

RESEARCH ARTICLE

A Typology of Crowd Configurations Based on Crowd Attributes and Their Impacts on Crowdsourcing Outcomes

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ABSTRACT Crowdsourcing, as a crowd-centered approach, is becoming increasingly popular for organizations to conduct outsourcing, research and development (R&D), and marketing. The effectiveness of a crowdsourcing initiative, as manifested in specific outcomes, depends significantly on the salient characteristics of the configured crowd. This study aims to investigate which business purposes necessitate which crowds with which characteristics. Contributions of this study include: 1) introducing and defining three crowd attributes to depict the salient characteristics of a crowd, and 2) proposing a typology of eight crowd configurations by combining high or low levels of the three crowd attributes and examining each crowd configuration to highlight the relationships between crowd attributes and crowdsourcing outcomes. Eight mini cases corresponding to the eight crowd configurations are presented to illustrate how crowd configurations were implemented in real-life situations. The theoretical and practical implications are discussed respectively.


INDEX TERMS Crowdsourcing, crowd, crowd attributes, crowdsourcing outcomes, typology.

I. INTRODUCTION

Crowdsourcing refers to outsourcing a task to a group of individuals in the form of an open call [1]. It creates alternative options for organizations to conduct outsourcing, R&D, and marketing [2], [3], [4]. For example, Xiaomi uses its crowdfunding platform to raise funds and conduct marketing research for prospective products. TiMi Studio Group initiates tournaments annually to call for skin designs for the characters in the game “Honor of Kings” and promote in-game purchases. Another example is Bing Dwen Dwen which is the mascot of the Beijing 2022 Winter Olympic Games. The cartoon panda with “iced shell” was inspired by a few winning designs out of more than 5,800 proposals in a contest initiated by the Beijing Organising Committee for the 2022 Olympic and Paralympic Winter Games.

As a crowd-centered approach, the labor, experience, and knowledge of crowds are the key resources that can be

leveraged by crowdsourcers [5]. These resources reside in unknown individuals and can be accessed through their engagement and interaction [6], [7]. Depending on specific business purposes, crowdsourcers may prioritize certain resources and specific ways to obtain the desired resources. For example, a secretary can initiate a micro-tasking project to transcribe simple documents. In this case, a few workers are required, and their labor is the desired resource; meanwhile, high levels of engagement and interactivity are unnecessary. A Software as a Service (SaaS) provider can launch a global open-source software (OSS) development project to innovate. In this case, a large number of highly skillful software developers are required, and their knowledge is the key desired resource; meanwhile decent engagement and interaction are essential to facilitate innovation. A marketer can sponsor an ideation campaign to promote brand awareness. In this case, a large number of consumers are required, and their experiences are the desired resource; a high level of interactivity is preferred to promote viral marketing while a high engagement seems to be unnecessary.

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While organizations are leveraging crowds to realize a growing number of business purposes, the extant research on crowdsourcing is less clear about which business purposes necessitate which crowds with which characteristics [8]. Specifically, who is involved in a crowd and who is not, what are the salient characteristics of a crowd, and what are the potential impacts of these characteristics on crowdsourcing outcomes remain unclear. In this study, we attempt to address these issues by identifying the roles in a crowd, defining the key crowd attributes, and proposing a typology of crowd configurations to reveal the synergized impacts of multiple crowd attributes on crowdsourcing outcomes. The rest part of this study is structured as follows: it starts with a literature review on crowd and crowdsourcing outcomes, which is followed by the definitions of a crowd and crowd attributes; then, a typology of crowd configurations is proposed by combining high or low levels of the identified crowd attributes and relating their impacts on crowdsourcing outcomes; eight mini cases are presented to illustrate how these crowd configurations were applied in practice; finally, both theoretical and practical implications are discussed.

II. LITERATURE REVIEW

A. CROWD

A crowd may refer to a group of online workers [9], consumers [10], volunteers [11], solvers [12], peers [13], donors [14], ideators [15], co-creators [16], contestants [17], and the most frequently mentioned contributors [18]. Definitions in the extant literature are generally vague. There is a lack of a clear boundary to distinguish who is involved and who is not. In addition, the ways of individuals' engagement are inconsistent. For example, Prpić *et al.* [6] regard a crowd as a group of individuals who are self-organized around a shared purpose, emotion, or experience. Brabham [19] explains that a crowd consists of individuals (persons and firms) who provide solutions in a crowdsourcing application. Pedersen *et al.* [20] define a crowd as a dynamically formed group of individuals who participate in the crowdsourcing problem. While there is a lack of a clear definition, a crowd is often implicitly used to refer to the major undertakers and is represented by individuals who directly deliver and facilitate required solutions [21]. For example, in the case of LEGO presented by Schlagwein and Bjørn-Andersen [10], the crowd is represented by the designers who submit their original LEGO brick designs, commentators who comment on the designs, and supporters who vote for the designs.

A crowd is not ingenerated but needs to be constructed [6]. It may emerge and grow naturally because of the voluntary mechanism [18]. Once a crowdsourcing initiative is open for participation, individuals can ignore it or take active actions, such as developing solutions, facilitating solutions, and withdrawing, as they wish during a specific period [22]. Hence, a crowd is naturally dynamic [23]. As time goes by, new entrants engage while some individuals leave; some individuals become vibrant while some become silent.

Meanwhile, a crowdsourcer can intervene in the formation process in multiple ways. Primarily, promotion methods can be applied [24]. By leveraging the networks of the crowdsourcer, platform, and crowd, a crowdsourcing initiative can be widely spread out [25], [26], [27]. The wider range it is broadcasted, the more individuals can be accessed, which can potentially increase the crowd size. Moreover, a crowdsourcer can set up thresholds, such as qualifications, experience, and expertise, in advance to exclude disqualified individuals [28]. This can impact the constitution of a crowd.

Moreover, a crowdsourcer can intervene in individuals' engagement by controlling their motivations and behaviors. From the crowd perspective, motivations are generally categorized into extrinsic and intrinsic motivations [29]. Extrinsic motivations can be activated by incentives, such as financial rewards, career opportunities, and reputation [11], [30], [31]. Intrinsic motivations can be activated by incentives, such as interest, altruism, and fun [32], [33], [34]. In addition, previous studies reveal that individuals' behaviors can be simultaneously influenced by the crowdsourcer, platform, and peers [21], [35], [36]. Specifically, individuals are sensitive to rewarding strategies [37], task designs [38], and interaction strategies [39] executed by crowdsourcers. Technical functions and managerial practices on platforms (e.g., system designs, task recommendation and allocation systems, gamification mechanisms, contribution mechanisms, intellectual property management, and contributor gatekeeping) can also affect how individuals behave [40], [41], [42]. Peers can generate impacts regarding ways of co-working as teams, competing with each other, and obtaining social standing in virtual communities [43], [44], [45]. On this basis, a crowdsourcer can elaborate a mix of incentives and practices to impact the engagement of individuals.

B. CROWDSOURCING OUTCOMES

The crowdsourcing outcomes in this study take a holistic view of value from the crowdsourcer's perspective, referring to the core benefits that a crowdsourcer can derive from a crowdsourcing initiative. By investigating crowdsourcers' motivations, antecedents to crowdsource, and perceived value in the literature, the common crowdsourcing outcomes are identified, including problem-solving, innovation, marketing excellence, and cost reduction [21], [46], [47]. These crowdsourcing outcomes are not identical or mutually exclusive. Problem-solving is a general interpretation that can cover a majority of crowdsourcers' motivations, antecedents, and perceived value. Innovation can be a specific type of problem-solving. Marketing excellence can be an outcome that accompanies problem-solving. Cost reduction is a hysteretic outcome when a problem is properly solved.

1) PROBLEM SOLVING

A crowdsourced problem usually explicitly or implicitly specifies a concrete number of solutions to be obtained and the desired quality, hypothetically speaking, 10 creative graphic designs in a contest, 100 constructive ideas in an

ideation, and as many valid votes as possible in a crowd-voting. While the expected quantities represent the minimum quantities of solutions to be collected from crowds, creativity, constructiveness, and validity are the desired quality of solutions. If there is a lack of solutions, a crowdsourced task is liable to fail [36], [48]. This particularly matters when solutions (contributions) are added together in their entirety (e.g., in crowd-voting). When selecting the few best solutions (e.g., in ideation), insufficient contributions limit the number of alternative choices, which in turn increases the risk of lacking high-quality solutions. Even if sufficient contributions are collected, failing to meet the expected quality standards cannot yield the expected crowdsourcing outcome.

In a broad sense, problems can be categorized into routine and complicated problems. Routine problems are self-contained, simple, and short-termed; therefore, limited effort, intellectual input, and time are required from crowds [48], [49], [50]. In such scenarios (e.g., crowd-voting, micro-tasking, and crowdfunding), the numbers of solutions are significant. As long as there are sufficient solutions, problems can be easily solved. In contrast, complicated problems are novel, complex, and time-consuming, which require substantial effort, intellectual input, and time from crowds [48], [51], [52]. Collecting sufficient contributions is a precondition to solving a complicated problem, and whether the problem is properly solved is determined by the quality of acquired solutions. In such scenarios (e.g., OSS development, micro-sourcing, and wikis), both the quantities and quality of solutions are significant.

2) INNOVATION

Crowdsourcing can facilitate innovation in two ways, via divergent and convergent thinking. Divergent thinking refers to the process of creating multiple unique solutions to a problem [53]. In a crowdsourcing initiative, divergent thinking happens when many individuals independently make unique contributions to solve a crowdsourced problem [54]. It can be a source of innovation because a large number of diverse individuals can be more innovative than a limited number of internal experts in solving certain problems [29]. In general, divergent thinking in crowdsourcing is not necessarily sophisticated or professional but is often applied to generate the input of innovation, such as insightful information, alternative choices, and collective preferences [6], [21], [55]. For example, Starbucks promoted divergent thinking on My Starbucks Idea to collect suggestions for product and service innovation. In such a scenario, innovation via divergent thinking can be seen as a specific case of routine problem-solving. The number of unique contributions is significant.

Convergent thinking designates obtaining a well-defined solution to a problem by following logical steps [53]. In a crowdsourcing initiative, convergent thinking happens both individually and collectively. In the former scenario, individuals work independently and intensively to offer their best solutions to the crowdsourced problem; in the latter scenario, individuals make, review, assess,

filter, combine, and modify contributions collaboratively to offer the best solutions [13], [23], [56]. Convergent thinking can be a potential source of innovation because it attempts to detect novel solutions and improve the quality [56], [57]. It can generate transitional or even terminal output for innovation. For example, the winning designs in the contest for the mascot of the Beijing 2022 Winter Olympic Games were inspirations for the design of Bing Dwen Dwen. Innovation via convergent thinking can be seen as a specific case of complicated problem-solving. Both the quantity and quality of solutions are significant.

In practice, divergent and convergent thinking can be combined to facilitate innovation. While divergent thinking can generate unique solutions, convergent thinking can ascertain feasible ones and improve the quality of the output [57]. On LEGO ideas, for example, LEGO promotes divergent thinking to facilitate massive original proposals designed by fans. Meanwhile, peer and expert reviews are implemented as convergent thinking to filter high-quality proposals and improve their quality.

3) MARKETING EXCELLENCE

Crowdsourcing has been widely applied to conduct marketing activities [2], [5]. It can promote marketing excellence mainly in three ways: via mass marketing, customer relationship management (CRM), and viral marketing. A crowdsourcer can target a deliberately formed crowd and conduct mass marketing initiatives to disseminate marketing information [2], [46]. The number of accessed individuals matters because it reflects the scope of marketing. A crowdsourcer can also establish and maintain relationships with individuals in a crowd [26], [58]. Individuals' engagement is significant as it can reflect the closeness of established relationships. In addition, a crowdsourcer can leverage individuals' networks to expand marketing influence [10], [35], [59]. By facilitating interactions among individuals, more individuals are actively involved, making the crowdsourcing initiative trending. Marketing excellence is about leveraging a formed crowd for marketing purposes, which is less reliant on the quantity or quality of solutions. It can be an additional outcome that accompanies problem-solving. Alternatively, marketing excellence is the main pursuit while the crowdsourced problem is designed as a gimmick that attracts individuals.

4) COST REDUCTION

In comparison to in-house operations or outsourcing, crowdsourcing can be more cost-effective in performing certain tasks [21]. A major reason for this is that a crowd usually possesses weak bargaining power, whereas a crowdsourcer retains strong bargaining power to set the offer [9]. Additionally, financial rewards are not a compulsory feature of crowdsourcing. Even if there are financial rewards, only a few individuals are rewarded [22]. In some scenarios, a crowdsourcer can acquire multiple solutions for one task but only pays for the best one [46]. Major factors that may compromise

cost reduction are the uncertainties and risks associated with maintaining relationships with a large number of unknown individuals [4]. The voluntary mechanism makes it difficult for a crowdsourcer to have tight control over a crowd. This can be amplified by intensive multilateral interactions [24]. The need to govern potential uncertainties and risks, such as insufficient and low-quality contributions, turnover, cold starts, and malicious behaviors, may increase the overall cost [22].

Therefore, in pursuit of cost-effectiveness, a crowdsourcer is expected to fully activate the strengths of crowdsourcing and reduce potential uncertainties and risks simultaneously. Cost reduction is highly relevant to a crowdsourcer's existing resources and capabilities [4]. For example, compared to taking advantage of existing consumers, constructing and managing a crowd with strangers tends to be costlier. An experienced firm, which has developed relevant capabilities, is likely to manage crowdsourcing more cost-effectively than a new entrant. Another issue to be considered is that cost reduction is hysteretic. It is not a standalone outcome and can be discussed only after other expected crowdsourcing outcomes have been realized.

III. CONFIGURING A CROWD

The review on crowds indicates that a crowd has not yet been clearly defined, and crowdsourcers can construct and manipulate crowds on purpose. Meanwhile, the review on crowdsourcing outcomes implies that diverse crowdsourcing outcomes are relevant to different characteristics of crowds. On this basis, we believe that crowdsourcers can purposefully manipulate crowds with matched characteristics to pursue different crowdsourcing outcomes; in principle, there exists ideal crowd configurations for specific crowdsourcing outcomes. This, accordingly, raises a series of issues to be addressed. The first issue calls for a clear definition of a crowd in crowdsourcing. The second issue concerns the salient crowd characteristics that can be directly manipulated by crowdsourcers and their impacts on crowdsourcing outcomes. The third issue seeks to discover the matches between crowd configurations and crowdsourcing outcomes. In the following section, we address these issues.

A. DEFINING A CROWD

A widely accepted definition in the literature defines crowdsourcing 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 [60] (p.11)." This definition regards a crowd as a group of diverse individuals who voluntarily undertake a crowdsourced task. Meanwhile, scholars indicate that not all individuals will take actual actions, and the ways of their engagement can be different [22], [23], [36]. Hence, there exist different roles in a crowd.

In this study, we distinguish three roles of individuals, including solvers, facilitators, and bystanders. Specifically,

in a crowdsourcing initiative, solvers refer to individuals who directly develop and deliver solutions to the crowdsourced problem; facilitators do not deliver solutions directly but facilitate the delivery of solutions by, for example, disseminating, improving, and inspiring solutions; bystanders are aware of the crowdsourcing initiative but do not take any active action. As previously discussed, the voluntary mechanism allows individuals to act freely [18]. The roles of individuals, therefore, may switch over time. An individual may act in different roles during the lifecycle of a crowdsourcing initiative. To avoid any confusion, we use solvers, facilitators, and bystanders to describe individuals according to their accumulated actions before the time spot when a crowd is observed. Thus, an individual can be either a solver, facilitator, bystander, or both a solver and facilitator; nevertheless, an individual cannot simultaneously be a solver/facilitator and bystander.

Bystanders can be set as a relatively clear boundary of a crowd. Primarily, bystanders normally generate limited impacts on the delivery of solutions as they have not taken any active action. In contrast, solvers and facilitators both have contributed to the delivery of solutions. In addition, the presence of bystanders can be hardly traced whereas the presence of solvers and facilitators can be easily traced. On this basis, solvers and facilitators are included in a crowd whereas bystanders are excluded (as shown in Figure 1). Then, we define a crowd as a group of individuals with certain labor capacity, various resources, and diverse expertise who actively contribute to the development and delivery of solutions to a crowdsourced problem.

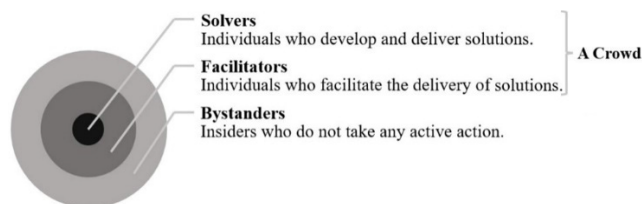


FIGURE 1. Roles in a crowd of a crowdsourcing project.

B. CROWD ATTRIBUTES

Scholars have identified numerous characteristics of a crowd, such as diversity, size, experience diversity, participant independence, equality among individuals, knowledge, network decentralization, location, growth rate, goal orientation, and interaction [8], [61], [62]. Some characteristics, such as size, growth rate, and interaction can be directly manipulated by crowdsourcers while some characteristics, such as diversity, knowledge, and goal orientation cannot be directly controlled. As an illustration, the experience diversity of a crowd is a post-hoc characteristic that describes an already constructed crowd. A crowdsourcer cannot directly decide the diversity of individuals' experiences during the construction process but can impact it by increasing the crowd size. However, the voluntary mechanism and ex-ante unknown

individuals cannot guarantee that the experience of new entrants can enrich the existing experience pool.

We introduce crowd attributes to depict the salient characteristics that universally exist, significantly impact crowdsourcing outcomes and can be directly manipulated by crowdsourcers. By connecting the reviews on crowds and crowdsourcing outcomes, three crowd attributes are introduced, namely magnitude, engagement, and interactivity. We will respectively define these crowd attributes, explain how they can be manipulated by crowdsourcers, and discuss their impacts on identified crowdsourcing outcomes (as summarized in Table 1). Considering the hysteretic nature and reliance on crowdsourcers' existing resources and experience, cost reduction is not discussed.

TABLE 1. Crowd attributes and their impacts on crowdsourcing outcomes.

Crowd Attributes	Major Impacts	Impacted Crowdsourcing Outcomes
Magnitude	The quantity & diversity of solutions.	<ul style="list-style-type: none"> - Routine problem-solving. - Innovation via divergent thinking.
	Accessed individuals.	<ul style="list-style-type: none"> - Marketing excellence via mass marketing.
Engagement	The quality of solutions.	<ul style="list-style-type: none"> - Complicated problem-solving. - Innovation via individual convergent thinking.
	Mutual relationship.	<ul style="list-style-type: none"> - Marketing excellence via CRM.
Interactivity	The quantity & diversity of solutions.	<ul style="list-style-type: none"> - Routine problem-solving. - Innovation via divergent thinking.
	The quality of solutions.	<ul style="list-style-type: none"> - Complicated problem-solving. - Innovation via collective convergent thinking.
	Individuals' networks.	<ul style="list-style-type: none"> - Marketing excellence via viral marketing.

Magnitude is defined as the number of unique individuals (solvers and facilitators) in a crowd. A crowdsourcer can set specific thresholds in advance to clarify who can and cannot be involved [63]. Then, promotions and incentives can be elaborated and executed to expand the magnitude of the crowd. The wider range of the crowdsourcing initiative is broadcasted, the more bystanders can be accessed [24]; thereafter, any bystander who is successfully activated to take active action becomes a part of the crowd [29]. Magnitude impacts multiple crowdsourcing outcomes in different ways. Primarily, the magnitude of a crowd directly affects the number of solutions. Scholars have empirically proved that the size of a crowd generally positively affects the number of solutions [8], [48], [61]. A higher magnitude indicates that more solvers and facilitators (if applicable) are involved, which can facilitate the delivery of more solutions. Hence, maintaining a proper magnitude can directly solve a routine problem or supply sufficient solutions to a complicated problem. Moreover, an expanded magnitude can facilitate divergent thinking by improving the diversity of solutions [55], [64], which can be a favorable source of innovation [56]. A higher magnitude can also facilitate marketing excellence

because more individuals, including bystanders, solvers, and facilitators, have been accessed, and they can be targeted by mass marketing initiatives [2].

Engagement is defined as the overall quality of effort individuals (solvers and facilitators) devote to making contributions to the delivery of required solutions. As discussed in the literature review, a crowdsourcer can intervene in the engagement by elaborating appropriate incentives [11], [29], [33], designing interesting and challenging tasks with proper complexity [38], [48], [51], applying gamification approaches [52], [65], [66], leveraging collaborative/competitive mechanisms [18], [24], [67], encouraging interactions [21], [23], [36], and any combination of these. Engagement significantly impacts the quality of contributions because deeper engaged individuals would generally invest more resources, exert more effort, and spend more time developing and improving solutions [23], [61]. A higher engagement, therefore, is beneficial in solving a complicated problem. It can also facilitate individuals' convergent thinking, which can be a source of innovation. In addition, enhancing engagement can be seen as a CRM initiative that attempts to strengthen the mutual relationships between the crowdsourcer and the crowd [58]. Hence, engagement can positively impact marketing excellence.

Interactivity is defined as the overall vitality of interactions among individuals (solvers and facilitators). A crowdsourcer can intervene in the interactivity of a crowd by designing or selecting a competitive, collaborative, neutral, or a mixed mechanism [21], [35], [36], developing or selecting specific functions (e.g., comment, forward, share, like/dislike, favorite, report, and vote) [18], [66], and encouraging multilateral interactions through, for example, conducting random draws, applying gamification approaches, giving privileges to recognized idea leaders, and creating virtual communities [34], [65], [68]. In essence, interactions are unnecessarily the final solutions to a crowdsourced problem but facilitate the development and delivery of solutions. Interactivity generates impacts on crowdsourcing outcomes by leveraging the collective effort of individuals. A higher level of interactivity indicates that individuals are more active, socialized, and collaborative in multilateral interactions [12], [23]. Scholars have empirically proved that interactions, especially peer feedback and collaborations, can inspire the development of new solutions and improve the quality of existing solutions [52], [56], [70]. Hence, maintaining a proper interactivity can facilitate both routine and complicated problem-solving. It also encourages divergent and collective convergent thinking (Chan *et al.*, Majchrzak and Malhotra, Ren *et al.*), which can be sources of innovation. In addition, a higher interactivity can make a crowdsourcing initiative more trending across individuals' networks [13], [23], [56]. By leveraging crowd-based viral marketing initiatives, a crowdsourcer can pursue marketing excellence. Notably, interactions work better when there are many highly engaged individuals. Without sufficient individuals (low magnitude), interactivity alone cannot guarantee

the quantity or diversity of solutions, which affects routine problem-solving and innovation via divergent thinking. A small number of individuals can hardly support large-scale viral marketing initiatives, which impacts marketing excellence. Moreover, without deeply engaged individuals (low engagement), interactivity alone cannot guarantee the quality of solutions or facilitate decent convergent thinking, which affects complicated problem-solving and innovation via convergent thinking. Thus, a high interactivity works better with a high magnitude and engagement but fades out with a low magnitude and engagement.

C. CROWD CONFIGURATIONS

A crowdsourcer can configure a crowd by manipulating the crowd attributes. In this study, we use low and high levels to roughly distinguish between two extremes of a crowd attribute in an ideal type. Through maintaining high or low levels of magnitude, engagement, and interactivity, eight crowd configurations are available. They are (1) $M_H E_H I_H$, with a high magnitude, high engagement, and high interactivity, (2) $M_H E_H I_L$, with a high magnitude, high engagement, and low interactivity, (3) $M_H E_L I_H$, with a high magnitude, low engagement, and high interactivity, (4) $M_H E_L I_L$, with a high magnitude, low engagement, and low interactivity, (5) $M_L E_L I_L$, with a low magnitude, low engagement, and low interactivity, (6) $M_L E_L I_H$, with a low magnitude, low engagement, and high interactivity, (7) $M_L E_H I_L$, with a low magnitude, high engagement, and low interactivity, and (8) $M_L E_H I_H$, with a low magnitude, high engagement, and high interactivity (as shown in Figure 2). In each configuration, manipulated crowd attributes synergize to impact diverse crowdsourcing outcomes. Hence, a crowd configuration might be good at serving specific crowdsourcing outcomes. A crowdsourcer, therefore, can configure an ideal crowd in pursuit of specific crowdsourcing outcomes (as summarized in Table 2).

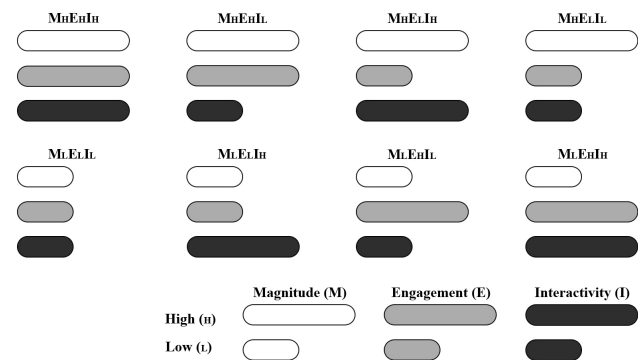


FIGURE 2. Eight crowd configurations based on high and low levels of crowd attributes.

$M_H E_H I_H$ is configured by maintaining a high magnitude, high engagement, and high interactivity, creating a large, engaged, and interactive crowd. This configuration can generate a large number of high-quality solutions by individuals and their collaborations. Therefore, it is capable to solve

both routine and complicated problems. Moreover, $M_H E_H I_H$ encourages divergent, individual convergent, and collective convergent thinking. Hence, it can be employed to facilitate innovation via multiple sources. $M_H E_H I_H$ also creates favorable conditions for conducting mass marketing, CRM, and viral marketing initiatives. Thus, it can be applied for marketing excellence.

$M_H E_H I_L$ is configured by maintaining a high magnitude, high engagement, and low interactivity, creating a large, engaged, and less interactive crowd. This configuration can generate a large number of high-quality solutions by individuals. Hence, it can be applied to solve routine and complicated problems. In addition, $M_H E_H I_L$ encourages divergent and individual convergent thinking, which can be the major sources of innovation. This configuration also creates favorable conditions for conducting mass marketing and CRM initiatives, which can facilitate marketing excellence.

$M_H E_L I_H$ is configured by maintaining a high magnitude, low engagement, and high interactivity, creating a large, less engaged, and interactive crowd. This configuration can generate a large number of solutions by individuals and their collaborations. However, because individuals are less engaged, their individual and collective effort cannot guarantee high-quality solutions to complicated problems. Hence, $M_H E_L I_H$ is more applicable for routine problem-solving. Moreover, this configuration encourages divergent thinking, which can be a major source of innovation. Potential collective convergent thinking is restricted by less engaged individuals. $M_H E_L I_H$ also creates favorable conditions for conducting mass and viral marketing initiatives, which can facilitate marketing excellence.

$M_H E_L I_L$ is configured by maintaining a high magnitude, low engagement, and low interactivity, creating a large, less engaged, and less interactive crowd. This configuration can generate a large number of solutions by individuals. Nonetheless, high-quality solutions are not guaranteed. It, therefore, can be applied to solve routine problems. Moreover, $M_H E_L I_L$ encourages divergent thinking, which can be a source of innovation. The configuration also creates favorable conditions for conducting mass marketing initiatives, which can be employed to pursue marketing excellence.

$M_L E_L I_L$ is configured by maintaining a low magnitude, low engagement, and low interactivity, creating a small, less engaged, and less interactive crowd. This configuration is likely to generate a small number of solutions by individuals while the quality is not guaranteed. Hence, $M_L E_L I_L$ can be applied to solve routine problems when a small number of solutions are required; it is highly risky for complicated problem-solving. Moreover, since this configuration does not encourage divergent or convergent thinking, it is not applicable for innovation. Because $M_L E_L I_L$ does not create favorable conditions for conducting marketing initiatives, it is not applicable for marketing excellence.

$M_L E_L I_H$ is configured by maintaining a low magnitude, low engagement, and high interactivity, creating a small, less engaged, and interactive crowd. This configuration is

TABLE 2. Crowd configurations and their impacts on crowdsourcing outcomes.

Crowd Configurations	The Number of Solutions		Problem Solving		Innovation		Marketing Excellence		Facilitations		
	A small number (S)	A large number (L)	Routine (R)	Complicated (C)	Divergent thinking (D)	Individual convergent thinking (C _i)	Collective convergent thinking (C _c)	Mass Marketing (M)	CRM (C)	Viral Marketing (V)	Matter (Y) or not (N)
M _H E _H I _H	L	L	R+C		D+ C _i + C _c			M+C+V			Y
M _H E _H I _L	L	L	R+C		D+ C _i			M+C			N
M _H E _L I _H	L	L	R		D			M+V			Y
M _H E _L I _L	L	L	R		D			M			N
M _L E _L I _L	S	S	R		-			-			N
M _L E _L I _H	S	S	R		-			-			Y
M _L E _H I _L	S	S	R+C		C _i			C			N
M _L E _H I _H	S	S	R+C		C _i + C _c			C			Y

likely to generate a small number of contributions by individuals and their collaborations. However, because individuals are less engaged, their individual and collective effort can hardly guarantee high-quality solutions to complicated problems. Consequently, it is applicable to solve routine problems when a small number of solutions are required. Moreover, a small number of less-engaged contributors and facilitators can hardly facilitate decent divergent or convergent thinking. Hence, M_LE_LI_H is not applicable for innovation. In addition, this configuration does not create favorable conditions for mass marketing or CRM initiatives. A small number of individuals can hardly support viral marketing unless these individuals are highly influential in their communities. Therefore, M_LE_LI_H is not suitable for marketing excellence.

M_LE_HI_L is configured by maintaining a low magnitude, high engagement, and low interactivity, creating a small, engaged, and less interactive crowd. This configuration can generate a few high-quality solutions by individuals. Hence, M_LE_HI_L can be applied to solve routine and complicated problems when a small number of solutions are required. Moreover, this configuration encourages individual convergent thinking, which can be a source of innovation. This configuration also creates favorable conditions for conducting CRM initiatives with a few individuals, which can facilitate marketing excellence.

M_LE_HI_H is configured by maintaining a low magnitude, high engagement, and high interactivity, creating a small, engaged, and interactive crowd. This configuration can generate a small number of high-quality solutions by individuals and their collaborations. Hence, it can be applied to solve routine and complicated problems when a small number of contributions are required. Moreover, M_LE_HI_H does not encourage divergent thinking but encourages individual and collective convergent thinking which can be leveraged to pursue innovation. Because a limited number of individuals are involved, both mass and viral marketing are restricted. Unless individuals are highly influential in their communities, viral marketing is not supported. However, this configuration creates favorable conditions for conducting CRM initiatives with a few individuals, which can facilitate marketing excellence.

IV. MINI CASES AND DISCUSSIONS

In this section, we present eight mini cases that correspond to the eight crowd configurations. Applying multiple-case designs, each case supports a particular purpose within the overall scope of inquiry [71]. The logic underlying the application of multiple cases either predicts similar outcomes or predicts contrasting outcomes yet for anticipatable reasons. Case data were collected from multiple platforms/applications via direct observations enabled by open/authorized access. In each case, we introduce the background, depict the attributes of the configured crowd, and summarize the captured crowdsourcing outcomes. We then discuss the crowd configuration concerning the potential relationships between the crowd configurations and the crowdsourcing outcomes.

A. A CASE OF M_HE_HI_H

LEGO Ideas is a platform run by LEGO to facilitate product innovation by collecting original LEGO brick designs from fans. In the Product Ideas module, registered users can submit their proposals which comprise the original designs together with written descriptions and keywords. Designers firstly work individually on their proposals and submit them online for review. Then, registered users can comment on and support the submitted proposals, which are the sources for designers to improve their proposals and acquire as many supporters as possible. If a proposal accumulates 10,000 supporters within the regulated time frames (100 supporters within 60 days, 1,000 within another 12 months, 5,000 within another 6 months, 10,000 within another 6 months), the designer will receive a virtual badge exhibiting “10K Club Member,” and LEGO experts will review the proposal to decide whether it is feasible for merchandising. If yes, the LEGO experts will finalize the design and prepare it for sale. The designer is acknowledged as the product designer and rewarded with 1% of the total net sales and 10 copies of the product. If the proposal is disapproved, the designer will receive three LEGO products worth 500 USD in combined value.

Product Ideas on LEGO Ideas is a typical case that configures an M_HE_HI_H for crowdsourcing. A high magnitude was

observed. By July 2022, there were more than 2.3 million registered users, about 2,700 exhibited proposals (a large number of expired ones were not displayed), and each design had accumulated tens to thousands of supports and comments, indicating that there were a large number of solvers (designers) and facilitators (commentators and supporters) constituting a huge crowd. The engagement was maintained high. As introduced by LEGO, “it can take up to several years and you will have to work hard to build awareness of your project until it gains the necessary 10,000 supporters.” The complexity of the crowdsourced task and the loyalty of fans made platform users highly engaged. A large number of long-term, highly committed solvers and facilitators were identified. The crowd interactivity was perceived as high. Massive multilateral interactions, including support, comments, and shares, showed a highly collaborative environment which significantly promoted design processes. Notably, a 10,000-support was the threshold set for unlocking the LEGO expert review process.

By configuring an $M_H E_H I_H$, LEGO acquired a large number of diverse and complicated solutions (2,700 exhibited and massive expired proposals). LEGO benefited from multiple sources for product innovation. The solutions were developed individually by a large number of solvers while solvers exerted considerable effort (divergent thinking and individual convergent thinking). Facilitators and solvers subsequently collaborated to improve the quality of solutions (collective convergent thinking). Moreover, the configured crowd served marketing excellence well. LEGO was able to conduct mass marketing initiatives by targeting more than two million registered users. Meanwhile, by enabling channels for the crowd to showcase their creations, communicate directly with the firm, and be involved in the R&D processes, LEGO enhanced its relationship with a large number of consumers (CRM). Successful viral marketing had also made the crowdsourcing initiative trending.

B. A CASE OF $M_H E_H I_L$

The Apple Developer Program is run by Apple for application development. A developer enrolls as an individual or organization by providing the required information and paying annual membership fees. Then, members can work on their applications and submit them online for review. Apple claims that 90% of submitted applications are reviewed and given feedback within 24 hours. If an application is declined, App Review will clarify the problems and suggest the areas for improvement. Developers are required to revise and update their applications until they are approved. Once approved, developers can prepare for listing in the App Store. In addition to technical preparations, it is necessary to decide on business models for revenues and set out associated distribution strategies (a list of options provided by Apple). After being listed, applications can be consumed by Apple’s product users. Apple collects commissions from direct sales and follow-up sales (e.g., in-app purchases, subscriptions, and advertising revenues). Developers are required to update

their applications regularly to adjust to the latest operating systems.

The Apple Developer Program is a representative case that configures an $M_H E_H I_L$ for crowdsourcing. Apple maintained a considerably high magnitude. The reputation of Apple and the huge market created by more than 1.5 billion sold Apple devices attracted application developers globally. As of November 2020, there were more than 28 million registered developers from 227 regions. A high engagement was maintained observed. Application development is usually a long-term and complex process consisting of a series of activities, from conceptualizing the idea to programming, testing, debugging, follow-up updating, and marketing. Developers were required to exert considerable effort to develop applications. Meanwhile, Apple assisted developers by providing abundant resources necessary to configure the entire development process, professional consultation services (e.g., App Review, Apple Engineers, and AppleCare), and marketing support. The interactivity was perceived as low. Developers generally worked on their applications individually and might compete with each other, particularly when their applications were listed within the same category in the App Store.

By configuring an $M_H E_H I_L$, Apple acquired a large number of diverse and complicated solutions (more than 1.8 million applications by November 2020). Creative applications enriched the App Store and created huge financial flows. Apple claims that, in 2019, the App Store facilitated over 519 billion USD in commerce globally. Apple benefited from multiple sources of innovation. The solutions were developed individually by a large number of solvers while solvers exerted considerable effort (divergent thinking and individual convergent thinking). Thereafter, solvers continuously improved and updated their applications to improve the quality and adjust to the latest operating systems (individual convergent thinking). Apple also leveraged the crowd for marketing excellence. By using applications as carriers for mass marketing, Apple created huge revenue streams. Moreover, Apple had successfully maintained long-term relationships with a large number of developers by providing abundant value-added services and sharing revenue streams.

C. A CASE OF $M_H E_L I_H$

Weibo, with more than 229 million active daily users as of 2020, is a leading Chinese social media platform. It is a web- and mobile-based platform that combines real-time self-expression, social interaction, content aggregation, and distribution for users to create, share, and discover high-quality user-generated content. The Game Video Channel (GVC), an official enterprise account operated by Weibo, focuses on sharing gaming-relevant content with its more than 2.35 million followers. Between 13 November and 25 December 2020, the GVC initiated the “Happy Gaming Collection” campaign to call for funny gaming videos. To join the campaign, any registered user on Weibo could post an originally filmed or edited gaming video at least one minute in length by using “#Happy Gaming Collection#” in a post. Once

successfully posted, a video can be given thumbs-ups, commented on, and forwarded by any registered user. The numbers of thumbs-ups, comments, and forwards accumulated during the specified period were set as the key parameters for judging the popularity. The GVC committed to promoting the most popular videos via multiple official channels and would then sign up the most popular creators for future cooperation.

The “Happy Game Collection” is a typical case that configures an $M_H E_L I_H$ for crowdsourcing. Taking advantage of the existing followers, the GVC maintained a high magnitude. By the end of the campaign, there were more than 1,000 solvers and massive facilitators (estimated by more than 2,670,000 comments with a vast number of thumbs-ups and forwards) constituting a large crowd. Crowd engagement was perceived as low. Because entertainment was highlighted over profession, filming and editing a short gaming video was relatively easy. Solvers did not need to be highly engaged. Meanwhile, it was captured that the official trending statistics dropped rapidly in a few days after a sharp surge, indicating that the majority of the facilitators stayed focused for a short period. A high interactivity was observed. According to the number of trackable facilitations, solvers and facilitators interacted intensively. For example, one popular video accumulated 697 forwards, 577 comments, and 6,626 thumbs-ups. Notably, these facilitations were set as parameters to judge the popularity of the videos.

By configuring an $M_H E_L I_H$, the GVC acquired a large number of diverse and simple solutions (more than 1,000 gaming videos). It benefited from the divergent thinking of the crowd for innovation. Solutions were developed and delivered by numerous individuals. Any single solution was not regarded as a direct source of innovation. Instead, in their entirety, all videos together with facilitations (accumulated thumbs-ups, comments, and forwards) were the key sources by which the GVC generated a better understanding of its followers and capture the latest trending patterns in gaming. Moreover, the configured crowd was used for marketing excellence. By conducting mass marketing and facilitating viral marketing, the GVC generated decent clout on the platform and acquired new followers.

D. A CASE OF $M_H E_L I_L$

Since 2015, Mi Crowdfunding has been an online platform operated by Xiaomi to nurture competitive products. Xiaomi selects customer-centric and extremely cost-effective products featuring cutting-edge technologies and innovative functions for crowdfunding. Mi Home Intelligent Safe (a storage security case) was one of the products open for crowdfunding. Between 7 September and 16 September 2020, the crowdfunding was launched on a dedicated webpage, where the product features were introduced. A targeted fund of 60,000 CNY was established. The target fund was to be achieved before 10:00 on September 16. Any registered platform user could review the product and pay a discounted price of 599 CNY (649 CNY was the retail price) or donate one CNY. Immediately after the deadline, if the raised fund did not meet

the target, crowdfunding would fail, and all the money raised would be refunded. If the target fund was met, crowdfunding would be successful. The manufacturer would then use the funds raised to manufacture and ship the products to those users who had paid at the discounted price. A small proportion of users who donated one CNY would also get a chance to win a product through a random draw. The successfully crowdfunded product would then be added to the Mi Home ecosystem and available for purchase at Xiaomi’s online stores at a retail price of 649 CNY.

The Mi-home intelligent safe crowdfunding is a typical case that configures an $M_H E_L I_L$ for crowdsourcing. The magnitude was perceived as high as there were 22,102 donors. The crowd engagement was maintained low. The funding process was easy and fast. For most donors, it was unnecessary to stay engaged because limited action could be taken before the deadline. Meanwhile, the campaign succeeded far ahead of the deadline because the target fund was met soon after its initiation. The interactivity was perceived as low since limited interactions were observed.

By configuring an $M_H E_L I_L$, Xiaomi acquired a large number of simple solutions (3,262,561 CNY raised for the product, 5,446% of the target). The funds were raised by a large number of donors. Each donation accounted for a specific proportion of the total funds raised. Xiaomi did not seek innovation through individual solutions; however, the collection of solutions reflected the preferences of the crowd, indicating that the crowdsourced product was perceived as innovative and cost-effective (divergent thinking). Moreover, the project can be viewed as a mass marketing initiative by which Xiaomi successfully promoted the crowdfunded product.

E. A CASE OF $M_L E_L I_L$

MTurk is an online platform where requesters connect with diverse, on-demand, scalable workers to complete virtual tasks that require human intelligence (HIT). An HIT can be simply described as a single, self-contained, virtual task that a worker can work on voluntarily, submit a solution, and collect a reward for completion. The observed HIT was proposed by a requester in September 2020. The HIT required a worker to simply type the text, as displayed in the images. The reward and time allotted were 0.03 USD and 30 minutes. Once the HIT was accepted, a worker was required to submit a solution within 30 minutes. During this period, the HIT would no longer be available to other workers. If the submitted solution was accepted by the requester, the worker collected the promised reward plus a bonus (if applicable); if the solution was declined or overdue, the HIT was returned and made available again.

The observed HIT on MTurk is a representative case that configures an $M_L E_L I_L$ for crowdsourcing. The magnitude was perceived as low as the crowd consisted of only one solver. The ease of the task and contactless process indicate that the engagement was low. Since no interaction was observed, the interactivity was also perceived as low. The crowd configuration generated one simple solution, which

was sufficient for the crowdsourcer. Neither innovation nor marketing excellence was applicable.

F. A CASE OF $M_L E_L I_H$

Zhihu is an online query-based community that allows users to share their experiences and knowledge. Any registered user can post queries for others to answer and answer others' queries. The accumulated answers to a specific query become the search results for similar queries. According to the official statistics on Zhihu (2020), users had generated more than 240 million answers to more than 44 million queries by 2020. The observed query asking "how well an adult can learn to play the piano" was posted by a registered user in 2017. After being released online, users could review, comment on, agree/disagree on, share, and report the query and answers. In general, the answer that received the most agreements was regarded as the most popular and best in quality.

The observed query on Zhihu is a typical case that configures an $M_L E_L I_H$ for crowdsourcing. The magnitude was low as the crowd consisted of 14 solvers and tens of facilitators (estimated by counting the comments and agreements). The engagement was perceived as low. Because the query was based on personal experiences, answering the question was easy and fast. Conversely, the interactivity was relatively high. The crowdsourcer, contributors, and facilitators communicated with each other extensively, which was recorded in about 90 comments. The most popular answer had accumulated about 100 agreements.

By configuring an $M_L E_L I_H$, the crowdsourcer acquired a small number of easy solutions (14 answers). The solutions were originally developed by a small number of individuals. Facilitators further supplemented these contributions by discussing with each other, solvers, and the crowdsourcer. Their collective preferences also reflected the quality and popularity of solutions, serving as valuable references for the crowdsourcer and other platform users to make judgments. Neither innovation nor marketing excellence was pursued by the crowdsourcer.

G. A CASE OF $M_L E_H I_L$

Established in 2006, 680.com is a brokering crowdsourcing platform. The observed website construction project was initiated by an anonymous crowdsourcer via the bidding model in October 2019. The crowdsourcer specified detailed requirements regarding the early-stage construction of a website for overseas real estate trading and offered a bidding range between CNY 5,000 and 10,000. After its online release, the project was open for bidding. Each bid was a detailed proposal explaining why the bidder should be chosen and specifying an estimated time for completion with a bidding price. The deadline for bidding was on 7 November 2019. The crowdsourcer would then choose one of the bidders or decline all of them in five days. If a bidder was chosen, the crowdsourcer would work with the bidder to accomplish the project. The bidder would be paid according to the placed bidding price and actual performance. Both sides would then

provide feedback on each other, signaling the end of the project.

The observed project is a typical case that configures an $M_L E_H I_L$ for crowdsourcing. Specifically, the crowdsourcer maintained a low magnitude as only one out of the 17 bidders was chosen as the final solver (developer). Therefore, the crowd consisted of one contributor and 16 facilitators. The engagement was perceived as high. Because web construction was relatively complicated, the developer invested substantial resources and exerted considerable effort to complete the task. Crowd interactivity was low as interactions between individuals did not happen.

By configuring an $M_L E_H I_L$, the crowdsourcer acquired a complicated solution. In addition, the crowdsourcer established a close relationship with the contributor through collaboration. Although innovation or marketing excellence was not pursued by the crowdsourcer, the case proves that the configuration is capable to facilitate innovation via individual convergent thinking and marketing excellence via CRM initiatives.

H. A CASE OF $M_L E_H I_H$

A new restaurant in Dalian called for local food critics to comment on its food and service in May 2022. The campaign consisted of two phases. During the first phase, the owner of the restaurant broadcasted the invitation on a short video platform. Then, some local food critics physically visited the restaurant without informing the owner in advance, consumed, and posted their filmed videos with comments on the short video platform. After one month, the owner of the restaurant initiated the second phase by hosting an offline focus group. Five food critics whose video accumulated the best statistics (the numbers of reviews, likes, comments, and forwards) were invited. Before the focus group, the restaurant owner comprehensively inducted the cuisine and services of the restaurant. Then, during the two-hour focus group, food critics professionally commented on the food and services offered by the restaurant and collaboratively come up with a list of areas for improvement. The owner of the restaurant reimbursed food critics' all expenses and paid extra fees for consultation services.

The observed focus group is a typical case that configures an $M_L E_H I_H$ for crowdsourcing. The crowdsourcer maintained a low magnitude as the crowd consisted of five solvers (who are also facilitators). A high engagement was observed. Solvers were required to give professional and detailed feedback on each cuisine within time limits via face-to-face communications. The interactivity was also high as contributors interacted with each other intensively to contribute to the development and delivery of the final solutions.

By configuring an $M_L E_H I_H$, the crowdsourcer acquired a small number of relatively complicated solutions (a list of feedback and areas of improvement). Solvers contributed individually and collaboratively to the delivery of solutions. Although the crowdsourcer did not seek innovation, the configuration exhibited its potential of yielding innovative

outcomes through individual and collective convergent thinking. Regarding marketing excellence, the crowdsourcer established close relationships with the solvers. Considering that the invited food critics are influential in their online communities, the established relationships are beneficial to future operations.

V. CONCLUSION

Crowdsourcing has been increasingly applied by organizations to supplement conventional ways of outsourcing, innovating, and marketing. A significant dimension of strategic crowdsourcing concerns constructing the right crowds with matched characteristics to serve diverse business purposes, which is the main research focus of this study. This study contributes to theories in the following ways. First, three crowd attributes, namely magnitude, engagement, and interactivity are introduced to depict the salient characteristics of a crowd. Specifically, magnitude refers to the number of unique individuals (solvers and facilitators) in a crowd. Engagement designates the overall quality of effort individuals (solvers and facilitators) devote to contributing to the development and delivery of solutions. Interactivity is defined as the overall vitality of interactions among individuals (solvers and facilitators). These attributes universally exist, can be directly manipulated by crowdsourcers, and significantly impact crowdsourcing outcomes. Second, a typology of eight crowd configurations is proposed by combining high or low levels of the identified crowd attributes and relating manipulated crowd attributes to crowdsourcing outcomes in each configuration. The analysis indicates that different crowd configurations are good at serving different business purposes in different ways, which is confirmed by the presented mini cases.

This study also provides insightful implications for practitioners to manage crowdsourcing initiatives. In principle, there are optimal crowds with matched attributes to serve different business purposes. Therefore, it is vital to generate a clear understanding of the business purposes to be achieved before initiating a crowdsourcing project. Then, practitioners should be clear about how crowdsourcing can realize the business purposes, which raises a series of concerns, including whether the crowdsourced problem is routine or complicated, how many solutions are required, in which ways (divergent, convergent, or both) innovation is facilitated, in which ways (mass marketing, CRM, viral marketing, or any combination) marketing excellence is promoted, and whether facilitations matter. Consequently, the most suitable crowd configurations that serve the business purposes can be identified by referring to the typology. Discussions in this study also reveal ways to manipulate the crowd attributes, which can be general guidelines for practitioners to construct the desired crowd in practice.

We anticipate two limitations of this study. First, magnitude, engagement, and interactivity cannot cover all characteristics of a crowd. As previously discussed, scholars have identified many different characteristics. We did not

attempt to cover all of them but focused on finding the universally existent characteristics that can be directly manipulated by crowdsourcers and generate significant impacts on crowdsourcing outcomes. The elaboration of the three crowd attributes followed deductive reasoning by reviewing the literature on crowd and crowdsourcing outcomes. Second, cost reduction, which is a common business purpose of crowdsourcing, is not discussed in the typology because of its hysteretic nature and reliance on crowdsourcers' existing resources. However, cost reduction can be a critical concern in practice. Maintaining a higher magnitude, engagement, and interactivity normally requires more financial investment. Meanwhile, this may increase uncertainties and risks, such as information overload, cold start, scams, copyright abuse, and privacy violations, which can outweigh the cost-effectiveness of crowdsourcing [72], [73], [74]. Hence, it is critical for crowdsourcers to take advantage of the existing resources and capabilities to manage the uncertainties and risks effectively.

In future research, this study is expected to inspire further investigations into crowds in crowdsourcing. Following the logic of the typology, qualitative research on additional crowd characteristics can be viable. In addition, quantitative investigations into the relationships between the crowd attributes and crowdsourcing outcomes would be a promising area of research.

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REFERENCES

- [1] J. Howe, "The rise of crowdsourcing," *Wired Mag.*, vol. 14, no. 6, pp. 1–4, Jun. 2006.
- [2] R. Gatautis and E. Vitkauskaitė, "Crowdsourcing application in marketing activities," *Proc.-Social Behav. Sci.*, vol. 110, pp. 1243–1250, Jan. 2014.
- [3] D. Lüttgens, P. Pollok, D. Antons, and F. Piller, "Wisdom of the crowd and capabilities of a few: Internal success factors of crowdsourcing for innovation," *J. Bus. Econ.*, vol. 84, no. 3, pp. 339–374, Mar. 2014.
- [4] D. Nevo and J. Kotlarsky, "Primary vendor capabilities in a mediated outsourcing model: Can IT service providers leverage crowdsourcing?" *Decis. Support Syst.*, vol. 65, pp. 17–27, Sep. 2014.
- [5] P. Whitla, "Crowdsourcing and its application in marketing activities," *Contemp. Manage. Res.*, vol. 5, no. 1, pp. 15–28, Feb. 2009.
- [6] J. Prpić, P. P. Shukla, J. H. Kietzmann, and I. P. McCarthy, "How to work a crowd: Developing crowd capital through crowdsourcing," *Bus. Horizons*, vol. 58, no. 1, pp. 77–85, Jan. 2015.
- [7] T. D. Vreede, C. Nguyen, G.-J. D. Vreede, I. Boughzala, O. Oh, and R. Reiter-Palmon, "A theoretical model of user engagement in crowdsourcing," in *Proc. Int. Conf. Collab. Technol.*, Berlin, Germany, 2013, pp. 94–109.
- [8] L. Erickson, I. Petrick, and E. Trauth, "Hanging with the right crowd: Matching crowdsourcing need to crowd characteristics," in *Proc. 18th Amer. Conf. Inf. Syst.*, Seattle, WA, USA, 2012, pp. 1–9.
- [9] 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.
- [10] 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.

- [11] 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.
- [12] M. Piazza, E. Mazzola, N. Acur, and G. Perrone, "Governance considerations for seeker–solver relationships: A knowledge-based perspective in crowdsourcing for innovation contests," *Brit. J. Manage.*, vol. 30, no. 4, pp. 810–828, Feb. 2019.
- [13] K. W. Chan, S. Y. Li, and J. J. Zhu, "Fostering customer ideation in crowdsourcing community: The role of peer-to-peer and peer-to-firm interactions," *J. Interact. Marketing*, vol. 31, pp. 42–62, Aug. 2015.
- [14] Y.-M. Li, J.-D. Wu, C.-Y. Hsieh, and J.-H. Liou, "A social fundraising mechanism for charity crowdfunding," *Decis. Support Syst.*, vol. 129, pp. 1–12, Feb. 2020.
- [15] I. Seeber, "How do facilitation interventions foster learning? The role of evaluation and coordination as causal mediators in idea convergence," *Comput. Hum. Behav.*, vol. 94, pp. 176–189, May 2019.
- [16] J. J. Zhu, S. Y. Li, and M. Andrews, "Ideator expertise and cocreator inputs in crowdsourcing-based new product development," *J. Product Innov. Manage.*, vol. 34, no. 5, pp. 598–616, Jul. 2017.
- [17] L. Jian, S. Yang, S. Ba, L. Lu, and L. C. Jiang, "Managing the crowds: The effect of prize guarantees and in-process feedback on participation in crowdsourcing contests," *MIS Quart.*, vol. 43, no. 1, pp. 97–112, Jan. 2019.
- [18] 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, Feb. 2018.
- [19] D. C. Brabham, "Moving the crowd at iStockphoto: The composition of the crowd and motivations for participation in a crowdsourcing application," *1st Monday*, vol. 13, no. 6, pp. 1–22, May 2008.
- [20] J. Pedersen, D. Kocsis, A. Tripathi, A. Tarrell, A. Weerakoon, N. Tahmasbi, J. Xiong, W. Deng, O. Oh, and G.-J. de Vreede, "Conceptual foundations of crowdsourcing: A review of IS research," in *Proc. 46th Hawaii Int. Conf. Syst. Sci.*, Hawaii, HI, USA, Jan. 2013, pp. 579–588.
- [21] J. Kotlarsky and D. Nevo, "Crowdsourcing as a strategic sourcing phenomenon: Critical review and insights for future research," *J. Strateg. Inf. Syst.*, vol. 29, no. 4, pp. 1–22, 2020.
- [22] Y. Sun, Y. Fang, and K. H. Lim, "Understanding sustained participation in transactional virtual communities," *Decis. Support Syst.*, vol. 53, no. 1, pp. 12–22, 2012.
- [23] A. Majchrzak and A. Malhotra, "Towards an information systems perspective and research agenda on crowdsourcing for innovation," *J. Strategic Inf. Syst.*, vol. 22, no. 4, pp. 257–268, Dec. 2013.
- [24] T. Kohler, "How to scale crowdsourcing platforms," *California Manage. Rev.*, vol. 60, no. 2, pp. 98–121, Oct. 2017.
- [25] X. Guan, W.-J. Deng, Z.-Z. Jiang, and M. Huang, "Pricing and advertising for reward-based crowdfunding products in E-commerce," *Decis. Support Syst.*, vol. 131, pp. 1–12, Apr. 2020.
- [26] H. R. He, J. Kotlarsky, and D. Nevo, "A process perspective on emerging value in tournament-based and collaborative crowdsourcing," in *Proc. 54th Hawaii Int. Conf. Syst. Sci.*, Hawaii, HI, USA, 2021, pp. 4209–4218.
- [27] Á. Herrero, B. Hernández-Ortega, and H. S. Martín, "Potential funders' motivations in reward-based crowdfunding. The influence of project attachment and business viability," *Comput. Hum. Behav.*, vol. 106, pp. 1–12, May 2020.
- [28] J. Wang, T. Kraska, M. J. Franklin, and J. Feng, "CrowdER: Crowdsourcing entity resolution," 2012, *arXiv:1208.1927*.
- [29] 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.
- [30] 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, Mar. 2019.
- [31] H. Liang, M.-M. Wang, J.-J. Wang, and Y. Xue, "How intrinsic motivation and extrinsic incentives affect task effort in crowdsourcing contests: A mediated moderation model," *Comput. Hum. Behav.*, vol. 81, pp. 168–176, Apr. 2018.
- [32] 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.
- [33] 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.
- [34] Y. Feng, H. J. Ye, Y. Yu, C. Yang, and T. Cui, "Gamification artifacts and crowdsourcing participation: Examining the mediating role of intrinsic motivations," *Comput. Hum. Behav.*, vol. 81, pp. 124–136, Apr. 2018.
- [35] 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.
- [36] Y. Zhao and Q. Zhu, "Evaluation on crowdsourcing research: Current status and future direction," *Inf. Syst. Frontiers*, vol. 16, no. 3, pp. 417–434, Apr. 2012.
- [37] F. Cappa, J. Laut, M. Porfirio, and L. Giustiniano, "Bring them aboard: Rewarding participation in technology-mediated citizen science projects," *Comput. Hum. Behav.*, vol. 89, pp. 246–257, Dec. 2018.
- [38] H. Zheng, D. Li, and W. Hou, "Task design, motivation, and participation in crowdsourcing contests," *Int. J. Electron. Commerce*, vol. 15, no. 4, pp. 57–88, Dec. 2014.
- [39] N. Camacho, H. Nam, P. K. Kannan, and S. Stremersch, "Tournaments to crowdsourcing innovation: The role of moderator feedback and participation intensity," *J. Marketing*, vol. 83, no. 2, pp. 138–157, Jan. 2019.
- [40] 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.
- [41] 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.
- [42] X. Liu, R. Nielek, P. Adamska, A. Wierzbicki, and K. Aberer, "Towards a highly effective and robust web credibility evaluation system," *Decis. Support Syst.*, vol. 79, pp. 99–108, Nov. 2015.
- [43] Y. Lu, P. V. Singh, and B. Sun, "Is a core-periphery network good for knowledge sharing? A structural model of endogenous network formation on a crowdsourced customer support forum," *MIS Quart.*, vol. 41, no. 2, pp. 607–628, Feb. 2017.
- [44] X.-L. Shen, M. K. O. Lee, and C. M. K. Cheung, "Exploring online social behavior in crowdsourcing communities: A relationship management perspective," *Comput. Hum. Behav.*, vol. 40, pp. 144–151, Nov. 2014.
- [45] S. Zhang, P. V. Singh, and A. Ghose, "A structural analysis of the role of superstars in crowdsourcing contests," *Inf. Syst. Res.*, vol. 30, no. 1, pp. 15–33, Mar. 2019.
- [46] H. Ye and A. Kankanhalli, "Investigating the antecedents of organizational task crowdsourcing," *Inf. Manage.*, vol. 52, no. 1, pp. 98–110, Jan. 2015.
- [47] A. Hassan Zadeh and R. Sharda, "Modeling brand post popularity dynamics in online social networks," *Decis. Support Syst.*, vol. 65, pp. 59–68, Sep. 2014.
- [48] M. Allahbakhsh, B. Benatallah, A. Ignjatovic, H. R. Motahari-Nezhad, E. Bertino, and S. Dustdar, "Quality control in crowdsourcing systems: Issues and directions," *IEEE Internet Comput.*, vol. 17, no. 2, pp. 76–81, Mar. 2013.
- [49] R. Buettner, "A systematic literature review of crowdsourcing research from a human resource management perspective," in *Proc. 48th Hawaii Int. Conf. Syst. Sci.*, Hawaii, HI, USA, Jan. 2015, pp. 4609–4618.
- [50] E. Schenk and C. Guittard, "Towards a characterization of crowdsourcing practices," *J. Innov. Econ. Manage.*, vol. 7, no. 1, pp. 93–107, Apr. 2011.
- [51] D. Durward, I. Blohm, and J. M. Leimeister, "The nature of crowd work and its effects on individuals' work perception," *J. Manage. Inf. Syst.*, vol. 37, no. 1, pp. 66–95, Mar. 2020.
- [52] B. Morschheuser, J. Hamari, J. Koivisto, and A. Maedche, "Gamified crowdsourcing: Conceptualization, literature review, and future agenda," *Int. J. Hum.-Comput. Stud.*, vol. 106, pp. 26–43, Oct. 2017.
- [53] J. P. Guilford, "The structure of intellect," *Psychol. Bull.*, vol. 53, no. 4, pp. 267–293, 1956.
- [54] M. K. Poetz and M. Schreier, "The value of crowdsourcing: Can users really compete with professionals in generating new product ideas?" *J. Product Innov. Manage.*, vol. 29, no. 2, pp. 245–256, 2012.
- [55] 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.
- [56] J. Ren, J. V. Nickerson, W. Mason, Y. Sakamoto, and B. Graber, "Increasing the crowd's capacity to create: How alternative generation affects the diversity, relevance and effectiveness of generated ads," *Decis. Support Syst.*, vol. 65, pp. 28–39, Sep. 2014.
- [57] R. Y. J. Chua, Y. Roth, and J.-F. Lemoine, "The impact of culture on creativity: How cultural tightness and cultural distance affect global innovation crowdsourcing work," *Administ. Sci. Quart.*, vol. 60, no. 2, pp. 189–227, Dec. 2014.

- [58] S. Djelassi and I. Decoopman, "Customers' participation in product development through crowdsourcing: Issues and implications," *Ind. Marketing Manage.*, vol. 42, no. 5, pp. 683–692, Jul. 2013.
- [59] F. M. Schweitzer, W. Buchinger, O. Gassmann, and M. Obrist, "Crowdsourcing: Leveraging innovation through online idea competitions," *Res. Technol. Manage.*, vol. 55, no. 3, pp. 32–38, Dec. 2015.
- [60] E. Estellés-Arolas and F. González-Ladrón-De-Guevara, "Towards an integrated crowdsourcing definition," *J. Inf. Sci.*, vol. 38, no. 2, pp. 189–200, Mar. 2012.
- [61] H. Hong, Q. Ye, Q. Du, G. A. Wang, and W. Fan, "Crowd characteristics and crowd wisdom: Evidence from an online investment community," *J. Assoc. Inf. Sci. Technol.*, vol. 71, no. 4, pp. 423–435, May 2019.
- [62] C. L. Tucci, A. Afuah, and G. Viscusi, *Creating and Capturing Value Through Crowdsourcing*. Oxford, U.K.: Oxford Univ. Press, 2018.
- [63] D. Geiger, S. Seedorf, T. Schulze, R. C. Nickerson, and M. Schader, "Managing the crowd: Towards a taxonomy of crowdsourcing processes," in *Proc. 17th Am. Conf. Inf. Syst.*, Detroit, MI, USA, 2011, pp. 1–11.
- [64] L. Robert and D. M. Romero, "Crowd size, diversity and performance," in *Proc. 33rd Annu. ACM Conf. Hum. Factors Comput. Syst.*, Seoul, Republic of Korea, Apr. 2015, pp. 1379–1382.
- [65] D. H.-L. Goh, E. P. P. Pe-Tham, and C. S. Lee, "Perceptions of virtual reward systems in crowdsourcing games," *Comput. Hum. Behav.*, vol. 70, pp. 365–374, May 2017.
- [66] B. Morschheuser and J. Hamari, "The gamification of work: Lessons from crowdsourcing," *J. Manage. Inquiry*, vol. 28, no. 2, pp. 145–148, Aug. 2018.
- [67] 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.
- [68] A. Ihl, K. S. Strunk, and M. Fiedler, "The mediated effects of social support in professional online communities on crowdworker engagement in micro-task crowdworking," *Comput. Hum. Behav.*, vol. 113, pp. 1–11, Dec. 2020.
- [69] A. Özyaygen and C. Balagué, "Idea evaluation in innovation contest platforms: A network perspective," *Decis. Support Syst.*, vol. 112, pp. 15–22, Aug. 2018.
- [70] B. Schemmann, A. M. Herrmann, M. M. H. Chappin, and G. J. Heimeriks, "Crowdsourcing ideas: Involving ordinary users in the ideation phase of new product development," *Res. Policy*, vol. 45, no. 6, pp. 1145–1154, Jul. 2016.
- [71] R. K. Yin, *Applications of Case Study Research*. Newbury Park, CA, USA: Sage, 2003.
- [72] 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.
- [73] J. Love and R. Hirschheim, "Crowdsourcing of information systems research," *Eur. J. Inf. Syst.*, vol. 26, no. 3, pp. 315–332, Dec. 2017.
- [74] D. Schlagwein, D. Cecez-Kecmanovic, and B. Hanckel, "Ethical norms and issues in crowdsourcing practices: A habermasian analysis," *Inf. Syst. J.*, vol. 29, no. 4, pp. 811–837, Oct. 2018.



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