries, bonuses and commissions, and social, through mechanisms that act on hierarchy, status and recognition (i.e. appreciation from peers, the organizer or the sponsor) (Brabham, 2010; Ebner et al., 2009; Leimeister et al., 2009). Cash awards or reputational recognition are linked to an increase in the number of contributions, but less likely to meet the needs of task providers (Patel et al., 2023).

These findings highlight the importance of platforms combining a variety of symbolic incentives that activate both intrinsic and extrinsic motivations (Battistella & Nonino, 2012; Chanal & Caron-Fasan, 2010). Indeed, empirical studies have proposed that the most valuable contributors are those that combine high levels of intrinsic enjoyment and a diverse cognitive

[6] Previous studies have shown evidence that intention to participate predicts actual participation .

base in different domains of competence (Frey et al., 2011; Zheng et al., 2011). There is also a need for more qualitative studies that explore in detail the differences in motivations among various user profiles and at different stages of the innovation process.

Quality assessment

Evaluating performance consists of applying different methods to determine the commitment of participants and the quality of their contributions. This function involves constantly performing manual (i.e. by a human being) or automated (i.e. AI systems and data mining) controls. Manual control is almost inevitable, especially in the case of innovation CS, since to date only human intelligence is capable of processing complex contextual information, which allows efficient evaluation of subjective tasks. An important dimension of manual control is its ability to correct errors through feedback (Boons et al., 2015). This function can be fulfilled by administrators and/or requesters (e.g. Innocentive, Xprize); by a jury of experts (e.g. OpenIdeo, Dell IdeaStorm) or; by peers, which we call çrowdvoting", where the crowd expresses its opinion through likes, votes or comments (e.g. Threadless, TopCoder) (Bullinger et al., 2010, Ebner et al., 2009, Stol and Fitzgerald, 2014). Automated monitoring is the use of AI capabilities for identifying textual content patterns, which help predict the quality of contributions in real time.

They are commonly found in combination with reputation systems. Leaderboards allow automated ranking of users through the accumulation of points or medals. However, these systems do not provide detailed feedback, which is crucial for progress in solution generation. In addition, the amount of feedback is positively related to the perception of respect by solution generators, who feel that their ideas are being considered (Boons et al., 2015).

Regulations

Boundary resources are also crucial to bring efficiency and stability to the system, helping to prevent problems derived from endogenous factors. For example, rigorous gatekeeping systems, supported by boundary resources such as registration forms, systems to detect automated program traffic (e.g. ReCaptcha) and authentication (identity verification), are fundamental to avoid vulnerabilities in the site such as massive spam, identity theft and malicious data retrieval (phishing).

On the other hand, the terms and conditions make the process more transparent, being a legal agreement, often presented as a simple legal notice. In this context, the platform, in its role as a service provider, supplies information on policies that reward or penalize behaviors considered right or wrong. This agreement is essential and defines the spirit of the collaboration between the platform and user groups. It not only provides information on the security of transactions and measures to prevent abuse, but also influences the perception of procedural and distributive fairness of workers. It is important to remember that the platform collects data on user behavior and then uses it to offer services to client firms, which consists of intelligently assisting in designing contests that meet their objectives.

Communication channels

Activating communication channels implies a shift from a purely competitive dynamic to a collaborative one. The literature has explored collaboration and identified various effects on participants' problem-solving ability. Empirical research based on data from Kaggle reveals that positive performance in discussion forums and solution-sharing spaces is positively correlated with individual performance (Hutter et al., 2011; H. Khasraghi & Hirschheim, 2022). This suggests that participation through comments and solution sharing attracts the attention of other competitors, generating constructive feedback that improves the team's chances of developing superior solutions. However, it is important to note that actively contributing in forums could have adverse consequences on the performance of teams with a significant number of expert users. The high opportunity cost associated with devoting valuable time to these activities could affect their ability to address critical and specialized tasks. Despite these advances in understanding the effects of collaboration at different levels among participants and teams, it remains to be investigated what type of content or topics play a crucial role in their performance. Furthermore, the influence of past collaboration experiences in community forums on team formation in competitions on platforms such as TopCoder, Tongal or Kaggle has not been explored.

On the other hand, previous studies have examined the relationship between willingness to collaborate in teams and the likelihood of success in ICS contests. Research based on data from specialized data science platforms has revealed that participants who collaborate in teams are significantly more likely to win prizes and bonuses, especially when there are prior ties due to previous collaborations (Dissanayake et al., 2015; X. Zhang et al., 2020). Despite providing

insights into the influence of past experiences on willingness to collaborate, it is crucial to further explore how different boundary resources set by managers affect this behavior. In addition, little is known about the problems associated with collaboration. For example, none of the studies included in our sample explored how to design effective boundary resources that mitigate the "free riding" problem, where team members might keep their opportunity costs low and benefit from rewards driven by the other team members effort (Frey et al., 2011).

A team's ability to solve problems has been approached primarily from the perspective of the individual skills of its members, rather than being viewed as a joint cognitive ability (Riedl & Woolley, 2017). Some studies have explored desirable characteristics in teams, examining the effects of team size, intellectual capital (IC) and social capital (SC) on their performance. In the context of innovation competitions in data science platforms, (Dissanayake et al., 2015) found that both past collaboration experiences and past successes are positively correlated with performance, but CS would be more important for team leaders than for experts, and vice versa. In highly competitive contests, teams would perform better if the expert is not at the center of the team's social network. While leader profiles, which occupy privileged positions in networks, are key to connecting nodes among other user groups, resulting in meaningful exchanges, increased participation, and innovative ideas and solutions (Bullinger et al., 2010). This means that each team member should play a specific role, with experts focusing on innovation activities and leaders coordinating activities among members.

Despite the potential of collaboration to generate value, the literature shows concerns regarding the architecture of certain ICS platforms, such as Quirky and LEGO Ideas. These platforms tend to favor the creation of new ideas, neglecting the evolution of existing solutions and hindering knowledge integration. The lack of incentives to work on other users' ideas poses a challenge that requires the exploration of boundary resource design strategies that encourage the simultaneous generation and evolution of solutions.

On the other hand, marketing communication channels play the role of promoting services to attract new users, providing constant information about the platform's performance, values, and objectives, informing about active projects, and sharing community updates through landing pages, blogs, newsletters and social media profiles. At the same time, it plays a crucial role in accountability, stimulates new discussions, and demonstrates that the community is active, that things are happening. Previous research has shown that the positive presence of the platform in media, such as radio, print and blogs, reinforces feelings of pride among users (Boons et al., 2015).

4.2. INTERMEDIATION BOUNDARY RESOURCES

Discoverability

Groups of innovation seekers and innovation providers are constantly searching for each other. Companies face ongoing shortfalls in their ability to innovate, while solvers seek additional sources of revenue, learning opportunities or simply wish to satisfy their desire for challenges. This dynamic leads to the convergence of these players in ICS ecosystems, attracted by positive cross-network effects. As intermediaries, these platforms are responsible for promoting visibility among ecosystem players. Task providers need to be able to identify potential contributors, and innovation providers need to find the tasks they are interested in. Facilitating the discovery of contributors enables companies to mobilize the knowledge needed to solve problems. Therefore, in order for each actor to capture a portion of the value generated in these operations, it is essential that the platform provides various filtering functions.

Filtering tools, which are based on metadata and historical user data, improve discoverability and offer benefits to both groups of users. In the case of solvers, they facilitate the search for discussions and tasks that match their interests, classifying them according to complexity, subject matter and task duration, as well as incentives (monetary or non-monetary) and process status (in progress, under evaluation and completed).

On the other hand, these tools allow task providers to easily identify solver profiles, making it possible to create contests targeted at specific segments of interest. A practical example of this is the TopCoder approach, where client companies can parameterize contests and define the type of profile targeted by the challenge. Platform administrators oversee contest operations to ensure that the contest runs smoothly. Ultimately, filtering tools also help administrators identify the most relevant discussions, highlighting them to encourage their continued evolution on the platform. This proactive approach contributes to the constant improvement and strengthening of the connection between the various players on the ICS platform.

Table 5: Non-Exhaustive List of Third-Party ICS Platform Boundary Resources

Area	Boundary Resource	Description	Design Application	Relevant Research
Discoverability	Filtering tools	An engine designed to categorize contests and discussions, enhancing discoverability for both innovators and task providers according to their interests.	Search bars, filtering buttons with categories.	Piazza et al. (2022)
	Personal profiles	A page that displays user's background, skills, experience, and preferences, serves as a window to expose competences for potential collaborations or job opportunities.	User's education, participation history, skills, ratings or reviews, a brief bio and social media links.	Ren et al. (2020)
Contract management	Conflict resolution systems	Process to address and resolve disputes or disagreements between seekers and solvers.	Disputes mediation centers for arbitration and spaces for complain management.	Feller et al. (2012)
	Pricing systems	Rates or fees for services delivered to seekers.	Subscription fees, transaction fees, premium services and advertising.	Chen et al. (2020a)
	IP transfer services	Strategic administration and protection of intellectual property assets produced within the contest.	Escrow services and due diligence services.	Bauer et al. (2016) Mazzola et al. (2018)

Contract management

Contract management is a topic that has been dealt with almost exclusively in research that had intermediary platforms as its empirical context. This is explained by the inclusion of a new actor to whom the platform gives temporary access to the potential benefits of the crowd. This would introduce problems related to disagreements between the parties that would require the intervention of the platform through mediation and conflict arbitration services.

The issue of intellectual property transfer also poses challenges. In integrated platforms, owners acquire the solutions directly, however, in the presence of a third party, this process would require additional services such as due diligence services. Furtheremore, many platforms offer services to help clients capture value and better integrate it into the organization. This is because often, the results of these processes that occur outside the organizational structure can cause internal conflicts such as the "not invented here" problem, where there is an internal rejection of innovations that were not created by internal teams.

It has also been observed that intermediaries must manage problems associated with the transfer of intellectual property, but which are directly related to the solvers. The fear of loss of knowledge power, which involves the loss of proprietary knowledge and the exclusive right to

the benefits derived from that knowledge, has negative effects on trust (Liu et al., 2021). Therefore, it is crucial that the platform provides mechanisms for participants to perceive that other economic agents will not exploit their knowledge for their own benefit. As an example, the Taskcn platform has implemented a plagiarism control system to ensure that proposals are original creations.

5. CONCLUSIONS

In their search for optimal solutions to their innovation problems, organizations opt for innovation crowdsourcing as a new method for obtaining new knowledge. Despite its potential to add value, the management of these platforms is not an easy task because it involves a complex context where control and coordination, distribution of power and value distribution is complicated by limitations such as the absence of conventional incentives to encourage commitment such as contracts, salaries, and social benefits.

In this context, to exercise their limited authority and influence behaviors aimed at meeting strategic objectives, ICS platforms require boundary resources, a set of tools that serve as an interface to regulate the remote relationship between platform managers and user groups. These mechanisms are interdependent and can influence each other, either strengthening or weakening each other's effectiveness. The primary objective lies in influencing user behavior to foster the emergence of innovations in an organic, rather than planned, manner (Tiwana, 2014).

Our systematic review of a sample of 101 articles selected under a series of rigorous parameters allowed us to contribute elements for the advancement of the conceptualization of the design and governance of ICS platforms, identifying the factors that influence the value creation process. Our morphological approach allowed us to identify the most well-documented boundary resources and to classify them into categories. Furthermore, this systematic approach allowed us to deduce the boundary resources that correspond more to integrated or intermediary models, something that, to our knowledge, has not been done by another research.

ICS platform managers use various boundary resources to actively manage trust relationships, stimulate motivation and distribute power among different user groups. Trust building stands out as a crucial element for successful operations, as it constitutes a coordination mechanism that replaces formal agreements. Access control mechanisms (e.g., registration forms and authentication systems) and the clear specification of the conditions of participation

are essential to promote the transparency of the process. However, there is a knowledge gap regarding the implementation of tools that foster trust among solvers, a key aspect to promote collaborative behaviors. This area presents a valuable opportunity for future research, which could shed light on effective strategies for building and strengthening trust in innovative collaborative environments.

Although our review showed that the literature has extensively explored the effects of intrinsic and extrinsic incentives on participation intention and performance, a knowledge gap persists regarding the long-term sustainability of motivation. We argue that the establishment of closer relationships among members, through the formation of communities and teams, would play a key role in building stronger and more durable structures. In this sense, it is crucial to continue researching effective incentives to foster group-oriented behaviors. Addressing these issues involves exploring strategies that foster connection among participants, promote collective identity building, and value long-term collaboration over immediate benefits. Encouraging interaction, providing opportunities for continuous learning, and consistently recognizing contributions are essential elements in transforming fragmented platforms into strong communities and teams that endure over time. This approach not only strengthens individual motivation, but also contributes to the cohesion and continued success of the platform over time.

In this context, the managers of these platforms are faced with a persistent dilemma: how to create flexible and open spaces that encourage the emergence of innovations, without running the risk of losing control and user cohesion. This dilemma translates into a constant tension between centralization and decentralization in the management of these platforms. In response to this challenge, our research provides a solid theoretical basis for conceiving the design and governance of these platforms from a more flexible perspective, emphasizing the use of different boundary resources that fulfill a dual function, that of securing the proper development of activities, but providing technological resources that facilitate the production of appropriate and good quality solutions.

From this perspective, we propose that platforms should not see the community simply as observers of innovation processes, but as driving actors. In a community, repeated interaction among its members provides the opportunity to build a system of implicit norms for control and coordination, as well as a strong community support system. This web of norms and mutual support allows members to coordinate effectively in the generation of new knowledge, collaborate in the joint construction of projects and propose innovative solutions. We emphasize

the importance of informal control and coordination mechanisms, such as self-monitoring and clan control, in empowering the community. This empowerment, in turn, enables the community to influence the adoption of behaviors that align with the achievement of strategic objectives. In this sense, we recognize that community empowerment through these informal mechanisms is essential to cultivate a collaborative dynamic and effectively achieve shared goals.

Our research represents an essential contribution to the digital innovation literature by shedding light on the role of these platforms in coordinating unique, hard-to-replicate solutions that meet the needs of client companies. Its primary role lies in providing an efficient support system, resourcing, and securing the proper conduct of operations, while fostering collaboration between groups of solvers. The selection of the boundary resources that make up this system depends on both the ability to align its resources and technological tools with the established objectives.

Future research should expand our understanding of the influence of boundary resources on the dynamics of simultaneous competition and collaboration that we observe in many ICS platforms. It is essential to delve deeper into the effects of factors such as team size and the combination of various team member characteristics. The persistent task is to understand what elements make a team truly unique. What are the characteristics that impact the synergy effects among members of certain teams, enabling them to generate unique ideas and solutions that are difficult to imitate? Can crowdsourcing generate partnerships comparable to Lennon-McCartney in music, Jobs-Wozniak in computing, and Watson and Crick in science? These questions demand continued analysis to illuminate the complex dynamics underlying team innovation.

Finally, our analysis responds to the call of Gol et al. (2019) who highlight the importance of new studies that clarify the differences between different crowdsourcing governance models. Our thorough review of previous literature has the potential to be used by owners and managers of these platforms or client firms seeking to extract the creative in inventive potential of the crowd, to understand the influence of design mechanisms on value creation and, thus, devise more efficient ICS systems.

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APPENDIX

Appendix A: Search query strings

Scopus search query

TITLE-ABS-KEY (crowdsourc* OR "crowd sourc*" OR "crowd work" OR crowdwork) AND (TITLE-ABS-KEY (ecosystem$ OR platform* OR marketplace* OR communit*)) AND (TITLE-ABS-KEY (design OR governance OR management)) AND (TITLE-ABS-KEY (innovat* OR creativ* OR inventiv* OR idea* OR solution*)) AND (LIMIT-TO (PUBSTAGE,"final"))) AND (LIMIT-TO (DOCTYPE, "cp") OR LIMIT-TO(DOCTYPE, "ar")) AND (LIMIT-TO (LANGUAGE, "English") OR LIMIT-TO (LANGUAGE, "Spanish") OR LIMIT-TO (LANGUAGE, "French"))

WoS search query

TS=(crowdsourc* OR "crowd sourc*" OR "crowd work" OR crowdwork) AND TS=(platform$ OR ecosystem$ OR marketplace$ OR communit*) AND TS=(design* OR govern* OR manag*) AND TS=(innovat* OR creativ* OR inventiv* OR idea$ OR solution$ OR "macro task*" OR macrotask*) NOT DT=(Early Access OR Book Chapter) AND DT=(Article OR Proceedings Paper) AND LA=(English OR Spanish OR French)