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### COVER PAGE

**Title:** Crowdsourcing: Toward innovation of project management and mass customization

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**Abstract:** This paper explores how mass customization process and delivery is improved through crowdsourcing firms' innovative project practices and processes. Five firm-based case studies were conducted in Australia and the United States of America of firms which operationalised crowdsourcing projects. This included 31 firm executive and crowd participant interviews. Findings suggest that crowdsourcing injects dynamism, huge crowd size, up-down scaling of resources, earlier customer involvement and participation as well as improved delivery speed in project management (PM) practices and mass customization processes. Crowdsourcing brings mass resources at low cost and applies the crowd in a fluid manner for agile and speedy delivery results in PM and mass customization. This study challenges conventional processes and practices concerning project management and mass customization and provides a new and enhanced understanding via crowdsourcing mechanisms. Crowdsourcing firms and characteristics that are important to PM practices and delivery of mass customized outcomes are explored as a way to achieve cost efficiency, scale, flexibility, and risk reduction.

**Keywords:** innovation, crowdsourcing, projects, project management, mass customization, management strategy

**Topic (Theme):** OSCSM and innovation

## 1. Introduction

Projects are conceived as essentially temporary, time-limited, globally practiced, often require tasks to be performed which may never have been performed before, and can be utilised to create unique, novel products and services (Bryde, 2003; Geraldi *et al.*, 2011; Malach-Pines *et al.*, 2009). The Project Management Institute (PMI) (2016) amplifies this point through its definition emphasizing a project as a temporary endeavor which has a clear beginning and end and discrete scope and resources, which is undertaken to create a distinctive and novel product, service or result.

There appears increasing pressure for business and project managers to create operational models and adaptive functional architectures so as to be operationally agile and to inject dynamism, novelty or uniqueness into their management of projects in order to be successful (Lewis *et al.*, 2002). This paper is responding to these calls to help understand newer adaptive functional architectures which respond to dynamic environments in a novel and agile manner.

Crowdsourcing is a new operational strategy that is revolutionizing the operations and project management (PM) space as a result of a confluence of decades of macro change. Crowdsourcing was a term first coined by Jeff Howe (2008) which he defined as the act of a company taking a function once performed by employees and outsourcing it to an undefined (and generally large) network of people in the form of an open call. In its modern context, it is widely practiced online and attracts large participatory crowds. Crowdsourcing has been evolving since Howe's original definition and now encompasses nascent and hybrid business forms whereby the firm's crowd may concurrently fulfil multiple roles including de facto employee, (sub-) contractor, co-creator, decision-making collaborator, idea-generator and even consumer (Boudreau and Lakhani, 2013; Chafkin, 2008).

Crowdsourcing has been used more recently by firms as an operational business model, and these firms are termed *crowdsourcing-centric* in this study. These are firms where the majority of their funding comes from using the crowd dynamically, and indeed existentially, in their operations. Modern crowdsourcing-centric firms attract and engage large distributed and amorphous crowds to produce goods and services through project delivery methods to produce mass customized items. The project practices inside these crowdsourcing-centric firms appear novel and innovative and hold promise for producing mass customized goods and services with more dynamism, earlier customer focus and input as well as improved speed to market - elements which have been suggested as highly attractive to mass customization producers (Akinc and Meredith, 2015). For example, Threadless (2016), an online t-shirt retailer, produces unique and dynamically-created mass customized t-shirts by involving multiple injections of crowd co-creation and/or decision-making at various points in each t-shirt production project. The (artist) crowd, in this instance, produce t-shirt designs which another (decision-making) crowd vote to include or reject. Those crowd-voted-in-designs are sent off by Threadless for bulk printing and the voting crowd then become consumers and buy the mass customized product for which they have voted. Each t-shirt design, production and sales process is an agile product development project, with the various crowd inputs lowering the project risks.

Given these newer developments with crowdsourcing-centric firms, as with Threadless, and the increasingly novel manner in which they are using crowds, there is growing scholarly interest in understanding the value crowdsourcing generates in

executing dynamic and complex projects. Scholarly research in this pivotal area is in an embryonic stage (Liu *et al.*, 2016). This is particularly so in project environments, which can efficiently produce mass customized results, because there is a scholarly and practitioner interest in understanding new and innovative forms of project delivery and more efficient ways that goods and services can be mass customized through efficient operational practices (Åhlström and Westbrook, 1999; Geraldi *et al.*, 2011).

In summary, the purpose of the paper is to explore the nascent concept of crowdsourcing-centric firms and examine the important characteristics of and the innovative processes used inside these firms which help to execute novel project delivery which results in efficient mass customized output. The key research questions which drive this study are:

*RQ 1.* What are the important characteristics related to crowdsourcing-centric firms' project delivery?

*RQ2.* How is innovative mass customization delivered through crowdsourcing-centric firms reflected in project practices and processes?

## **2. Literature Review**

*2.1 Crowdsourcing and its links to Project Management and Mass Customization.* Mass customization alludes to 'flexible' production of uniquely customized goods and services distributed out to a mass market via agile supplier networks (Åhlström and Westbrook, 1999; Davis, 1987; Feitzinger and Lee, 1997). Global markets are moving to demanding speedy, cost-competitive and efficient delivery of unique, customized products and services for a global customer base (Akinc and Meredith, 2015). The ultimate aim of mass customization is to provide consumer choice for individuals of specific custom designed and selected items with the efficiency and lower costs inherent in mass production processes (Gilmore and Pine II, 1997; Kincade *et al.*, 2007). Kincade *et al.* (2007) posit that mass customization has developed to encompass elements like consumer co-design and co-creation which represent a shift from linear production processes and reduces sensitivity to time-to-market pressures. Crowdsourcing business models often use co-design and co-creation to help build innovative products and services (Chesbrough, 2011).

Filippini (1997) notes the development of general operational management (OM) processes and practices have advanced in a broader, yet more integrated manner, upstream with suppliers and downstream with clients. In a modern context where end-point consumers are now increasingly also arbiters of value, crowdsourcing firms work with crowds so that such crowds become critical upstream and downstream arbiters of value (Priem, 2007; Priem *et al.*, 2013). Crowds may function upstream effectively inside the firm at early points in the cycle to produce items or ideas, assist with decision-making and market products and then, downstream to purchase those same products (Boudreau and Lakhani, 2013).

Crowd based mass customization is now an operational reality. Crowdsourcing firms have started using input from crowd communities to bring more certainty to the make-to-forecast approach (Akinc and Meredith, 2015) by injecting consumer crowds very early in the production cycle. The use of low cost and widely available information and communications technology teamed with enormous crowd labor has enabled individuals and communities of people to act as either temporary or longer term stakeholders of the

organisation, especially as contributors to the firm's production and outputs, and move the efficient frontier forward relative to more traditional forms of business model and employment (Liu *et al.*, 2016). The operational novelty suggested by crowdsourcing of being able to team efficiency of production with project agility to result in low cost processes resulting in continual project turnover has generated close interest by scholars (Kohler, 2015).

While mass customization is usually positioned in relation to manufacturing environments, newer crowd-based organizations where crowds are used innovatively to produce goods (and services) can be positioned in a hybrid context where product manufacture combines with crowd-based project management. Åhlström and Westbrook (1999) posited the view that there are a wide variety of methods to achieve mass customization and so limiting the focus to only manufacturing environments is unnecessarily restrictive. For our earlier example of crowdsourcing firm Threadless, for example, blends an iterative online process of collaboration with manufacturing and online retail.

Many crowdsourcing based firms are completing a multitude of recurring projects, sometimes in the hundreds and thousands, where they are effectively creating a line flow of unique projects comprising outputs/ services. For example, the crowdsourcing firm Kaggle (2016) runs data analysis competition projects on behalf of clients who have difficult-to-solve data problems and for which the solution would provide cost savings and/or revenue generation. From an online community of more than 500,000 data scientists (Kaggle, 2016), which Kaggle has attracted and cultivated, data-centric projects are put out to the community in the form of competitions and the data experts compete in teams or individually to solve the problem for a winning cash payment or sometimes no payment - simply for the kudos of winning. A real-time leader-board is a feature which updates instantaneously every time a team/individual submits an entry. The leader-board encourages competitive striving among the active data specialist crowd to out-perform other entrants and Kaggle's project results have consistently out-performed industry standards by healthy margins since its inception. Each winning algorithm in Kaggle's competitions represents a unique project output and is the result of the competitive output of a large crowd of fine minds. It is a mass-customization service which brings a finely customized algorithm to clients through a large crowd of competing expert data specialists working on individual data problem projects. Kaggle CEO Anthony Goldbloom recently commented about the power of his company's crowdsourcing model:

We've never hosted a competition that hasn't significantly outperformed the previous state of the art. Moreover, for just about every competition we've hosted, the best entries reach a plateau, which we interpret to be the limit of what's possible given that amount of 'information' available in the dataset....Having hundreds of eyes on your data often brings up new insights and raises questions that had never been asked. (Shapiro, 2011).

The statement above highlights that the result for crowdsourcing clients/ consumers is a mass customized result for each project via a mass of humanity's 'hundreds of eyes', represented by the crowd, collectively doing a multitude of projects. The salient point is that crowdsourcing brings mass resources and combines it with innovative project processes to create a low-cost yet resource-rich system.

*2.2 Redesigning mass customization through crowdsourcing.* The implications of such innovative crowdsourcing-based mass customization demand and supply models, such

as that used by the example crowdsourcing-centric firms of Threadless and Kaggle, has implications for the make-to-forecast strategy of mass customization (Akinc and Meredith, 2015). Such business models, where the mass customization is linked to the demand side very early in the production process reduces the risk markedly, while at the same time reducing time-to-delivery, by ensuring the mass customization more closely fits consumer demand at the earliest point in the production cycle. This rolls back the make-to-forecast approach much closer to the fast delivery times of the make-to-stock approach which is characterized by low customization but near instantaneous delivery (Akinc and Meredith, 2015; Holweg and Pil, 2001). In terms of risk reduction, the type of mass customization inherent in these types of crowdsourcing business models, involving early involvement of consumer crowds choosing *en masse* the customized design, reduces the likelihood of rejected or compromised orders or unwanted finished goods (Akinc and Meredith, 2015). Whilst the crowds do not commit to actually purchasing at this early stage of voting, the collective act of voting and the implied commitment to the design, has always ensured that the final mass produced t-shirt typically sells out (Hollender and Breen, 2010). This novel co-design principal of allowing crowd members to submit and vote for designs also supports the research of Kincade *et al.* (2007) which develops the notion that co-design in mass customization processes works to truncate product development and delivery times.

There is still sparse literature and research on crowdsourcing and how it is characterized in relation to project management and mass customization. Little is known about the workings and characteristics of pure-play crowdsourcing-centric firms and how they approach project practices and how mass customization works in this context.

### 3. Methodology

Given the knowledge base is still in an early stage of development, the use of an exploratory case study methodology is considered appropriate so as to enable the collection of specific and detailed information and to provide detailed and rich insights (Barratt *et al.*, 2011; Eisenhardt, 1989; Eisenhardt and Graebner, 2007; Yin, 1994).

*3.1 Case selection and context.* Theoretical sampling was used for the selection of case studies (Eisenhardt, 1989). The theoretical sampling involved using five case studies of pure-play crowdsourcing-centric firms. These firms all engage crowds in an existential manner, whereby they are solely reliant on the large crowds they attract to deliver projects. Each firm attracts crowds which are larger than 100,000 people, had been established more than three years and were recognised publicly as crowdsourcing firms – in most cases the firms were publicly (proudly) self-proclaimed crowdsourcing firms on their firm website and in press articles. All five firms delivered mass customized output via project delivery processes. Most of the firms selected for the study had won major industry awards and public accolades for their unique (and successful) approach to business. Details of cases, their industry segment and location is provided (Table 1).

Table I. *Case study details*

Firm	Headquarters	Staff (FTE)	Crowd size	Industry	Firm maturity	Interviewee designation
Firm A	Australia	75	1,340,000	Design	Start-up – Founded 2008	Founder/CEO CTO Product Manager 3 crowd members

Firm B	USA	50	5,000,000	Services	Start-up – Founded 2007	Founder/CEO Founder/CTO CFO 3 crowd members
Firm C	Australia	300	7,300,000	Services	Start-up – Founded 2009	Founder/CEO CTO Client Manager
Firm D	USA	20	105,000	Science	Start-up – Founded 2010	Chairman Founder/CEO Scientist 4 crowd members
Firm E	USA	106	2,500,000	Fashion/ design/ retail	Start-up – Founded 2000	Founder/CEO Chief Creative Officer Business Manager 2 crowd members

*3.2 Data collection and sources.* During mid-2011 to mid-2012 five company-based case studies were conducted which included in-depth interviews with 15 crowdsourcing business executives including founders and also matched with 16 crowdsourcing crowd members associated with the firms. Interviews were conducted in both Australia and the USA. Both sets of informants, that is, firm executives and crowd members were deemed to have unique insights and expert knowledge of crowdsourcing in a real-life context. The firm executive participants were c-level informants and also included founders of all firms. It was important that the firm founders were interviewed due to their lifecycle experience commencing at the firm foundation to provide a particularly intense insight. All executive informants had been at the firm for more than 12 months.

The crowd members were experienced and dedicated to crowd-based work. The crowd informants had extensive crowdsourcing experience and indeed some informants were performing crowd-based tasks up to 18 hours a day, every day. The crowd were included to allow for an understanding at a deep level how the whole process of crowdsourcing worked, that intrinsically crowdsourcing-centric firms relied existentially on the crowd and both major crowdsourcing stakeholders be included.

The case studies used multiple sources of data such as interviews, qualitative surveys, emails and phone calls, site visits and observational data, media/news reports, document and image analysis, online website material, firm blogs and website public web-posting sites. A summary of the data sources, quantity and types is illustrated at Table 2.

Table 2. *Data Inventory*

Themes	Data Type	Quantity	Data Source
Interviews	Interviews	15	Expert informants
Interviews	Phone calls	16	Expert informants. Support staff. Crowd members.
Observation	Site visits	3	Business premises occupants
Observation	Observational data	15 hours	Notes, recordings re site visits; Notes from two-way exchanges in crowd community sites; Notes and recordings from 2-day industry conference.
Online	Company web home-page	118 visits to home-pages	In-house corporate communications, selling communications, Internal News articles. Company philosophy. Specialty crowd web-sections.

Online	Company Facebook	16 visits to Facebook accounts	In-house corporate communications, Feedback from clients and crowd members, complaints and praise from crowd members, company events. Company philosophy and mission statements. Specialty crowd sections.
Online	Company Twitter	4 visits to 3 Twitter accounts	In-house corporate communications, company events, company philosophy and mission messages.
Online	Company blogs	45 visits to company blog-sites	Expert company informants including founders and high level executives.
Online	Emails	83	Expert informants. Support staff. Crowd members.
Online	Image analysis	41	In-house communication images. Firm event images. Showcase images.
Online	Company documents	39	Company conference presentations. Company brochures. Press releases.
Online	Media and News reports	42	Online newspaper and practitioner journal reports. Online trend reports.

The crowd members who were interviewed were located in eight countries including Australia, New Zealand, Philippines, Serbia, United Kingdom (UK), Ukraine, USA and Venezuela. These diverse countries were included to provide evidence for the study's internal validity related to case selection. The study also included a balance of both developed and developing countries to help strengthen research triangulation. All crowd interviews were conducted one-to-one. In terms of the 16 crowd members who were interviewed, 6 were based in developing countries and 10 in developed countries.

Interview length averaged 40 minutes. All interviews were audio-recorded and directly transcribed *in vivo*. The executive interviews were semi-structured. Of the 16 interviewed crowd members utilised for the study, six were recruited through online appeal and a further 10 were recruited 'snowball' style via initial personal contact with crowdsourcing community colleagues. The interview length were much shorter in case of the crowd. Any ambiguities were resolved and follow up interviews were conducted with both CEO's and the crowd to clarify those ambiguities.

Information emanating from the combined responses of the informant was evaluated to saturation point. At this point of saturation it became clear that no further new information was emerging and incremental learning was sharply diminishing (Eisenhardt, 1989).

*3.3 Data coding and analysis.* The data for this study was analysed inductively (Strauss and Corbin, 1998). Elements in the text were examined and identified its relevance to the overarching research questions. The overarching editing approach was supplemented by conducting a thematic analysis for example based around questions associated with how crowdsourcing businesses worked, how they were structured and how crowd members were engaged and paid (or not) (Gioia *et al.*, 2012). Following recommendations by scholars in the general management and OM discipline, analysis was supplemented by conducting a within-case and cross-case analysis as doing so for a multiple case study research design to enhance the generalisability of the findings (Meredith, 1998; Miles and Huberman, 1994). Each interview transcription was checked by a professional transcriber and then subsequently by each informant. Once this process was complete, a further line-by-line *in-vivo* coding analysis was conducted using *NVivo 10* software.

In keeping with the prescriptions of Glaser and Strauss (1967), the study prescribed consistent interview and written survey questions to all informants in each of the two

groups so as to allow constant data comparison data across both groups of informants over time. Such repetitive data collection resulted in the exponential building up of themes until no new themes were appearing and data saturation was thereby achieved. All crowd interviewees were sent their own interview in written transcription form after the interview to confirm its accuracy to ensure the reliability and validity of the data. To ensure reliability and validity multiple data sources were examined (Table 2).

#### 4. Findings

*4.1 Within Case Analysis.* A within-case analysis (Eisenhardt and Graebner, 2007) was conducted for each of the five firm-based case studies to highlight operational aspects. A summary of each firm is presented as follows:

*Firm A.* Firm A is based in Melbourne, Australia. It operates primarily in the online graphic design space, where it is a leader in its field. It has a crowd ‘philosophy of ‘anyone, anywhere, anytime’ in terms of its crowd. This effectively means there are no barriers to entry for producing work. The company runs design projects where it serves as a mediator for customer/crowd and makes money as a percentage on transactions.

The results of the crowd production are mass customized to the client’s written project brief which can be as brief or detailed as clients wish. The client may clarify or change the brief at any time in the process and there is no obligation to purchase or use any of the designs the crowd produce. The client will typically receive more than 100 designs per brief and scores or hundreds of individual crowd members may be involved in tailoring designs based on his/her interpretation of the client’s brief. Excessive production takes the form of unwanted designs and the client makes the decision to discard unwanted production items. The client will receive designs within less than an hour and will usually have many (over 100) multiple designs within 72 hours. This process is typically much faster, cheaper and gives higher levels of choice to the client than the traditional pathway of outsourcing to a design agency. The model Firm A uses to raise revenue is summarised below in Figure 1.

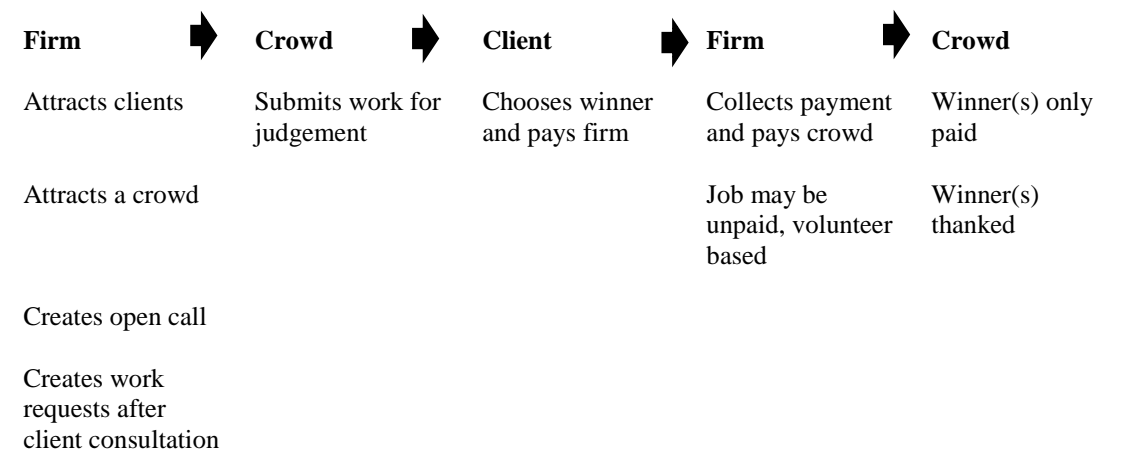


Figure 1. Schematic of workflow In Firm A

*Firm B.* Firm B is based in San Francisco in the USA. Clients use it to have their data collected, cleaned and labelled. Again it is styled as an ultimate meritocracy, whereby only crowd member’s the output and the best selected crowd production receive monetary compensation. Algorithms decide which members of the crowd are the most



meritorious in terms of quality. The firm’s enormous crowd of 5 million is thereby automatically controlled and regulated through these advanced algorithms which test regularly for proficiency and accuracy. The firm guarantees the standard of its crowd based on the accuracy generated by its proprietary algorithms. This represents both a technical and governance efficiency. The crowd is paid often virtually, through points systems or through Internet-transferred store gift cards.

Clients run data-driven projects through the system and these are projects which require specifically scaled mass human intervention in data content. For example a client may require 100,000 people to work on a data content issue for only a few minutes. Projects for clients can be completed rapidly by scaling human resources working for minutes at a time. The firm has devised efficient payment systems to allow such scaling to occur on a large and recurring basis.

Having ‘many eyes’ on data content and being able to scale so many human resources for minutes, has created a unique form of mass customization, whereby projects can benefit from the combined efforts of hundreds of thousands of people, albeit possibly for only a relatively short time. The company claims that through this technique they produce seven human years of work daily.

The firm makes money from big client project contracts and has a number of Fortune 500 clients. The quality-output checking algorithms and innovative payment systems combine to create huge efficiencies of scale. The client receives results within minutes and most projects will be started and ended within 24 hours. The operational model Firm B uses to raise revenue is summarised below (Figure 2).

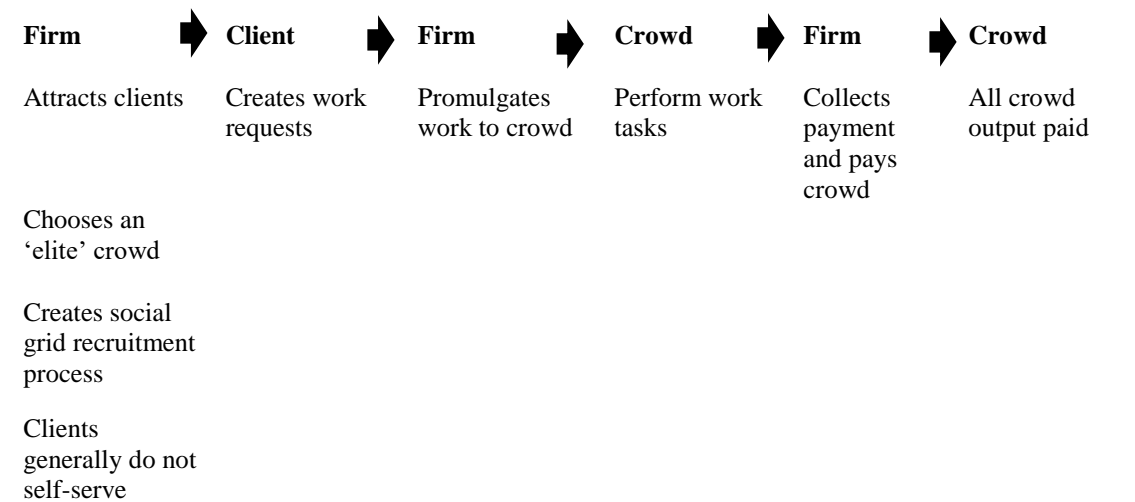


Figure 2. Schematic of project workflow in Firm B

*Firm C.* Firm C is based in Sydney in Australia. It is an online crowd-based freelance project services firm. It also runs crowdsourcing contests on behalf of clients for projects requiring efficient mass customization. The crowd in these contests compete against each other to either be chosen for their completed production items or for the chance to contribute for a particular project.

Again, the model used by the firm is a meritocracy whereby best production rises to the top. Its one-stop-shop website reduces search costs and is highly technically automated and thereby efficiently transactional so clients and crowd are not ‘known’

individually to the company in a traditional sense due to the huge human scale. The firm is the middle-broker between clients and crowd and takes a percentage of each transaction.

A crowd member is only paid if client chooses their production offering and so it is a winner-takes-all competition. Clients benefit from access to skilled crowd members who can produce online project tasks for client project managers. Firm C has reported that at times the crowd and clients collaboratively add new work categories for the executed projects. In this instance, the firm will take note of the new work category and add to the available work project categories on their website.

A client will typically start to receive results in as little as ten minutes and would not usually need to wait longer than a week to have transaction with a large number of crowd members. Final results are fully controlled by the client, who only pays if satisfied. The model Firm C uses to raise revenue is summarised below in Figure 3.

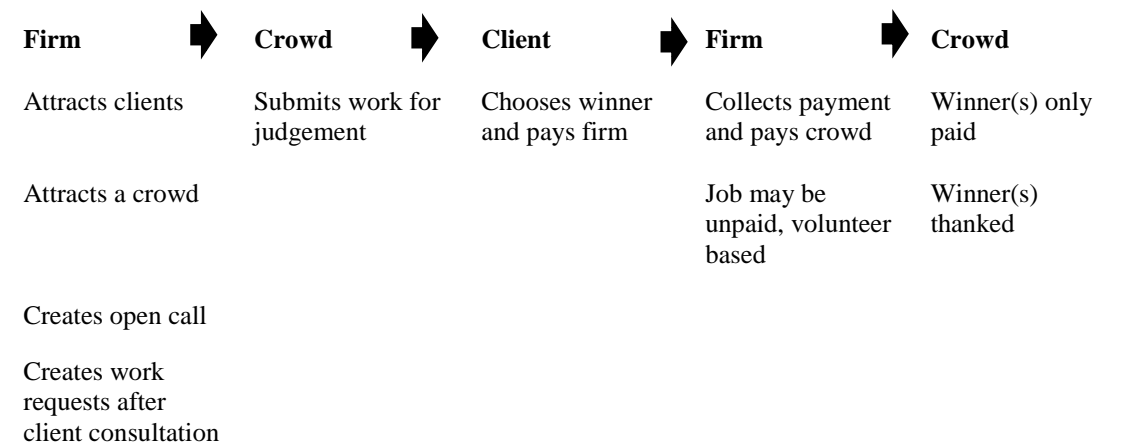


Figure 3. Schematic of project workflow in Firm C

*Firm D.* Firm D is based in San Francisco, USA. It runs a specialist data science and data prediction platform and offers specialised data analysis services for clients. This firm has a model of ‘anyone, anywhere, anytime’ for its crowd recruitment and a ‘winner-takes-all’ philosophy. The crowd self-select regarding data analysis/ prediction skill set and capability of delivering complex algorithms. No qualifications are required.

The crowd enters competitions to win (often large) prize-money, sometimes in excess of \$1 million. The firm boasts more than ten thousand registered PhD crowd members with many in well-paying day jobs. The firm’s key proprietary leader board is updated in real-time so teams know where they place during the course of the competition. Firm D has always out-performed established knowledge.

The firm is a middle-broker between client and crowd and makes money from individual firm competitions. Each project is mass customized by virtue of having the many fine analytical minds of large numbers of crowd members competing against each other to improve and innovate. Results from crowd transactions can commence within 24 hours or less. The model Firm D uses to raise revenue is summarised in Figure 4.



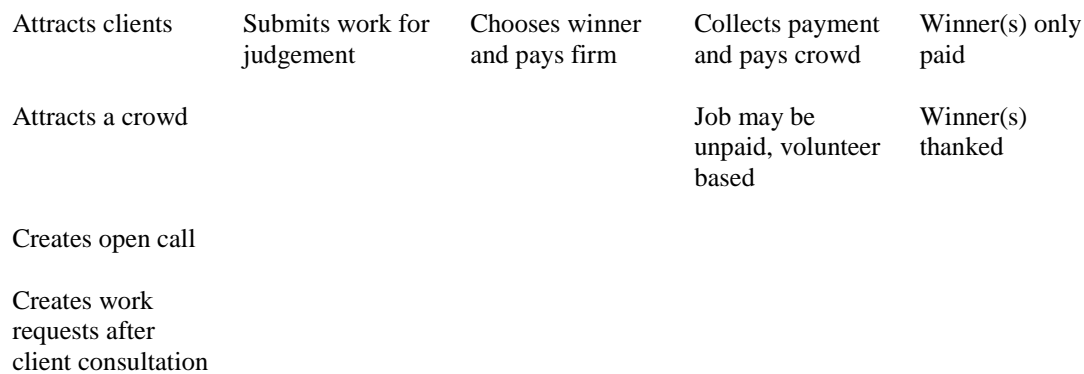


Figure 4. Schematic of project workflow in Firm D

*Firm E.* Firm E is based in Chicago, USA and is an online fashion retailer. The firm uses a model for crowd recruitment of ‘anyone, anywhere, anytime’. There are three crowds which are curated by firm e including ‘artist’, ‘voting’ and ‘buying’ crowd. The artist crowd enters always-open design submission competitions and most do not win because there are about 300 entries per week and only around 10 of those chosen by the voting crowd.

The voting crowd choose the t-shirt designs they like best and these are sent off by the firm for production. In this sense the products are mass customized through the engagement of the voting/buying crowd who effectively signal to the company at the earliest stages how they want their designs customized and what they are willing to purchase. The buying crowd (which includes but is not limited to both the artist and voting crowds) are informed when the manufactured product is available and all mass customized units of production typically sell out.

The firm has limited staff to control or overlay the decision-making of the voting crowd and is thereby transactionally efficient in its use of labor-alternative crowds. The project process takes around a week from start to finish. The voting and buying crowds are not paid by the firm – in fact the buying crowd pay the firm in the sense that they purchase the mass customized t-shirts or other production items.

The firm has won a significant national public innovation awards. They make money on each production unit sold and have expanded recently to other related products such as coffee mugs to increase their consumer reach. The model Firm E uses to raise revenue is summarised below in Figure 5.

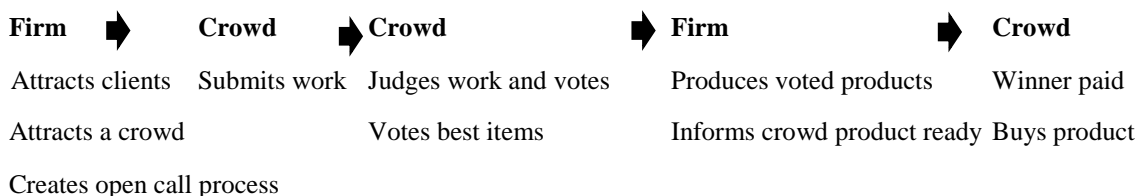


Figure 5. Schematic of project workflow in Firm E

4.2 Cross-Case analysis. Table 3 presents the relationships in a cross-case analysis (Eisenhardt and Graebner, 2007) for the five cases of project management characteristics, mass customization elements and how they work in combinations of the

cases. The project management characteristics include that the crowd resource provided novelty, speed, uniqueness, dynamism and large scale engagement that reduces risk.

The similarities apparent in a cross-case analysis (Table 3) include that all firms are online, global, are always available, efficiently scaled and flexible, combine firm and crowd in an existential manner and have truncated delivery and turnaround timeframes. Similarities among crowdsourcing firm's crowds include that they are large in volume, English-literate, task-centric, participative and output a mass customized product/service. Most firms would self-label as an ultimate meritocracy, whereby the best production rises to the top and self-perceive as unique, innovative and trailblazers.

The advantages of crowdsourcing for doing multiple, customized projects can be considered by comparing the case study crowdsourcing firms to organizations attempting to do similar work in traditional business models, meaning the use of conventional workforces. Firms B and D, for example, offer highly varied solutions to data analytic and other technical challenges, utilizing the resources of a multitude of experts (the crowd). If a traditionally-employed or contracted workforce were used instead in these firms, they could not have the range of capabilities provided by the crowd, and single teams would attack each challenge, as against the many in the crowd. A traditional PM model using employed or contracted project teams would also not be able to be flexible in volume terms the way the crowd can, as needs vary. It would have higher fixed costs than the crowd's negligible fixed costs, and would likely even have variable costs as well. Employees would need to be selected and performance managed, whereas the crowd does not. Further, the skill-set of the employed workforce would be high in inertia and lower in innovativeness than the dynamism of the crowd. Finally, the scale and depth of talent could not be anything as extensive as the crowd has become.

For Firms A and E, for example, if 'regular' employees were used instead of the crowd, there would be many fewer competing potential designs, and the range of creativity of these would likely be lower, being limited to that of a finite, in-house design function. Research as to popularity and therefore expected demand for each design would be lesser without the crowd, and more expensive, and less accurate conventional market research or trial-and-error would be used, leading to inferior outcomes, risk and waste. And once production is conducted, the market would not be known, identified and focused as with a crowd. As the Product Manager, Firm A, says: "at its heart, we have used crowdsourcing as a way to disrupt an industry". Echoing this sentiment, Firm E, CEO and founder, remarks: "What we're really doing is we're opening up a whole area of the market that didn't really exist before."

In terms of the notion that a project is characterized typically as having results which are often novel (Davies and Brady, 2016), an examination of the cross case analysis (Table 3) reveals that most crowdsourcing firms saw their crowd-involving projects as typically 'novel' and 'trailblazing' and the results as 'unique' and process as 'innovative'. These projects were all conducted within truncated timelines when compared to traditional, non-crowdsourcing firms. Most projects were started and completed typically within a week and some in considerably less time. In some firms, such a firms A, B and C, results could start arriving in 10 minutes or less. Firm A created a new production item every five seconds around the clock and firm B claimed to project manage seven human-years of work daily with less than 50 staff. In term of the traditional performance elements of project management, time, cost and quality, crowdsourcing was demonstrated in the case studies to be capable of moving the efficient frontier of these forward in various combinations across the three. Using a

crowd can take out time from a project. Crowds reduce employee cost, both direct and indirect, and they can also reduce the risk of quality problems arising, in the sense of project outcomes missing the market or customer requirement.

Table 3. *Cross Case analysis of firms and characterizations of PM and Mass Customization*

<b>PM characteristics</b>	<b>Mass customization elements</b>	<b>Where it works?</b>	<b>When it works?</b>	<b>Who it involves?</b>
New, novel (firms A, C, D and E)	Output is mass customized (all firms)	Globally – most countries represented (all firms)	Always on, follow-the-sun, 24/7 timeframe (all firms)	Firm, crowd, client are all critical elements (all firms)
Unique, trailblazing (firm A, B, C and E)	The quality of end product and speed it is produced is key (firms A, D and E)	Where flexibility is valued (all firm’s crowds)	Mutual benefits are apparent and attainable (all firms)	Developed/Developing world (firms A, B, C, D and E)
Short-term and quick turnaround (all firms)	Competition-focussed (firms A, C, D and E)	Online across ubiquitous Web 2.0 networks (all firms)	Firm, crowd and client interact in a systemic manner (all firms)	Trailblazing, innovative firms (firms A, B, C and E)
Innovative process involving large groups of crowd members who may also be customers (firms A, C, D and E)	Co-operation-focussed (firms A, D and E)	Generally English-literate participants are required (all firms)	Firm and crowd interact in a relational manner breeding trust (firms A, D and E)	Participative, task-centric, engaged crowds (all firms)
New way of doing business or conducting a project (firms A, B, C and E)	Customers are involved in tailoring end product at multiple stages (firms A,D, E)	Some in services (firms B, C,D) some in production (firms A, C, E)	Task is clear (all firms)	Underground, edgy, engaged, participative clients (firms A, B and E)
Dynamic (firms B, C, D, E)	Firm/Crowd/Client interdependent system (all firms)	Crowds are very ‘large’ (all firms)		
Innovative response to uncertainty/risk (firms B, C)	Efficient scale management (all firms)			

Tables 4, 5 and 6 present selected informant quotes from stakeholders illustrating the project management, mass customization and operational configuration of the cases. The outcomes of risk reduction, uniqueness, cost efficiency and innovation in conducting a multitude of projects can be deduced from these quotes across the cases.

#### 4.3 Informant Quotes

Table 4. *PM Characteristics*

‘Clients...we have 6.7 Million that have signed up to the website to date. At any given time, point in time there’ll be something like 12,000 (clients) online... there’s 700 Million now in terms of jobs that have been posted that have gone through the system in total which breaks down to about 4 Million Projects.’ (CTO, Firm C).
‘I think the fact that we were the first player in the States, and that we’re still here and that we’ve grown the community to hundreds of thousands.’ (Business Manager, Firm G).
‘But I would say, at its heart, we have used crowdsourcing as a way to disrupt an industry...’ (CTO, Firm A).
‘So it’s very disruptive in terms of what we are able to pay.’ (CEO and Founder, Firm D).
‘Yes, sometimes they (the client) can get 80 – 100 different designers.’ (CTO, Firm A).
‘What we’re really doing is we’re opening up a whole area of the market that didn’t really exist before.’ (CEO and Founder, Firm E).
‘Certainly better, I mean the accuracy – we run a whole bunch of these competitions and we have never failed to out-perform the best that a company can do themselves or using a consulting firm.’ (CEO and Founder, Firm D)

Table 5. *Mass Customization elements*

‘You might have a thousand pieces of content, and tomorrow you might have ten thousand or one hundred thousand, so we can actually scale (the crowd) for that and it doesn’t drastically increase your cost nor does it take a big amount of time to actually make that happen, whereas it would with a traditional outsourcing firm or an internal team. (CTO, Firm B)
‘We can do it better, faster and cheaper, and I mean that, it’s better, it’s faster and it’s cheaper.’ (CFO, Firm B).
‘What I have to be able to do is to deliver (clients) an answer in which I have mathematical statistical proof of that there is a 95% probability that the number I’ve given them is correct.’ (CFO, Firm B).
‘I mean we have a new design that is submitted to the site every five seconds, right, so it’s a huge amount of work.’ (Product Manager, Firm A).
(Firm B) can produce several years of work per day. (CEO and Founder, Firm B).
‘There are 100 million people that are members of communities at which (Firm B) work is available...Four million have actually done tasks for us, and on the average day we have 20,000 – 25,000 new people and we have no idea who they are, they are just an IP address.’ (CFO, Firm B).

Table 6. *Where/ when it operates and who is involved*

‘I mean we have designers in 192 countries.’ (Product Manager, Firm A).
‘I don’t know exactly how many countries, but it would be I’d say about 100, it’s definitely more than 100.’ (CEO and Founder, Firm D).
‘We’ve got 7.3 million (crowd) and growing, and our closest competitor has got two .. so we’ve got more skills, a deeper marketplace, more liquid market place etc., so there’s a lot of benefits there.’ (CEO/Founder, Firm C).

## 5. Discussion

To the best of our knowledge, this study is one of the first to contribute linking crowdsourcing to the PM literature and mass customization processes. The first contribution is thereby to explore how crowdsourcing-centric firms work and then to tie in the type of crowdsourcing practised with PM and mass customization processes. The findings indicate that crowdsourcing firms practice project management using large crowds in a dynamic and existential manner to create, implement and consume unique, mass customized goods and services. The crowd can now perform tasks which have historically not been able to be undertaken until the advent of ubiquitous networks and omnipresent global communications, occurring only in the past decade (Wexler, 2011).

Crowdsourcing firms use crowds to perform tasks that have never been performed before in the sense that the tasks require the focused work of the many eyes or many fine minds of the crowd to coagulate to a customized result. Most of the crowdsourcing-centric firms in the study utilise crowds of considerable size with two firms numbering attracted crowds over a million individuals (Table 1). In addition, the nature of the crowd which is characterized as an amorphous mass collaboration of diverse, omnipresent, co-operative individuals/ groups appears at *prima facie* glance a non-logical choice of existential business partner for crowdsourcing-centric firms. This is due to the fact that the large attracted crowds are, in most of the five cases, unpaid and may readily disappear, rendering such crowd-dependent firms unviable. For crowdsourcing-centric firms to use the crowd as such an essential partner in their project management delivery is surprising and unprecedented.

The second contribution is based on empirical observations across the five crowdsourcing firms of how the PM was practised and how the mass customization was operationalized. A schematic derived from the various within-case analyses (Fig 1-5) of the operational project workflow across all five firms is summarised below in Figure 6.

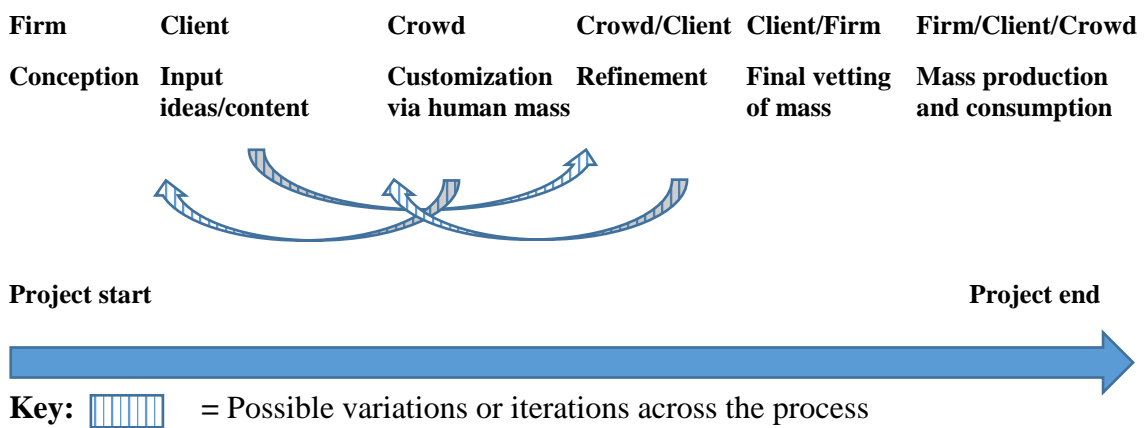


Figure 6. *Schematic of Project/Process Flow for Crowdsourcing firms' projects*

Figure 6 highlights key attributes of crowdsourcing projects and how the process flows across the firm, client and crowd to achieve mass customization. The process flows dynamically from project start to project end and encompasses various firm/client/crowd roles. However, a number of variations and iterations regarding the various roles of the firm, client and crowd are well-tolerated and easily accommodated across the flow processes of crowdsourcing-centric firms. These variations and iterations are represented by the striped arrows (Figure 6). The process, especially concerning the injection of the crowd at various points, is highly fluid and flexible.

Padalkar and Gopinath (2016) conclude that after six decades of PM research there is still an ongoing search for explanations of project performance linked to practices. From their research, one of the main calls for research in PM is for future researchers to develop normative models to reflect current best practice. The contribution of this study is that it responds to that call and attempts to map critical practices in PM linked to crowdsourcing (Figure 6). In terms of crowdsourcing project management, the firm, client and crowd link in a fluid manner and variations within the process are easily accommodated. The crowd can be injected across the whole project lifecycle for ideation, content, mass customization, mass refinement, decision-making, finalization stages, review and then even mass consumption (as with Firm E). The process is not

necessarily fixed in order for every project for every firm. Variation and dynamism across where crowd and client interact is deliberately fluid and flexible. This ensures clients can have a greater or lesser role in the final product and the crowd can submit more/less ideas, customization and refinement across the whole project lifecycle until the point of final vetting leading to final product/service production/consumption.

Crowdsourcing-centric firms appear to have deep faith in crowds to be reliable and productive project partners in spite of its amorphous, fluid characteristic. This faith appears well-grounded with most clients experiencing results that are: “better, faster and cheaper” (CFO, Firm B); that ‘out-perform the best that a company can do themselves or using a consulting firm.’ (CEO, Firm D); or have “more skills, a deeper marketplace, more liquid market place etc.” (CEO, Firm C).

The third contribution is in terms of how mass customization is delivered through crowdsourcing-centric firm project practices and processes. The use of end users in terms of achieving mass customization is critical in the crowdsourcing process and the early, continuing and sustained involvement of those end users is a key feature of crowdsourcing style mass customization.

Scholars have characterized mass customization as a type of customer co-production, whereby consumers are incorporated in the design of products and services and add value through the shared production activity (Hunt *et al.*, 2013; Vargo and Lusch, 2004). Consistent with this view, Åhlström and Westbrook (1999) found that the two main issues firm encounter with mass customization relate to understanding the wants of the customer and managing the supply chain. In terms of the supply chain, they conclude that there are opportunities for improvements in in-bound logistics if mass customization is to succeed and a neat solution is to “customize products at the point of reception...referred to as ‘adaptive customization’” (p. 272). Gilmore and Pine II (1997) highlight a number of approaches to mass customization which include ‘adaptive’ and ‘collaborative’.

Adaptive customization refers to the firm making it possible for customers to customize the product easily on their own. Collaborative customization concerns collaborating directly with individual consumers to understand their needs then to identify the exact item to fulfil those needs, and then to make customized items for them. The overall notion suggested by Gilmore and Pine II (1997) is that end users may be involved in mass customization processes in a variety of manners in order to improve and streamline end results. In the same vein, Kincaid *et al.* (2007) posit that emphasising a consumer-focused process facilitates new types of mass customization processes which positively affect time-to-market demands. The study findings point that managing the desire for customization for end users is critical in the crowdsourcing process and the early, continuing and sustained involvement of those end users is a key feature of crowdsourcing style mass customization. The findings suggest that adaptive and collaborative customization processes can occur throughout the crowdsourcing cycle. In the schematics of work flow (Figures 1 to 5) both crowd and client (and sometimes the crowd and client are the same group as with Firm E) are involved intimately at the very start of the process so the crowd is clear before customization process commence what direction to take the product.

Scholars have highlighted the trade-off for producers between crafting bulk customizable goods and services while at the same time maintaining a competitive speed-to-market to keep consumers happy (Åhlström and Westbrook, 1999; Mather,



1988; Meredith and Shafer, 2007). As Akinc and Meredith (2015, p. 733) suggest: “This paradigm parallels the process-product positioning choices” which forms a continuum from manufacture/engineer-to-order with its process focus to the other end of the continuum end represented by make-to-stock with its product focus. Akinc and Meredith (2015) analysed new manufacturing approaches to mass customization to examine favourable combinations of customization/delivery performance. The newest approach, make-to forecast, was delineated as a continual release of customizable products to production made upon forecasts of what producers believe (albeit partially blindly) will order. These customizable products are able to be modified after-the-fact to match down-the line customer requirements as customer’s orders become more defined and specific (Akinc and Meredith, 2015). The delivery times are truncated under this process so delivery to customers is much faster.

The study findings suggest a reduction of the trade-off between high levels of collaborative customization and speed-to-market. This occurs through agile and fluid use of the crowd in the process. The crowd can be used to generate ideas or produce large numbers of items and can even become consumer of the mass customized items (Figure 6). The advantage of having a process where fluidity is emphasised and the crowd can easily be injected, or scaled up or down or huge crowd numbers consulted in the same moment cannot be under-stated. Collaboration and adaptability of customization during early or during frequent interludes in the process translates to improved delivery timeliness performance and result. Customization can be wrought and re-wrought in a dynamic manner during the course of the process due to the ease with which the crowd can be applied (or not) at the various stages. The product/service forecasting of producers is enhanced by the sheer bulk human output of the crowd which ultimately results in a lower risk process, consistent with the findings of Hunt *et al.* (2013). The crowd at times represents or becomes the client (Figure 5). In other configurations the crowd interact dynamically with the client throughout the cycle to refine and alter customization without compromising delivery timeliness (Figures 1-4).

Agile manufacturing carries the advantage of responding quickly and effectively to market demands while also proactively developing future market opportunities; and the combination of agility and mass customization creates competitive advantage for firms (Brown and Bessant, 2003). The agility of the crowdsourcing process is that it can place the crowd as value arbiter in the customization process anywhere in the cycle with relative ease. This comes much closer to meeting the newer challenges outlined in literature (Anderson, 1997; Kincade *et al.*, 2007) in terms of mass customization moving from a linear system of production and distribution activities to a more integrated, fluid and consumer-focused group of activities.

In addition, all crowdsourcing firms in the study were transactionally efficient achieving transactional cost reduction through governance, procedural and technical controls wrought by the firm. For example, efficiency was suggested by high levels of crowd production and concomitant exchange frequency in the crowdsourcing firms in the study, for example Firm C received over 300 crowd produced items daily. Such vast quantities of crowd mass customized items were controlled and governed by strict technology protocols and in most cases unwanted production over-supply (waste) was efficiently dispensed with by either the client or the crowd, not the firm.

## **6. Consolidation**

### *6.1 Implications for practitioners*

The implications for practitioners is that using crowdsourcing in project practices is developing now as a real option for bringing in bulk human resources at low cost to help shorten timelines and offer the advantages of ‘many eyes’ or ‘fine minds’ contributing to quality outcomes. For practitioners, the ease of bringing in the crowd rests with being able to tap into crowdsourcing-centric companies who act as middle-brokers so as to make access to bulk crowds relatively easy for client firms.

Practitioners who desire a co-creation aspect to mass customization, and who want flexibility at bringing in consumers fluidly during the mass customization process, can now consider attracting idea- /production-/ consumer- crowds. Consensus is building that offering customized consumer variety in competitive settings will increase competitive advantage - although traditionally offering varietal customization would also potentially reduce productivity and increase costs (Da Silveira, 1998; Pine, 1993; Stablein *et al.*, 2011).

### 6.2 Future research and limitation

This embryonic study opens a fertile area for future research in crowdsourcing and its novel application to OM. A suggestion for future research is to examine crowdsourcing as a simple firm routine rather than as an existential business model. The study is limited to crowdsourcing-centric firms and caution should be exercised in assigning results generalisability to mainstream firms using crowdsourcing as business routine.

### 6.3 Conclusion

Projects by nature are temporary, time limited and require tasks to be performed which may never have been performed before. Crowdsourcing, with its inherent characteristics pointing to elements of novelty, agility and process efficiency, is an excellent framing tool for modern project practice. This is due to its efficient matching of vast crowd resources to quick-turnaround projects. It also moulds into the temporal dynamics and truncated timeframes characteristic of projects.

The use of crowdsourcing in this new study suggests the ability to combine agile flexibility through the innovative injection of large productive crowds at critical points in the production process, combined with the ability to achieve high efficiencies and low costs that come with scale economies usually associated with mass production line flow. Crowdsourcing can mitigate the trade-off in mass customization between high levels of collaborative customization and speed-to-market. Crowdsourcing develops a newer agile paradigm reflecting complex production environments encompassing co-creation and fluid, flexible process elements. Crowdsourcing incorporates low (no) costs for crowd work and multiple forms of agility and flexibility through having fluid, multi-role and productive output of thousands of crowd members in a single, efficient and flexible process.

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