RESEARCH ARTICLE

Investigating Business Sustainability of Crowdsourcing Platforms

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ABSTRACT Nowadays, crowdsourcing has become a popular way of sourcing. As intermediaries that connect crowdsourcers and crowds, crowdsourcing platforms integrate state-of-the-art information technologies and specialized organizational functions to host and govern crowdsourcing projects. The extant literature on crowdsourcing has investigated numerous aspects of crowdsourcing platforms. However, a majority of studies are project-oriented and short-term focused. There is a lack of a holistic view of crowdsourcing platforms as enterprises with a developmental perspective. This study aims to address this issue by investigating business sustainability of crowdsourcing platforms. By considering temporal dimensions and multiple interpretations of business sustainability, a conceptual framework is proposed to investigate the sustainability of a crowdsourcing platform by analyzing the key business process, value co-creation, and business development, which is a major theoretical contribution of the study. A case study of LEGO Ideas is presented to illustrate the practical implementation of the proposed framework. Both theoretical and practical implications are discussed.

I. INTRODUCTION

A Chinese idiom says, ''three assistant generals equalize the most intelligent strategist.'' A similar say in Western cultures states that ''two heads are better than one.'' The wisdom of the ancestors implies that a group of non-experts may exceed a small number of experts under certain circumstances, which is exactly the core concept that underpins crowdsourcing. The term ''crowdsourcing'' was first introduced by Howe [1]. Estellés-Arolas and González Ladrón-de-Guevara define it as a ''type of participative online activity in which an individual, an institution, a non-profit organization, or company proposes to a group of individuals of varying knowledge, heterogeneity, and number, via a flexible open call, the voluntary undertaking of a task'' [2] (p. 11). By tapping into external, ex-ante unknown, and demographically diverse individuals,

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crowdsourcers can expand their resource boundaries to supplement conventional ways of sourcing [3].

A typical crowdsourcing initiative involves three major stakeholders: a crowdsourcer, platform, and crowd [4]. A crowdsourcer is a requester who posts a task to call for undertakers. Thereafter, individuals can voluntarily undertake the crowdsourced task and become part of a crowd. A platform is a social-technical system that integrates state-of-the-art information technologies and specialized organizational functions to enable and facilitate platform users' engagement [3], [5], [6].

To date, a large number of platforms are providing brokerage services for crowdsourcing, and we have witnessed numerous successful cases, such as LEGO Ideas, Topcoder, and Threadless. Meanwhile, some platforms, such as Quirky, still suffer and have even gone bankrupt. The existing literature on crowdsourcing has investigated numerous factors that may impact the success of crowdsourcing initiatives.

However, a majority of studies are temporary project-oriented and short-term focused. There is a lack of a thorough understanding of crowdsourcing platforms as enterprises with a developmental perspective. In this study, we aim to address this issue by investigating business sustainability of crowdsourcing platforms. By considering temporal dimensions and multiple interpretations of business sustainability, we propose a conceptual framework that examines the key business process, value creation, and business development of a crowdsourcing platform for sustainability analysis. The rest of the paper is structured as follows: we first present what is known about crowdsourcing platforms; then, theoretical backdrops of the conceived framework regarding business sustainability are discussed, which is followed by an in-depth case study of LEGO Ideas and discussions; finally, theoretical and practical implications, limitations, and the future research are discussed.

II. CROWDSOURCING PLATFORM

Crowdsourcing platforms have commercialized "two heads are better than one" in a wide range of online crowdsourcing applications, such as crowdfunding, ideation, micro tasking, wiki, online contest, open-source software (OSS) development, crowd-voting, microsourcing, and many others. As digital intermediaries, platforms host and govern crowdsourcing projects by enabling and facilitating users' engagement [5]. In the following section, we present a literature review on crowdsourcing platforms. The presentation is structured into platform governance, project management capabilities, and platform assets.

A. PLATFORM GOVERNANCE

Platform governance considers corporate-level governance over a crowdsourcing platform. The initial concern is about core value units. According to Kohler [7], a core value unit specifies the value proposition of a crowdsourcing platform. It defines what a platform does, clarifies what the desired core value is, and relates it to potential platform users [8]. On LEGO Ideas, for example, LEGO brick design is the core value unit, creativity is the desired core value, and consumers of LEGO are the potential users. A platform may define a single core value unit or multiple units. For example, Threadless broadly defines graphic design (for apparel, accessories, and home decorations) as a single core value unit. Freelancer defines multiple core value units, including web design, logo design, word press ideas, and many others.

The following concern is about business models which describe how a business creates and captures value [9]. In the context of crowdsourcing, business models essentially consider how to acquire contributions from crowds for the defined core value units and how to derive the core value from contributions. Scholars generally distinguish between competitive and collaborative mechanisms [3], [4], [10]. In a competition, a crowdsourcer can select the best contributions from a pool [11] or select the best candidates based on profiles to make contributions [12]. In a collaborative initiative,

a crowdsourcer can benefit from collective labor and wisdom [13]. In addition, a crowdsourcer can acquire contributions in a neutral way [14]. On MTurk, for example, a Human Intelligence Task (HIT) can be undertaken by any platform user on a "first come, first served" basis.

Moreover, the archetypes proposed by Geiger and Schader [15] imply four potential business models. By distinguishing (1) whether contributions are heterogeneous or homogeneous and (2) whether value is derived from individual contributions or all contributions in their entirety, four systems are elaborated: crowd rating, creation, processing, and solving systems. In a crowd rating system, contributions are qualitatively identical and individually made by a crowd; value is derived from all contributions in their entirety. In a crowd creation system, contributions are valued differently according to their quality and are collaboratively made by a crowd; meanwhile, value is derived from all contributions in their entirety. In a crowd processing system, contributions are qualitatively identical and individually made by a crowd; value is derived from individual contributions. In a crowd-solving system, contributions are valued differently according to their quality and are individually made by a crowd; value is derived from individual contributions.

Another discussion by Kaganer *et al.* [16] identified four types of human clouds, including the facilitator, arbitrator, aggregator, and governor models. The facilitator model is essentially a profile competition by which a crowdsourcer selects the best profiles from all candidates to perform the crowdsourced task. The arbitrator model is a contribution competition by which a crowdsourcer can obtain the best solutions from a pool of contributions. The aggregator model allows the crowdsourcer to divide a task into many small and easy pieces, on which individuals in a crowd can work; the crowdsourcer then collects all the pieces of work and reassembles them as the final output. In the governor model, a platform takes over the full responsibility of project governance and implementation. Thus, crowdsourcing is handled by the platform on behalf of the client.

In addition to the above taxonomies, business models in crowdsourcing can be explained in many other ways. For example, by distinguishing (1) between paid and non-paid/speculative work and (2) between requester (crowdsourcer) initiated and worker (crowd) initiated work, Howcroft and Bergvall-Kåreborn [5] proposed four types, namely online task crowdwork, "playbour" crowdwork, asset-based services, and professional-based freelance crowdwork. Franzoni and Sauermann [17] distinguished (1) between open and closed participation and (2) between open and closed disclosure of intermediate inputs, and proposed a taxonomy of four ways to conduct crowd science (using crowdsourcing for research purposes). Kohler [7] identified nine dimensions to be addressed when designing a crowd-driven business model. These dimensions include customer segments, value propositions, customer relationships, channels, key activities, key resources, key partnerships, cost structure, and revenue streams.

Another area of platform governance takes the perspective of an enterprise to examine the business in the long run. First, the platform value, which refers to the long-term accumulated valuation of platform users toward a crowdsourcing platform, can be discussed on the corporate level. Scholars have revealed that credibility, trust, fairness, and reputation positively affect platform success [18], [19]. Second, scaling, which considers ways to expand crowdsourcing platforms, is a part of platform governance. For example, Kohler [8] regards it as adding value at an exponential rate while investing additional resources at an incremental rate. To achieve this, a platform is required to promote the quantity and quality of value-adding engagement and tightly control incurred costs [20]. Third, the development of external networks is relevant to platform governance. The extension of networks with well-known business partners by, for example, recruiting famous firms as crowdsourcers and taking advantage of partners' networks for crowd recruitment can consolidate and expand the business [8], [21].

Sustainable business is a critical part of long-term concerns for crowdsourcing platforms [22]. However, the extant literature on crowdsourcing has not extensively discussed this area. While relevant findings are fragmented, and most studies are short-term project-oriented, there is a lack of investigations into crowdsourcing platforms as enterprises with a developmental perspective. This calls for a thorough understanding of business sustainability in the context of crowdsourcing platforms.

B. PROJECT MANAGEMENT CAPABILITIES

Project management capabilities refer to a platform's capabilities for managing crowdsourcing projects. Primarily, a platform should be able to regulate and explain how it works in written documents [6]. Specifically, platform instructions explain the lifecycle of a crowdsourcing project and the roles of a crowdsourcer, platform, and crowd at different stages during the lifecycle [23]. Platform rules regulate users' online behaviors by specifying what is prohibited and appreciated [24]. Privacy policies clarify how crowdsourcing platforms collect and use user data [19]. Intellectual property (IP) policies provide details relevant to IP ownership, transfer, and distribution [25]. Formal contracts are agreements among stakeholders that specify the obligations of each party [26]. Fee and reward structures are designed to show the reward and charging schemes for platform users [27], [28]. These regulations, rules, instructions, and policies are usually integrated into terms of service.

Then, a platform should develop a series of capabilities to host and manage crowdsourcing projects. Task management capabilities aim to sustain high-quality tasks with good liquidity. According to Blohm *et al.* [6], a platform can conduct task clarification, decomposition, and pretesting to reduce ambiguities and potential errors. Similarly, Bimpikis and Markakis [29] indicate that effective analysis of task complexity can significantly reduce the performance loss caused by uncertainties. Meanwhile, a platform can also act as a gatekeeper to detect potential fraud, improper content, and misleading information [30]. By improving the quality of crowdsourced tasks, a platform can improve its overall performance [31]. Another relevant issue is task liquidity, which considers both task dissemination and distribution. Scholars have developed different strategies, models, and algorithms for task recommendation and distribution by considering and prioritizing multiple factors such as crowd expertise, interest, and reliability [15], [32], [33]. The common aim is to deliver the right tasks to the right individuals at the right time.

Engagement management capabilities endeavor to enhance platform users' involvement in value generations. The extant literature reveals numerous ways to facilitate user engagement. For example, Heo and Toomey [34] empirically investigated the impacts of a platform's simple system-generated visual feedback on a crowd's motivations to contribute, finding that visual feedback generally has a positive effect while different types impact users differently. Numerous scholars have investigated the influences of gamification approaches on crowd engagement. The design of a gamification mechanism depends on the complexity of the tasks to be crowdsourced [35]. Morschheuser and Hamari [36] indicate that gamification can be an effective approach to increase crowd participation. Particularly, virtual rewards can activate intrinsic motivations, increase perceived enjoyment, and improve the quality of engagement [37]. Ihl *et al.* [38] examined the impacts of social support on crowd engagement. The findings show that social support from professional communities enhances group identifications among individuals and the perceived meaningfulness of undertaking the task, thereby fostering crowd engagement. Deng *et al.* [39] reveal that a crowd's continuous participation is influenced by task characteristics and the digitally enabled platform environment. Lan and Toubia [40] prove that the strategic timing of releasing contributions to particular types of crowd members may influence their behaviors. Rotman *et al.* [41] highlight the positive impacts of collaborations on enhancing crowd engagement and productivity. In addition, scholars have developed mechanisms to detect malicious behavior [42] and encourage civil conversations [43].

Contribution management capabilities attempt to improve the quality of contributions. Blohm *et al.* [6] proposed three general strategies for quality control: manual control by platform operators, automated control by systems, and peer evaluation by crowds. Different platforms may prioritize different strategies. Dai *et al.* [44] developed a structural approach that strategically aggregates multiple contributions to improve the output quality. Klein and Garcia [45] proposed an approach, which is named "bag of lemons," to leverage crowd members to filter bad contributions. Lampe *et al.* [43] developed a system tool to deal with information overload when too many contributions are made. Wooten and Ulrich [46] reveal that offering ongoing feedback can improve the quality of contributions.

C. PLATFORM ASSETS

The third dimension examines the critical assets of a crowdsourcing platform. Primarily, platform users constitute a category of critical assets [7], [20]. From the resource-based view [47], they are external resources that can be leveraged to expand a platform's resource boundary. According to transaction cost theory [48], platform users are potential crowdsourcers and crowd members who respectively act as the buyer and seller sides in transactions intermediated by a crowdsourcing platform. Based on the relational view [49], value is determined by the relationship between a platform and users as well as multilateral relationships among users. A crowdsourcing platform cannot survive without a sufficient number of users. On the buyer side, a lack of crowdsourcers limits the number of crowdsourcing projects. On the seller side, a lack of platform users restricts the supply of contributions, thereby increasing the risk of failure [6]. Therefore, it is vital for a platform to continuously recruit new users [8]. At the same time, inactive users do not create much value unless they become crowdsourcers and crowd members who are actively and continuously involved in value-generating interactions [50]. Thus, it is also important for a platform to sustain the activity of existing users on high levels. The existing literature reveals that the quantity and activity of platform users are highly relevant to their motivations. In general, motivations can be categorized as intrinsic and extrinsic motivations [51]. Intrinsic motivations can be activated by incentives such as enjoyment, pride, and altruism [51]–[53], and extrinsic motivations can be prompted by incentives such as monetary rewards, social fame, and career opportunities [50], [51], [54]. A platform, therefore, can attract users and sustain their activity by offering proper incentives.

Information technologies constitute another category of critical assets of a crowdsourcing platform. IT infrastructure (hardware, software, and network) constructs the technical foundations. Then, a platform develops algorithms, models, and tools, as integrated into information systems with user-friendly interfaces, to materialize business concepts. Scholars have investigated this area and introduced numerous ways to improve the efficiency and effectiveness of IT-enabled functions [55]–[57].

Crowdsourcing projects constitute the third category of critical assets. From a long-term perspective, accumulated crowdsourcing outcomes can reflect how well a platform conducts its business. This can also influence users' valuations of it. In addition, accumulated experience in managing crowdsourcing projects can be valuable references for a platform to determine future development and accordingly adjust the existing corporate governance, project management capabilities, and platform assets. This area, however, has not been extensively discussed in the existing literature.

III. THEORETICAL BACKGROUND & THE FRAMEWORK
A. BUSINESS SUSTAINABILITY

According to the World Commission on Environment and Development (WCED), sustainability development refers to
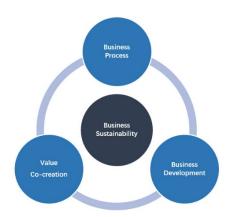

FIGURE 1. A framework for analyzing the business sustainability of a crowdsourcing platform.

development that satisfies the needs of the present without sacrificing the ability of future generations to meet their needs [58]. When this logic is applied to business, business sustainability can be interpreted as a company's ability to meet its current needs without sacrificing its ability to meet its future needs; hence, time is significant for business sustainability [59]. Moreover, a sustainable business can be defined in multiple ways, such as a representation of business processes; a mix of environmental, economic, and social indicators; system-level narratives; an integrated description of firm-level characteristics; and some combinations of these [60]–[64]. Taking temporal dimensions and multiple interpretations into consideration, we propose a framework to analyze the business sustainability of a crowdsourcing platform. The framework examines three dimensions, including the business process, value co-creation, and business development of a targeted crowdsourcing platform (as shown in Figure 1). These dimensions are further elaborated by relating business sustainability relevant concepts and theories to the presented review on crowdsourcing platforms.

B. BUSINESS PROCESS

The business process view regards a business process as a combination of activities within a business entity with a structure depicting their order and dependences [65]. It incorporates the major workflow, human resource allocation, information flow, knowledge transfer, and information system support of an organization [66]. From a business process management perspective, identifying the key business processes and measuring their effectiveness are significant to business sustainability [67]–[69]. By examining the key business process of a crowdsourcing platform we aim to verify the business legitimacy on a theoretical level. This is a short-term focus.

A crowdsourcing platform originates from the definition of the core value unit. A well-defined core value unit explicitly clarifies the platform's theme, core value, and potential platform users. The core value unit is then served by a suitable

business model that explains how to acquire contributions for the core value unit and how to derive the core value from contributions.

Project management capabilities designate a bundle of capabilities necessary for a platform to effectively and efficiently manage crowdsourcing projects. Project management capabilities should be compatible with the selected business model. Specifically, comprehensive documents should be created to regulate and explain how the platform works. Then, specific managerial capabilities should be developed to concretize the business model on the operation level. Task management capabilities aim to sustain high-quality tasks with high liquidity. Engagement management capabilities endeavor to enhance the involvement of platform users. Contribution management capabilities attempt to sustain the quality of crowdsourcing outcomes.

In addition, a crowdsourcing platform is required to acquire critical assets to perform the key business process. Platform users should be sufficient, active, and in line with the identified users as clarified by the core value unit. Thus, the platform possesses the right pool of crowdsourcers and crowd members to perform crowdsourcing activities. Moreover, the acquisition of proper IT assets is significant as IT infrastructure and functionalities constitute the technological foundations that enable and support the key business process and managerial capabilities. In addition, accumulated successful crowdsourcing projects can sustain a positive image of the platform, which may attract more individuals and facilitate their engagement.

C. VALUE CO-CREATION

Stakeholder theory regards a stakeholder as an individual or group that can affect or be affected by a focal entity [70]. Value co-creation leverages the collective efforts of internal and external stakeholders. The engagement of external stakeholders extends a focal entity's resource boundary by sharing assets, complementary resources and capabilities, knowledge, and governance [71], yielding a portfolio of value [72]. Therefore, value creation and distribution are discussed from multiple stakeholders' perspectives. Crowdsourcing is a typical case of value co-creation. On the business level (in comparison to the internal, industrial, and societal levels), the key stakeholders of a crowdsourcing platform include crowdsourcers, the platform (itself), and crowds. By examining the value co-creation of a crowdsourcing platform, we aim to determine whether value can be continuously created by and properly distributed to the major stakeholders, which is a mid- to long-term focus.

The value of a crowdsourcing platform originates from its core value which refers to the expected quality of the defined core value unit. Then, a selected business model theoretically explains how the core value unit is processed and how the core value is derived from crowd contributions, that is, the process of value co-creation and distribution in an ideal situation. This is further supplemented by project management capabilities which add more details on the operational level.

The value examined in a crowdsourcing project is the actual value perceived by stakeholders. From the crowd-sourcers' perspective, the quality of contributions determines whether the core values are realized. From the perspective of crowds, individuals may receive promised rewards, fulfill themselves with intrinsic value, or take nothing back. The actual value perceived by platform users can be much more abundant than the core, theoretical, or operational value. Ideally, all users should be satisfied with their perceived value through engagement. If dissatisfied, they tend to leave. From the platform's perspective, each successful crowdsourcing project can generate direct financial revenues, retain users, and add credit to its services. In the long run, accumulated crowdsourcing outcomes can be insightful references for the platform to judge whether value can be continuously created by and properly distributed to stakeholders. If not, the platform is required to adjust the existing platform governance, project management capabilities, and platform assets.

D. BUSINESS DEVELOPMENT

The third dimension considers the development of a crowdsourcing platform. Sustainable development integrates inside-out and outside-in approaches [73]. Using an inside-out approach, a focal entity attempts to improve the efficiency, effectiveness, and transparency of the existing processes. With an outside-in approach, opportunities and challenges in the environment drive the business to change. Hence, sustainable development incorporates improving the existing business and searching for new opportunities [74]. By examining the development of a crowdsourcing platform, we aim to figure out whether it can perform in the future at least as well as it does today, which is a long-term focus.

The development of a crowdsourcing platform relies on a thorough understanding of the existing business processes and value co-creation. The experience in managing crowdsourcing projects and accumulated crowdsourcing outcomes shed light on areas of improvement. A platform can reinforce its existing business by improving the key business process and value co-creation; accordingly, the existing platform governance, project management capabilities, and platform assets should be adjusted. When it is fully proven that the existing business process and value co-creation work steadily well, a platform may consider pursuing new opportunities. Embracing new opportunities requires changing the rules of the game. A platform may redefine the core value unit and/or add new units. Accordingly, it may be required to upgrade and/or redesign business models, develop new project management capabilities, and acquire new assets.

E. BUSINESS SUSTAINABILITY ANALYSIS

According to the above interpretations, the analysis of the key business process, value co-creation, and business development of a crowdsourcing platform respectively examine the short-term, short- to mid-term, and long-term business of a crowdsourcing platform. Results of the analysis attempt to reveal the business sustainability by verifying the legitimacy

TABLE 1. Data sources.

Official LEGO and Partners' Websites	
LEGO Ideas	https://ideas.lego.com/
LEGO	https://www.lego.com/en-us
LEGO-CUUSOO	https://cuusoo.com/brands/lego-cuusoo
Chaordix	https://chaordix.com/customer-stories/lego
Third-Party Communities	
theBrickBlogger	http://thebrickblogger.com/
BrickNerd	https://bricknerd.com/
Bricks McGee	https://www.bricksmcgee.com/
Swooshable	https://swooshable.com/
The Brothers Brick	https://www.brothers-brick.com/
Case Studies in the Literature	
Schlagwein & Bjørn-Andersen [76]	
Fagerstrøm et al. [77]	
Liu et al. [78]	

of the business, inspecting the status of value creation and distribution, and examining the paths of development.

IV. RESEARCH METHODS

This deductive research applies a single-case design, which is an appropriate choice when the case is critical, extreme (or unique), representative, revelatory, or longitudinal [75]. The selected case in this study can be described as a critical, representative, and longitudinal case. Specifically, it is to illustrate how the conceived framework is applied in practice. Moreover, LEGO Ideas is a representative crowdsourcing platform frequently mentioned in the extant literature on crowdsourcing. It is also longitudinal as we attempt to uncover the temporal dimensions of the sustainability. Primary and secondary data were collected, including direct observations and documentation on the official LEGO and its partners' websites, direct observations and documentation on third-party communities, and case studies in the existing literature (as shown in Table 1).

V. THE CASE OF LEGO IDEAS

A. BACKGROUND

The LEGO Group, now one of the world's largest toy manufacturers, was founded by Ole Kirk Kristiansen in 1932 and originated in his small carpenter workshop. The brand was named after the Danish words "leg godt," which means "play well" and represents the ideal of the brand. LEGO's iconic product, the LEGO brick, was introduced in 1958. Signature plastic bricks designed with studs and tubes enable an ingenious interlocking principle. With six 2×4 bricks, 915,103,765 different combinations can be available. LEGO bricks create unlimited building possibilities and are highly worshiped by fans all over the world. As the head of the Adult Fan of LEGO (AFOL) states, "The LEGO brick is a language to express ideas and tell stories, and there are billions of ideas to be shared and stories to be told" [79]. Being fascinated by the fruitful ideas of LEGO brick designs collected from multiple sources, such as postal mail, online fan communities, and even illegal website hacks, the LEGO Group started engaging with consumers in the product development process. It sponsored a series of crowdsourcing initiatives

from 2005 to 2014, including LEGO Factory, LEGO Design ByMe, and LEGO CUUSOO. Building upon the 6-year pilot crowdsourcing initiative LEGO CUUSOO, LEGO Ideas was launched in 2014 as a portfolio of strategies and practices centered on a specialized crowdsourcing platform.

B. PLATFORM GOVERNANCE

To reveal the platform governance of LEGO Ideas, we examined its core value unit, business models, and long-term strategies. As stated by the LEGO Group in its official history presentations, "today the LEGO Ideas website helps realize exactly this (ideas and stories created by LEGO bricks) through the amazing creativity of fan designers" [79]. The core value unit of the platform is the LEGO brick design, and creativity is the core value. LEGO's consumers are the major users who share and support their LEGO brick designs on the platform. Thus, the LEGO Group takes advantage of such a platform to collect creative LEGO designs from its consumers.

The LEGO Ideas Team implements three business models: the Activities, Contests, and Product Ideas models. The Activities model applies a collaborative mechanism. It was primarily designed as a training program and labeled as "quick build" and "beginners and up." In this model, the platform issues a themed activity to be designed with LEGO bricks on a weekly basis, and platform users can then participate by submitting their designs and socializing with each other. This will improve crowd members' design skills and engagement. The Contests model combines competitive and collaborative mechanisms. It consists of short-term contests and is labeled as "a passionate amount of time" and "for all skill levels." The platform regularly initiates themed contests in which platform users can participate by submitting their designs and competing to win rewards. The decisions regarding the winning designs are made by LEGO and/or platform users. In principle, the LEGO Group can acquire creative LEGO brick designs from the best contributions, and winners can win prizes. The Product Ideas model employs a collaborative mechanism. It is a long-term program and labeled as "as long as it takes" and "master-builder level." As no theme is given, platform users can be fully imaginative to create their own LEGO brick designs and collaborate with others to improve the designs. The submitted designs are judged collaboratively by platform users and the LEGO Group. In principle, the LEGO Group can obtain creative LEGO brick designs by selecting the best contributions, and officially selected winners can win the promised rewards.

The LEGO Ideas platform develops steadily. It was initially built upon a 6-year pilot crowdsourcing initiative, LEGO CUUSOO, in collaboration with the Japanese crowdsourcing platform CUUSOO in 2008. It was originally available in Japan and made available globally in 2011. The great success of LEGO CUUSOO significantly increased the volume of platform users and their engagement. Therefore, the LEGO Group decided to make a greater commitment to crowdsourcing by expanding and improving the platform. LEGO Ideas

was the solution. In 2014, the LEGO Group collaborated with Chaordix, who is a Canadian expert in managing virtual communities, to launch LEGO Ideas. The data on LEGO CUUSOO migrated to the new platform. The core value unit and core value remained the same. The core business model of LEGO Ideas roughly inherited how it worked on LEGO CUUSOO, and new business models, Activities and Contests, were subsequently introduced to supplement it. Moreover, the platform is updated incrementally to improve its project management capabilities. For example, the age limitation in terms of services was altered from 18 to 13. The unlimited timeframe for an idea to reach 10,000 supports was changed to a series of milestones. New features, such as responsive design, were added to enhance platform users' experience. Incremental updates continue as the platform is operated. The increasing number of high-quality designs demonstrates that the LEGO Ideas Team has effectively and efficiently promoted the quantity and quality of value-adding engagement. According to the statistics released by the LEGO Ideas Team, 26, 35, and 57 qualified contributions (supported by over 10,000 platform users within the regulated time frame) were collected from the Product Ideas model by the first 2020, second 2020, and first 2021 LEGO reviews, respectively. These numbers are much larger than the previous average of 10 to 12 qualified contributions in a single LEGO review. In addition, it was found that the commercialized contributions from LEGO Ideas collaborated with abundant famous IPs, such as Big Bang Theory (TV series), Winnie the Pooh, and 'Starry Night' by Vincent van Gogh. The collaboration strategy has contributed to the widespread of LEGO Ideas.

After 7 years of smooth operations since its launch in 2014, the LEGO Ideas platform is now a phenomenal crowdsourcing initiative. The LEGO brand values of "imagination, creativity, fun, learning, caring, and quality" have been deeply embedded in the platform. As an illustration, inspiring consumer creativity is the core rationale for the crowdsourcing platform, and the three laddered models are well designed to promote fun and learning. The LEGO Group has also demonstrated that it cares for a wide range of stakeholders, particularly children. In the recent activity "Build a Star. Make a Difference!" the LEGO Group promised to donate one LEGO toy set to a child in need for every submission. Regarding quality control, the LEGO Group takes advantage of both internal and crowd-based judgments and selects only the best contributions, which makes the LEGO Ideas product line highly competitive.

C. PROJECT MANAGEMENT CAPABILITIES
To analyze the project management capabilities of LEGO Ideas, we examined the capabilities developed for managing crowdsourcing projects, including setting rules and regulations, task management capabilities, engagement management capabilities, and contribution management capabilities.

1) TERMS OF SERVICE AND HOUSE RULES
On the platform, the terms of service and house rules primarily clarify the legal agreements between the platform and

platform users and advise them on their behaviors. The latest version of the terms of service is version 1.9. The detailed document explains "notice regarding data privacy," "accessing the platform," "user generated content," "intellectual property rights infringement," "rules of conduct," and other 10 topics. The house rules advise platform users to create a fun and respectful atmosphere. The document respectively specifies "respect other members," "keep your comments on topic," "don't advise, preach, or campaign," and other seven tips.

Activities, Contests, and Product Ideas are managed separately on the platform. Based on the terms of service and house rules, each model further supplements additional instructions and regulations to guide the implementation.

2) ACTIVITIES
According to the official induction, an activity is a small, informal, warm-up, regular, flash, and themed challenge without a winner or prize. It is designed to show creativity, learn, and have fun in a short burst. The LEGO Ideas Team claims to have made the rules for activities as simple as possible and encouraged creativity as much as possible. In the activity "Build a Star. Make a Difference!," the platform specified the themes of design, deadline, acceptable entry content, entry quality standards, and fine print (agreement on the terms of service). Registered platform users could then work on their designs and submit them online. Other platform users could review, comment on, like, share and report submitted designs.

3) CONTESTS
A contest is a formal, competitive, short-term (usually less than a few months), themed challenge with a fixed number of winners. In the contest "Do You Want to Go to the Seaside," for example, a banner displayed the name of the contest, all the phases (submission, judging, voting, and winning announcements with specific dates), and the current phase. Below the banner was the project specification. It started with a snapshot that summarized the key points, including "coastal build" as the theme, the size of the build between 150 and 50 bricks, "should not be related to any current or future LEGO Ideas gift with purchase," the prize pool, and the deadline. Then, detailed information was provided on three topics, namely "How it Works," "Contest Rules," and "Prizes." In "How it Works," it first explained the key events in each phase and the exact time frames. Specifically, the submission phase was set before May 11, 2021, at 6:00 a.m. EST. It was recommended to submit two to three days before the deadline in cases of return for modification. The judging phase was on May 18, 2021. The LEGO Ideas Team would review and select 15 entries. The voting phase was on May 18-25, 2021. Each platform user would have one vote to choose their favorite design among the 15 entries selected by the LEGO Ideas Team. Finally, the winner announcement would be made before May 31, 2021. The results of the voting phase would determine the grand prize winner and five

runner-ups. In addition, instructions were given regarding how to participate in the contest (e.g., design methods, photographing tactics, adding a short description, and uploading methods). "Contest Rules" contained detailed information about acceptable entry content (e.g., the size of designs, originality, copyright issues, and banned features), entry quality standards (e.g., tips for available tools for designing, photographing, photo editing, and display requirements), house rules (corresponding to the house rules discussed previously), judging criteria (specific criteria of the LEGO Ideas Team review and explanations about the process of judging and voting), and fine print (based on the terms of service). In terms of the prizes, the grand prize winner would get the exclusive opportunity to transform the design into a new LEGO Gift with Purchase set and four specific LEGO products. Each of the five runner-ups would receive three LEGO products.

After initiation, registered platform users worked on their designs individually and submitted them to the contest. Platform users could comment on, vote (during the voting phase), save, share, and report submitted designs. The LEGO Ideas Team could also comment on the designs, which would be displayed in another tag "official comments" separated from platform users' comments. Designers could socialize with platform users and the LEGO Ideas Team (although it was found that they seldom commentated in contests) and improve their designs during the submission phase. After the winner announcement phase, winners were rewarded. Most previous contests applied similar structures, albeit with some exceptions. For example, "A Galaxy of Celebrations" applied double rounds of judging (called expert review) and voting (called fan vote), and the "Celebrate 20 Years of Magic with LEGO Harry PotterTM!" contest included only a judging phase without a voting phase.

4) PRODUCT IDEAS

Product Ideas is the core business model on the platform. It is a formal, permanent, and collaborative challenge without a given theme or fixed number of winners. There is a dedicated page on the platform stating the guidelines of Product Ideas, and its major content is divided into five sections. The first section is "What is a Product Idea." A product idea is a proposal for a potential LEGO product that consists of photos or 3D renderings of an original LEGO brick model design, along with a written description. In addition, this section clarifies the relationship between a product idea and a LEGO set, the size of a design, the single concept principle, license issues, copyright issues, and most importantly, the process from an idea to a LEGO Ideas product. In principle, a LEGO idea must meet a series of milestones: it must be supported by 100 platform users in 60 days since submission, 1,000 platform users in another 365 days, 5,000 platform users in another 182 days, and 10,000 platform users in another 182 days. If an idea fails to meet any of these milestones, it becomes expired. Ideas that successfully reach 10,000 supporters are reviewed by the LEGO Review Board which consists of internal designers, product managers, and other

key team members. The reviews are scheduled three times a year (January, May, and September) and follow a process similar to that used for internal production. The LEGO Review Board determines which product ideas become LEGO Ideas products by evaluating the original model designs, concept presentations, and market potential. The chosen ideas are then taken over by the professional designers of LEGO for production and merchandising.

The second section, "How This Works," further supplements additional regulations, including age restrictions, policies of using currently available LEGO bricks only, originality issues, copyright issues, submission formats, editing and updating policies, collaboration policies, prohibitions of ideas, collaborations, profile transfer, and prohibitions of selling anything relevant to the product ideas. The third section, "Prizes and Rewards," declares that if an idea reaches 10,000 supporters and is chosen to be merchandised as an official LEGO Ideas product, the designer will be given 1% of the total net sales of the product, 10 copies of the LEGO Ideas set, and credit with bio in set materials as the LEGO Ideas set creator. However, follow-up products will be developed by the LEGO Group; therefore, designers would not be compensated. If an idea reaches the 10,000-supporter threshold but is disapproved for sale, the designer would be given LEGO products worth 500 USD in combined value. The fourth section, "Acceptable Content," regulates issues relevant to appropriate content, third-party intellectual properties, building part for designs, creativity, third-party licenses, usage of LEGO logos, and restrictions on using LEGO Ideas for other purposes. The fifth section, "Quality Standards," mainly addresses issues relevant to proposal presentations, including the requirements of images, text in images, the maximum number of images, description writing-up, and matchups between uploaded images and texts.

D. PLATFORM ASSETS

To analyze the platform assets of LEGO Ideas, we investigated its platform users, IT assets, and crowdsourcing projects.

1) PLATFORM USERS

LEGO Ideas has acquired a large number of highly active users. According to a recent community record, there were more than 2,034,000 registered users on the LEGO Ideas platform by November 2021. Since the majority are consumers (also fans) of LEGO, their engagement is highly active. Such a large number of highly active platform users has become a steady source of creativity. Among the vast number of contributors, over 266 platform users have achieved the 10K Club Member badge by successfully having at least one design accumulated over 10,000 supports within the time frame in Product Ideas. Moreover, multilateral interactions were ubiquitously observed under submitted contributions in Contests and Product Ideas. The product idea "The Meeting Point," for example, had accumulated over 700 comments and 9,700 supporters in about 2 months since its submission

on September 30, 2021. In the contest "Out of this World Space Builds!," the grand prize winner obtained over 1,000 comments during and after the contest and 2,869 votes in the one-week voting phase.

2) IT ASSETS

The LEGO Group has acquired the critical IT assets by collaborating with Chaordix. LEGO Ideas is powered by the Chaordix Community Platform, which is a cloud-based, all-in-one community operating system developed and operated by Chaordix. The system features integrated social networking, directories, communication channels, challenge engines, and market research tools. Moreover, Chaordix offers community management, design, training, and support services to help clients engage with their consumers. From LEGO CUUSOO to LEGO Ideas, Chaordix has upgraded the platform technologically and managerially to deal with the increasing volume of crowd engagement.

3) CROWDSOURCING PROJECTS

LEGO Ideas has accumulated abundant experience in hosting crowdsourced projects. In Activities, Contests, and Product Ideas models, an activity, contest, or product idea is respectively deemed as a crowdsourcing project. By November 2021, the platform had hosted 127 activities, 52 contests, and a large number of product ideas (about 37,000 ongoing proposals were displayed, and expired proposals were not displayed). Among these crowdsourcing projects, the most well-known are 31 product ideas (36 product ideas on shelf minus five that were designed during the LEGO CUUSOO period) that had been approved for production. The LEGO Group has benefited from crowd creativity for research and development and accelerated the speed to market. Additionally, by directly engaging with consumers, the LEGO Group has established and maintained close relationships with its consumers. Moreover, by involving platform users in the judging phases, the LEGO Group generates a better understanding of consumers' needs. From the platform user's perspective, in addition to extrinsic value, such as revenue shares, LEGO toy sets, and virtual honors, intrinsic motivations and value, such as interest, pride, and happiness, were commonly captured. For example, a 10K club member states, "Of course, I love building LEGO, and I combine this with my interests in filming and photography to share my creations with the world." Another 10K club member recalls, "I was in the car as I was about to go and have dinner. I kept reloading the page at 9999, as it took about 5 mins to get that last supporter! I had an update ready to post to thank everyone which I was also stressed about getting out in time but it all worked out in the end. It was almost a sense of relief when I hit that 10K mark. I had been working so hard to get it for so long and it almost felt surreal that I had finally done it."

VI. DISCUSSIONS

A. THE KEY BUSINESS PROCESS OF LEGO IDEAS

The key business process of LEGO Ideas tracks the flow and dependencies of its major activities. Primarily, the core value unit is clearly defined. It precisely clarifies the core value, accurately identifies the potential platform users, and explicitly explains the purpose of the platform. Then, the core value unit is well served by the three business models. The designs focus on facilitating creations of the core value unit and differ in durations, required skill levels, and contribution mechanisms, making them laddered and mutually supportive. Activities, as a training model, and Contests, as a mini version of Product Ideas, serve Product Ideas, as the core business model, by making platform users more skillful and experienced.

Developed project management capabilities are compatible. The updated terms of service and house rules are the foundations that guide operations on the platform. On this basis, dedicated instructions are in place to explain the general processes and regulations (e.g., privacy, copyright, intellectual property, formal contract mechanism, and informal relationship) in Activities, Contests, and Product Ideas. The three models are separately managed. In terms of task management, because the LEGO Group is the crowdsourcer, the LEGO Ideas Team can tightly control the crowdsourced tasks. Moreover, tasks are clearly defined with specific themes in Activities and Contests, yet loosely defined without a given theme in Product Ideas. This is convergent to the rationale of the laddered and mutually supportive model designs. By participating in themed activities and contests, platform users can practice their skills and gain experience. They are then encouraged to be fully imaginative to create their designs without limitations to a given theme in Product Ideas. LEGO Ideas does not employ task recommendations or allocation mechanisms. A major reason for this is that the existing platform users are already highly active; therefore, additional investments to acquire these capabilities are unnecessary. Concerning engagement management, the LEGO Ideas team enables multiple channels for multilateral interactions and applies proper gamification approaches. The statistics of platform user engagement prove the effectiveness of engagement management. Moreover, the LEGO Ideas Team actively engages in detecting improper behaviors and also takes advantage of platform users for detection. In terms of contribution management, multiple strategies are applied. In Activities, the quality of contributions is not assessed. In Contests, crowd votings and internal judges are commonly employed. A crowd voting is usually initiated after an internal judge; thus, in most cases, the final winners are decided by platform users. However, the LEGO Ideas Team still retains a high level of quality control because the finalists for crowd votings are determined by the team. In Product Ideas, an idea is first assessed by platform users, which usually takes a long time. Only if the 10,000-support milestone is successfully

achieved, will the LEGO Review Board assess the idea and make the final decision; hence, the LEGO Group retains full control over the output. The engagement of platform users in multilateral interactions not only gives voices to platform users but also reduces the huge workload to be handled by the LEGO Ideas Team.

The LEGO Ideas platform has acquired critical assets to perform the key business process. The number of registered platform users is considerably large and increasing steadily. Actual platform users are consumers and fans of the LEGO Group; therefore, they are voluntary, active, and committed. Such platform assets extend the LEGO Group's resource boundaries, supply endless "sellers" in platform-mediated transactions, and play crucial roles in value co-creation. With regard to IT assets, LEGO Group collaborates with Chaordix instead of acquiring them by itself. Such collaboration allows the external expert to handle IT at its best while the LEGO Ideas Team focuses on its core competencies.

In summary, the key business process of the LEGO Ideas platform is legitimate. The core value unit is clearly defined and well served by three laddered and mutually supportive business models. The LEGO Ideas Team has developed compatible project management capabilities to manage crowdsourcing projects in three business models, and critical assets have been acquired to enable and support the key business process.

B. THE VALUE CO-CREATION OF LEGO IDEAS

The value co-creation examines value creation and distribution from stakeholders' perspectives on LEGO Ideas. In the observed case, the crowdsourcer is the owner of the platform. Hence, the crowdsourcer and platform merge as one stakeholder. Platform users, who are potential crowd members, constitute another group of stakeholders. From LEGO's perspective, the core value is creativity which is the desired quality of the defined core value unit. By analyzing crowdsourcing projects as critical platform assets, LEGO has continuously acquired creativity from platform users. Moreover, by engaging in crowdsourcing initiatives, it has accelerated the speed from research and development to market, enhanced mutual relationships with consumers, and generated a better understanding of consumers' needs.

From the perspectives of crowd members, a mix of value was captured. In addition to extrinsic value, such as revenue shares, LEGO toy sets, and virtual badges, intrinsic value, such as interest, pride, and enjoyment, was commonly identified. Extrinsic value is not guaranteed on the platform, and only a few crowd members have experience of winning. In principle, extrinsic value alone can not sustain long-term value streams because crowd members without winning experiences are inclined to quit. In practice, intrinsic value plays a crucial role in motivating, compensating, and retaining crowd members. This is confirmed by the analysis of platform users as critical platform assets. Because platform users are consumers and fans of LEGO, they are highly intrinsically motivated and compensated.

In conclusion, value co-creation on LEGO Ideas is healthy. Many highly active and committed consumers of LEGO, as crowd members, have been properly motivated, compensated, and sustained by both extrinsic and intrinsic motivations and value. Therefore, LEGO, as the crowdsourcer and platform, can continuously acquire the core value and associated benefits. An ecosystem of value co-creation and distribution has already been established, which guarantees the health of the platform's mid- to long-term value streams.

C. THE BUSINESS DEVELOPMENT OF LEGO IDEAS

LEGO has incrementally improved LEGO Ideas since its initiation in 2014. The platform was built on LEGO CUUSOO, a 6-year pilot crowdsourcing initiative. LEGO Ideas inherited the platform governance of LEGO CUUSOO by keeping the core value unit, core value, and Product Ideas as the major business model. After the initiation, Activities, and Contests were added as auxiliary business models to support Product Ideas. Moreover, the LEGO Ideas Team is continuously developing and upgrading its project management capabilities. The terms of service and house rules are revised regularly. Existing capabilities have been strengthened while new ones are being developed. Concerning platform assets, LEGO Ideas inherited platform users and crowdsourcing projects from LEGO CUUSOO. Thereafter, it has acquired and hosted a large number of new users and projects. Meanwhile, LEGO switched the partnership from CUUSOO to Chaordix. The new IT asset provider could properly undertake and manage the technological and managerial needs brought by the increasing volume of engagement.

LEGO Ideas proactively embraces environmental opportunities. By initiating crowdsourcing, LEGO can better understand consumers' needs, strengthen their mutual relationships and leverage their creativity in research and development. LEGO Ideas is also open to collaborations with external IPs, which has extended its networks. Moreover, LEGO has embedded social care into the business. The platform has contributed to society by taking care of societal stakeholders.

In summary, LEGO Ideas has developed steadily. Building upon a thorough understanding of its existing business, the platform strengthens its key business process and value co-creation by improving the existing platform governance, upgrading project management capabilities, and acquiring new assets. It also grasps environmental opportunities by engaging external consumers, IPs, and other societal stakeholders. By combining inside-out and outside-in approaches effectively, LEGO Ideas has facilitated steady growth in the long run.

D. AN ANALYSIS OF THE PLATFORM SUSTAINABILITY

The investigations into the key business process, value co-creation, and platform development of LEGO Ideas proves the sustainability of the platform and reveals the rationales behind the scene. With a short-term focus, the key business process is legitimate. The core value unit is clearly defined and well served by business models. Compatible

project management capabilities have been developed, and critical assets have been acquired. With a mid- to long-term focus, value co-creation is healthy. An ecosystem of value co-creation and distribution has been established, where the major stakeholders can create and derive value continuously. Moreover, the platform develops steadily, which is achieved by strengthening the existing business processes, sustaining value co-creation, and engaging with external stakeholders.

VII. CONCLUSION

In this study, we developed a framework to investigate the business sustainability of a crowdsourcing platform. The framework considers temporal dimensions and multiple interpretations of business sustainability to examine the key business process, value co-creation, and business development of a target crowdsourcing platform. Specifically, by investigating the key business process, we aim to verify the business legitimacy of a target platform on a theoretical level (short-term focus); by examining the value co-creation, we aim to figure out whether value can be continuously created by and properly distributed to the major stakeholders (mid- to long-term focus); by analyzing the business development, we aim to determine whether it is capable to perform in the future at least as well as it does today (long-term focus). The results of the analysis generate implications regarding whether the crowdsourcing platform is sustainable and reveal the rationales. This is a major theoretical contribution of this study concerning that there is a lack of a holistic understanding of crowdsourcing platforms as enterprises with a developmental perspective in the extant literature on crowdsourcing.

Further, we designed a case study of LEGO Ideas to illustrate how the framework can be applied in practice. Discussions on the case can provide insightful references for practitioners to assess and improve business sustainability of crowdsourcing platforms. As an initial step, it is crucial to generate a thorough understanding of the existing platform governance, project management capabilities, and platform assets of the targeted crowdsourcing platform. Then, in analysis of the key business process, it is significant to examine whether the core value unit is clearly defined, whether the selected business model serves the core value unit well, whether compatible project management capabilities have been developed, and whether critical assets have been acquired. In analyzing the value co-creation, it is crucial to identify the major stakeholders and examine whether value can be continuously created by and distributed to the major stakeholders. In analyzing the platform development, it is critical to identify the potential paths and required adjustments to the existing platform governance, project management capabilities, and platform assets.

We anticipate two limitations of this study. First, the proposed framework does not include environmental concerns directly. Although scholars commonly regard environmental concerns (e.g., resource recycling, carbon neutrality, and green power) as a critical part of business sustainability, crowdsourcing platforms, as digital information systems, are less related to these issues. Second, the conceptual framework does not offer any specific metric for measurement. Therefore, it is for identifying the key dimensions and aspects to be examined when analyzing the business sustainability of a crowdsourcing platform; it is not for quantitative measurement.

In future research, it will be essential to apply and test the framework by investigating multiple crowdsourcing platforms. This calls for diverse case studies to discuss both successful and failed platforms. Moreover, as discussed in the limitations, the framework can be extended by adding specific metrics for measurement. This can make the framework a more comprehensive tool and inspire a series of quantitative research on the identified dimensions and aspects.

REFERENCES

[1] J. Howe, "The rise of crowdsourcing," *Wired Mag.*, vol. 14, no. 6, pp. 1–4, Jun. 2006.
[2] E. Estellés-Arolas and F. Gonzalez-Ladron-De-Guevara, "Towards an integrated crowdsourcing definition," *J. Inf. Sci.*, vol. 38, no. 2, pp. 189–200, Apr. 2012.
[3] D. Nevo and J. Kotlarsky, "Crowdsourcing as a strategic IS sourcing phenomenon: Critical review and insights for future research," *J. Strategic Inf. Syst.*, vol. 29, no. 4, pp. 1–22, Feb. 2020.
[4] Y. Zhao and Q. Zhu, "Evaluation on crowdsourcing research: Current status and future direction," *Inf. Syst. Frontiers*, vol. 16, no. 3, pp. 417–434, 2014.
[5] D. Howcroft and B. Bergvall-Kåreborn, "A typology of crowdwork platforms," *Work, Employment Soc.*, vol. 33, no. 1, pp. 21–38, May 2018.
[6] I. Blohm, S. Zogaj, U. Bretschneider, and J. M. Leimeister, "How to manage crowdsourcing platforms effectively?" *California Manage. Rev.*, vol. 60, no. 2, pp. 122–149, Oct. 2017.
[7] T. Kohler, "Crowdsourcing-based business models: How to create and capture value," *California Manage. Rev.*, vol. 57, no. 4, pp. 63–84, Aug. 2015.
[8] T. Kohler, "How to scale crowdsourcing platforms," *California Manage. Rev.*, vol. 60, no. 2, pp. 98–121, Oct. 2017.
[9] M. Bashir and R. Verma, "Why business model innovation is the new competitive advantage," *IUP J. Bus. Strategy*, vol. 14, no. 1, pp. 7–17, Mar. 2017.
[10] A. Ghezzi, D. Gabelloni, A. Martini, and A. Natalicchio, "Crowdsourcing: A review and suggestions for future research," *Int. J. Manage. Rev.*, vol. 20, no. 2, pp. 343–363, Jan. 2017.
[11] H. Ye and A. Kankanhalli, "Leveraging crowdsourcing for organizational value co-creation," *Commun. Assoc. Inf. Syst.*, vol. 33, pp. 225–244, Dec. 2013.
[12] V.-J. Khan, K. Papangelis, I. Lykourentzou, and P. Markopoulos, *Macro-task Crowdsourcing: Engaging the Crowds to Address Complex Problems*. Cham, Switzerland: Springer, 2019.
[13] Q. Liu, Q. Du, Y. Hong, W. Fan, and S. Wu, "User idea implementation in open innovation communities: Evidence from a new product development crowdsourcing community," *Inf. Syst. J.*, vol. 30, no. 5, pp. 899–927, Mar. 2020.
[14] K. J. Boudreau and K. R. Lakhani, "Using the crowd as an innovation partner," *Harvard Bus. Rev.*, vol. 91, no. 4, pp. 60–69, 2013.
[15] D. Geiger and M. Schader, "Personalized task recommendation in crowdsourcing information systems—Current state of the art," *Decis. Support Syst.*, vol. 65, pp. 3–16, Sep. 2014.
[16] E. Kaganer, E. Carmel, R. Hirschheim, and T. Olsen, "Managing the human cloud," *MIT Sloan Manage. Rev.*, vol. 54, no. 2, pp. 23–32, Dec. 2012.
[17] C. Franzoni and H. Sauermann, "Crowd science: The organization of scientific research in open collaborative projects," *Res. Policy*, vol. 43, no. 1, pp. 1–20, Feb. 2014.
[18] C. Fieseler, E. Bucher, and C. P. Hoffmann, "Unfairness by design? The perceived fairness of digital labor on crowdworking platforms," *J. Bus. Ethics*, vol. 156, no. 4, pp. 987–1005, Jun. 2017.
[19] Y. Zhang, C. D. Tan, J. Sun, and Z. Yang, "Why do people patronize donation-based crowdfunding platforms? An activity perspective of critical success factors," *Comput. Hum. Behav.*, vol. 112, pp. 1–27, Nov. 2020.

[20] T. Kohler and H. Chesbrough, "From collaborative community to competitive market: The quest to build a crowdsourcing platform for social innovation," *R&D Manage.*, vol. 49, no. 3, pp. 356–368, Apr. 2019.

[21] N. Kazemargi, C. Cerruti, and A. Appolloni, "Adopting open innovation in supply networks," *Int. J. Manage. Enterprise Develop.*, vol. 15, nos. 2–3, pp. 174–190, May 2016.

[22] A. Böckel, J. Hörisch, and I. Tenner, "A systematic literature review of crowdfunding and sustainability: Highlighting what really matters," *Manage. Rev. Quart.*, vol. 71, no. 2, pp. 433–453, Jun. 2020.

[23] C.-M. Chiu, T.-P. Liang, and E. Turban, "What can crowdsourcing do for decision support?" *Decision Support Syst.*, vol. 65, pp. 40–49, Sep. 2014.

[24] C. H. Au, K. K. Ho, and D. K. Chiu, "Managing users' behaviors on open content crowdsourcing platform," *J. Comput. Inf. Syst.*, pp. 1–11, Oct. 2021, doi: 10.1080/08874417.2021.1983487.

[25] J. Bauer, N. Franke, and P. Tuertscher, "Intellectual property norms in online communities: How user-organized intellectual property regulation supports innovation," *Inf. Syst. Res.*, vol. 27, no. 4, pp. 724–750, Dec. 2016.

[26] L. Hornuf and A. Schwienbacher, "Internet-based entrepreneurial finance: Lessons from Germany," *California Manage. Rev.*, vol. 60, no. 2, pp. 150–175, Dec. 2017.

[27] C. Thürridl and B. Kamleitner, "What goes around comes around? Rewards as strategic assets in crowdfunding," *California Manage. Rev.*, vol. 58, no. 2, pp. 88–110, Feb. 2016.

[28] Z. Wen and L. Lin, "Optimal fee structures of crowdsourcing platforms," *Decis. Sci.*, vol. 47, no. 5, pp. 820–850, Oct. 2016.

[29] K. Bimpikis and M. G. Markakis, "Learning and hierarchies in service systems," *Manage. Sci.*, vol. 65, no. 3, pp. 1268–1285, Mar. 2019.

[30] Y. Baba, H. Kashima, K. Kinoshita, G. Yamaguchi, and Y. Akiyoshi, "Leveraging non-expert crowdsourcing workers for improper task detection in crowdsourcing marketplaces," *Expert Syst. Appl.*, vol. 41, no. 6, pp. 2678–2687, May 2014.

[31] H. Geva, O. Barzilay, and G. Oestreicher-Singer, "A potato salad with a lemon twist: Using a supply-side shock to study the impact of opportunistic behavior on crowdfunding platforms," *MIS Quart.*, vol. 43, no. 4, pp. 1227–1248, 2019.

[32] J. Mo, S. Sarkar, and S. Menon, "Know when to run: Recommendations in crowdsourcing contests," *MIS Quart.*, vol. 42, no. 3, pp. 919–944, Mar. 2018.

[33] H. ul Hassan and E. Curry, "Efficient task assignment for spatial crowdsourcing: A combinatorial fractional optimization approach with semi-bandit learning," *Expert Syst. Appl.*, vol. 58, pp. 36–56, Oct. 2016.

[34] M. Heo and N. Toomey, "Supporting sustained willingness to share knowledge with visual feedback," *Comput. Hum. Behav.*, vol. 54, pp. 388–396, Jan. 2016.

[35] B. Morschheuser, J. Hamari, and A. Maedche, "Cooperation or competition—When do people contribute more? A field experiment on gamification of crowdsourcing," *Int. J. Hum.-Comput. Stud.*, vol. 127, pp. 7–24, Jul. 2019.

[36] B. Morschheuser and J. Hamari, "The gamification of work: Lessons from crowdsourcing," *J. Manage. Inquiry*, vol. 28, no. 2, pp. 145–148, Aug. 2018.

[37] D. H.-L. Goh, E. P. P. Pe-Than, and C. S. Lee, "Perceptions of virtual reward systems in crowdsourcing games," *Comput. Hum. Behav.*, vol. 70, pp. 365–374, May 2017.

[38] A. Ihl, K. S. Strunk, and M. Fiedler, "The mediated effects of social support in professional online communities on crowdworker engagement in microtask crowdworking," *Comput. Hum. Behav.*, vol. 113, pp. 1–11, Dec. 2020.

[39] X. Deng, K. D. Joshi, and R. D. Galliers, "The duality of empowerment and marginalization in microtask crowdsourcing: Giving voice to the less powerful through value sensitive design," *MIS Quart.*, vol. 40, no. 2, pp. 279–302, Feb. 2016.

[40] L. Luo and O. Toubia, "Improving online idea generation platforms and customizing the task structure on the basis of consumers' domain-specific knowledge," *J. Marketing*, vol. 79, no. 5, pp. 100–114, Sep. 2015.

[41] D. Rotman, K. Procita, D. Hansen, C. S. Parr, and J. Preece, "Supporting content curation communities: The case of the encyclopedia of life," *J. Amer. Soc. Inf. Sci. Technol.*, vol. 63, no. 6, pp. 1092–1107, Jun. 2012.

[42] M. Siering, J. Koch, and A. V. Deokar, "Detecting fraudulent behavior on crowdfunding platforms: The role of linguistic and content-based cues in static and dynamic contexts," *J. Manage. Inf. Syst.*, vol. 33, no. 2, pp. 421–455, 2016.

[43] C. Lampe, P. Zube, J. Lee, C. H. Park, and E. Johnston, "Crowdsourcing civility: A natural experiment examining the effects of distributed moderation in online forums," *Government Inf. Quart.*, vol. 31, no. 2, pp. 317–326, 2014.

[44] W. Dai, G. Jin, J. Lee, and M. Luca, "Aggregation of consumer ratings: An application to Yelp.Com," *Quant. Marketing Econ.*, vol. 16, no. 3, pp. 289–339, Dec. 2017.

[45] M. Klein and A. C. B. Garcia, "High-speed idea filtering with the bag of lemons," *Decis. Support Syst.*, vol. 78, pp. 39–50, Oct. 2015.

[46] J. O. Wooten and K. T. Ulrich, "Idea generation and the role of feedback: Evidence from field experiments with innovation tournaments," *Prod. Oper. Manage.*, vol. 26, no. 1, pp. 80–99, Jan. 2017.

[47] B. Wernerfelt, "A resource-based view of the firm," *Strategic Manage. J.*, vol. 5, pp. 171–180, Jun. 1984.

[48] O. E. Williamson, "Transaction cost economics and organization theory," *Ind. Corporate Change*, vol. 2, no. 2, pp. 107–156, 1993.

[49] J. H. Dyer and H. Singh, "The relational view: Cooperative strategy and sources of interorganizational competitive advantage," *Acad. Manage. Rev.*, vol. 23, no. 4, pp. 660–679, 1998.

[50] A. Baruch, A. May, and D. Yu, "The motivations, enablers and barriers for voluntary participation in an online crowdsourcing platform," *Comput. Hum. Behav.*, vol. 64, pp. 923–931, Nov. 2016.

[51] J. M. Leimeister, M. Huber, U. Bretschneider, and H. Krcmar, "Leveraging crowdsourcing: Activation-supporting components for IT-based ideas competition," *J. Manage. Inf. Syst.*, vol. 26, no. 1, pp. 197–224, Jul. 2009.

[52] S. L. Alam and J. Campbell, "Temporal motivations of volunteers to participate in cultural crowdsourcing work," *Inf. Syst. Res.*, vol. 28, no. 4, pp. 744–759, Dec. 2017.

[53] M. Boons, D. Stam, and H. G. Barkema, "Feelings of pride and respect as drivers of ongoing member activity on crowdsourcing platforms," *J. Manage. Stud.*, vol. 52, no. 6, pp. 717–741, Sep. 2015.

[54] L. Kuang, N. Huang, Y. Hong, and Z. Yan, "Spillover effects of financial incentives on non-incentivized user engagement: Evidence from an online knowledge exchange platform," *J. Manage. Inf. Syst.*, vol. 36, no. 1, pp. 289–320, Jan. 2019.

[55] D. R. Karger, S. Oh, and D. Shah, "Budget-optimal task allocation for reliable crowdsourcing systems," *Oper. Res.*, vol. 62, no. 1, pp. 1–24, 2014.

[56] J. Kim and W. Lee, "Stochastic decision making for adaptive crowdsourcing in medical big-data platforms," *IEEE Trans. Syst., Man, Cybern. Syst.*, vol. 45, no. 11, pp. 1471–1476, Nov. 2015.

[57] P. Wu, E. W. T. Ngai, and Y. Wu, "Toward a real-time and budget-aware task package allocation in spatial crowdsourcing," *Decis. Support Syst.*, vol. 110, pp. 107–117, Jun. 2018.

[58] *World Commission on Environment and Development (WCED)*, Our Common Future, Oxford Univ. Press, New York, NY, USA, 1987.

[59] P. Bansal and M. R. DesJardine, "Business sustainability: It is about time," *Strategic Org.*, vol. 12, no. 1, pp. 70–78, Feb. 2014.

[60] W. Stubbs and C. Cocklin, "Conceptualizing a 'sustainability business model'," *Org. Environ.*, vol. 21, no. 2, pp. 103–127, Jun. 2008.

[61] C. Labuschagne, A. C. Brent, and R. P. G. van Erck, "Assessing the sustainability performances of industries," *J. Cleaner Prod.*, vol. 13, no. 4, pp. 373–385, Mar. 2005.

[62] S. K. Sikdar, "Sustainable development and sustainability metrics," *AIChE J.*, vol. 49, no. 8, pp. 1928–1932, Aug. 2003.

[63] I. Hristov, A. Appolloni, and A. Chirico, "The adoption of the key performance indicators to integrate sustainability in the business strategy: A novel five-dimensional framework," *Bus. Strategy Environ.*, pp. 1–15, Apr. 2022, doi: 10.1002/bse.3072.

[64] N. S. Aydin and E. B. Tirkolaee, "A systematic review of aggregate production planning literature with an outlook for sustainability and circularity," *Environ., Develop. Sustainability*, pp. 1–42, May 2022, doi: 10.1007/s10668-022-02304-8.

[65] R. S. Aguilar-Savén, "Business process modelling: Review and framework," *Int. J. Prod. Econ.*, vol. 90, no. 2, pp. 129–149, Jul. 2004.

[66] W. M. P. Van der Aalst, "Business process management: A comprehensive survey," *ISRN Softw. Eng.*, vol. 2013, pp. 1–37, Feb. 2013.

[67] C. Armistead, J.-P. Pritchard, and S. Machin, "Strategic business process management for organisational effectiveness," *Long Range Planning*, vol. 32, no. 1, pp. 96–106, Mar. 1999.

[68] M. Zairi, "Business process management: A boundaryless approach to modern competitiveness," *Bus. Process Manage. J.*, vol. 3, no. 1, pp. 64–80, Apr. 1997.

[69] D. Binci, S. Belisari, and A. Appolloni, "BPM and change management: An ambidextrous perspective," *Bus. Process Manage. J.*, vol. 26, no. 1, pp. 1–23, Nov. 2019.

[70] R. E. Freeman, *Strategic Management: A Stakeholder Approach*. Cambridge, U.K.: Cambridge Univ. Press, 2010.

[71] V. Grover and R. Kohli, "Cocreating IT value: New capabilities and metrics for multifirm environments," *MIS Quart.*, vol. 36, no. 1, pp. 225–232, Jan. 2012.

[72] B. Freudenreich, F. Lüdeke-Freund, and S. Schaltegger, "A stakeholder theory perspective on business models: Value creation for sustainability," *J. Bus. Ethics*, vol. 166, no. 1, pp. 3–18, Feb. 2019.

[73] T. Dyllick and K. Muff, "Clarifying the meaning of sustainable business: Introducing a typology from business-as-usual to true business sustainability," *Org. Environ.*, vol. 29, no. 2, pp. 156–174, Mar. 2015.

[74] R. G. Lee and B. G. Dale, "Business process management: A review and evaluation," *Bus. Process Manage. J.*, vol. 4, no. 3, pp. 214–225, Sep. 1998.

[75] R. K. Yin, *Applications of Case Study Research*. Califonia, CA, USA: Sage, 2003.

[76] D. Schlagwein and N. Bjorn-Andersen, "Organizational learning with crowdsourcing: The revelatory case of LEGO," *J. Assoc. Inf. Syst.*, vol. 15, no. 11, pp. 754–778, Nov. 2014.

[77] A. Fagerstrøm, L. M. Bendheim, V. Sigurdsson, G. R. Foxall, and S. Pawar, "The marketing firm and co-creation: The case of co-creation by LEGO," *Managerial Decis. Econ.*, vol. 41, no. 2, pp. 226–233, Aug. 2019.

[78] W. Liu, J. Moultrie, and S. Ye, "The customer-dominated innovation process: Involving customers as designers and decision-makers in developing new product," *Design J.*, vol. 22, no. 3, pp. 299–324, Apr. 2019.

[79] LEGO. *LEGO HIstroy LEGO Ideas*. Accessed: Dec. 12, 2021. [Online]. Available: https://www.lego.com/zh-hk/history/articles/j-lego-ideas/

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