LUISS

Crowdsourcing as a Support to Solving Complex Problems in Entrepreneurial Settings

Doctoral thesis PhD in Management XXVIII cycle

Thesis presented by Federico Baldelli
Supervisor: Prof. Francesco Rullani
Co-Supervisor: Prof. Marion Poetz

Nothing is particularly hard if you divide it into small jobs.

Henry Ford

Acknowledgements

I am indebted and thankful to many people who supported me since I accepted to take on the challenge of doing my PhD.

First and foremost, I would like to give special thanks to my advisors, Prof. Rullani and Prof Poetz for their continuous and exceptionally stimulating support and patience provided over the entire PhD program.

I want to express my deep gratitude to the colleagues at the Department of Business and Management, LUISS Guido Carli and Copenhagen Business School for their conversations and pleasant work environment they provided.

I would like express appreciation to my wife Irena who spent sleepless nights with me and was always my support in the moments when there was no one to answer my queries. She has taken care of whatever needed without complaining, allowing me to focus on completing my dissertation. She has patiently endured many days, and weekends alone while I worked on this dissertation. She has been an endless source of encouragement and motivation, my best supporter. She has unconditionally endorsed me during my good and bad times. My gratitude for her is endless.

Table of contents

List of Tables

List of Figures

Abstract

Crowdsourcing is a newly-developed field that has helped a number of organizations to solved complex problems concerning quantities of information and resource accessibility. Many entrepreneurs have utilized crowdsourcing to their benefit, bypassing traditional forms of fundraising in order to increase their probability of success. Paper 1 will look specifically at the ways in which crowdsourcing can perform such a role, supporting the entrepreneur through each phase of the entrepreneurial process. Paper 2 will expand on this idea by exploring the effects that crowdsourcing can have on a company's performance. Looking specifically at data provided by AngelList, a popular crowdsourcing platform, we'll attempt to analyze the benefits that the technology has had on businesses by comparing crowdsourcing-based investment paths to those of traditional investors. Specifically, we measured the performance of both traditional and crowdsourcing-base business ventures over a 2-year period, using data extracted from Mattermark. We aim to shed light, here, on the ability of crowdsourcing to produce better performance in the medium-term. Paper 3 will investigate the effects that crowd size and diversity can have on the performance of a crowdsourced venture. AngelList's data set will be useful in unpacking the relationship between the volume and diversity of a syndicate's backers to see how these attributes can be beneficial or detrimental to a firm. While a significant amount of research has been undertaken around this topic, we have found that there are many gaps in the available literature. Where researchers have written extensively about the potential for crowdsourcing to support the discovery, exploitation and execution of entrepreneurial opportunities, much of this literature does not take into account the nature of currently-used crowdsourcing platforms. Throughout each of these papers, we'll attempt to expand into the territory left unexplored by existing research, paying specific attention to the individual attributes phase of the entrepreneurial model.

Structure of the Thesis

Title	Type	Level of analysis	Dataset
"Crowdsourcing As A Support To The Entrpreneurial Process"	Conceptual	Process level	_____
"Crowdsourcing and Performance of Online Syndicates"	Empirical	Firm level	Dataset on all Users and companies registered on AngelList (data extracted in 2014) (description of variables available in the Appendix)
"Crowd Size, Diversity and Performance of Complex Decision-Making"	Empirical	Individual level	Dataset on all Users and companies registered on AngelList (data extracted in 2014) (description of variables available in the Appendix)

PART I:

Crowdsourcing as a Support to the Entrepreneurial Process

Abstract

Over the past decade, crowdsourcing has become common practice among entrepreneurs. Companies have utilized crowdsourcing platforms for fundraise, manpower acquisition, capital generation and many other needs. While this practice has been widely explored throughout a number of academic studies, experts on the topic are yet to generate a cohesive understanding of the relationship between crowdsourcing and the entrepreneurial process. In this paper, using an entrepreneurial model found in literature (Shane, 2003), the potential benefits of crowdsourcing are studied. The study essentially analyses the process by which crowdsourcing supports entrepreneurs through the various stages of this model, and identifies the gaps in literature left unexplored by the researchers at present. The study highlights the potential advantages of crowdsourcing in various stages of entrepreneurial development.

Introduction

While research studies and statistics aid in understanding the benefits and effects of entrepreneurship as an activity, the entrepreneurial process itself is much more difficult to understand. Although the significance of the entrepreneurial process has been subject to study (Ahmad & Xavier, 2012), the inherent complicated environment in which an entrepreneurial entity operates can be hard to quantify, making our ability to comprehend its effects quite difficult. Dividing the entrepreneurial process into specific phases involving exploration and exploitation of opportunities (Shane, 2003), and then analyzing it as a complex problem can help to better grasp performance quality in the entrepreneurial process.

Crowdsourcing has become one of the resources most commonly used by individuals and organizations as they move through the entrepreneurial process. It has been applied to a variety of

entrepreneurial ventures ranging from brain storming (Bayus, 2013) to marketing (Gatautis & Vitkauskaite, 2014). However, its potential to solve complex problems has been debated. Some have argued that crowdsourcing is subjected to a level of problem *modularizability* (Afuah and Tucci, 2012) and that complex problems require a large number of diverse solvers to reach a solution (Chi et al., 2014). Researchers argue that as tasks become more complex, the crowd requires a greater degree of management, making the concept of crowdsourcing moot (Staffelbach et al., 2015). Others insist that crowdsourcing has the potential to adequately solve complex problems involved in entrepreneurship (Waldner & Poetz, 2015; Lakhani et al., 2007). Frameworks for crowdsourcing complex problems have also been developed (Kittur et al., 2011).

Platforms such as AngelList, Republic, Crowdcube, Funderbeam, Kickstarter or Indiegogo reduced information asymmetry, making it easier for crowdinvestors to identify teams that will more likely perform above average. There is still a need to provide systematic insights into the ways that crowdsourcing can facilitate complex problem solving in different phases of the entrepreneurial process. Existing literature has focused on the relationship of crowdsourcing to the discovery, exploitation and execution of opportunities, but neglected to examine into detail how the market is using crowdsourcing to solve complex problems in reality.

In this paper, we discuss the potential of crowdsourcing to facilitate the entrepreneurial process throughout various phases. In doing so, we analyze these phases, looking at the role of crowdsourcing in each. We also asses the existing subject literature, aiming to identify theoretical gaps and offer an expansion of this literature by looking at how various companies use crowdsourcing platforms to their advantage.

The Entrepreneurial Model

The process of entrepreneurship is a complex one, often involving an iterative, nonlinear, feedback driven approach (Bhave, 1994). It is therefore, a well-defined area of research (Bruyat & Julien, 2001). Several researchers have tried to model stages of the entrepreneurial process (Krueger et al., 2000; Minniti & Bygrave, 2001) while others have attempted to model entrepreneurship itself (Bosma et al., 2005; Salim, 2005). The model developed by Shane (2003)

is used in this paper to understand the complex problem setting in which an entrepreneur operates. According to this work, the entrepreneurial model consists of five parts: the individual's attributes, the environment, the discovery of opportunities, the exploitation of opportunities and their execution (Shane, 2003). Each of these elements plays a different role and is fundamental in determining the quality of an entrepreneur's performance.

Individual Attributes

The personality and relationships of an entrepreneur often affect the success or failure of an enterprise (Littunen, 2000). When looking at the individual's attributes, psychological and demographic factors like the entrepreneur´s or organization's motivation and cultural background are considered. In addition, the strengths and shortcomings of entrepreneurs with respect to the business environment and in relation to their competition also need to be analysed. The individual's expertise, knowledge-base, interpersonal skills and ability to negotiate are some of the characteristics that have the potential to critically influence the success or failure of an entrepreneur (Baum, & Locke, 2004).

When looking at a partnership or organization, the unit must be considered as a single entity. Stress should be given to the collective strengths and weaknesses of the unit rather than that of the people comprising it. It is important for the entity, as it grows, to be aware of its strengths and weaknesses in order for it to act accordingly (Shane, 2003).

Environment

The environment of an entrepreneur describes the industry within which it operates. Factors such as political conditions and cultural influences play a part in the entrepreneurial process (Alvarez & Urbano, 2011). Environmental factors also describe its macro-environment; the institutions, regulations and external factors that have the potential to affect it in some way. The macro-environment is comprised of a multitude of external factors such as local market conditions, diverse consumers and emerging markets. Share-price fluctuations, currency devaluations, recessions, inflation, production costs and political factors and should all be considered when looking at the environmental element of a specific entrepreneurial model (Nicolaou & Shane, 2010).

Entrepreneurial Opportunities

Entrepreneurial opportunities play an essential role within this process model, as it insists on the importance of observing entrepreneurship through a disequilibrium framework that emphasizes the individualities and presence of entrepreneurial opportunities (Shane, 2003). Looking at the ability of an entrepreneur to effectively plan and successfully execute opportunity exploitations is integral to this model. In their writing on technological companies, Hayek, (1945) and Kirzner, (1973) suggest that though entrepreneurs are likely to discover an opportunity earlier than the rest of the population, this time margin is very small. Opportunities might become less profitable when other companies take notice of the discovery's value and begin replicating it. Further, new technological developments can replace the value of the initial opportunity if entrepreneurs are not rapidly reacting to competitors.

Exploitation of Opportunities

Recognition and exploitation of opportunities is one key characteristic of an entrepreneur (Green & Smith, 2013). Many traits of the entrepreneur such as individual characteristics and networking capabilities play a part in determining an entrepreneur's ability to exploit an opportunity (Nicolaou et al., 2009). The importance of having the right social contacts and in the success or failure of an entrepreneur (Ozgen & Baron, 2007) and the effect of social media on entrepreneurship have been already established (Lea et al., 2006). Resource availability is arguably the key factor involved in converting these opportunities and social contacts into a viable enterprise (Stevenson, 1983).

Execution of Opportunities

Finally, literature about entrepreneurship defines execution as a phase that includes resource assembly, strategy and organizational design (Shane, 2003). As we can see in the figure below, all phases of the entrepreneurial process are interdependent and influence each other both directly and indirectly. Figure 1 shows the entrepreneurial model in a complex problem setting. The market in which the entrepreneur operates is influenced by a large number of variables, including economic conditions, cultural trends, influence of media and social and technological trends (Goldenberg et al., 2001). The entrepreneur must deal with competition (Moore, 1993) which comprises a vast quantity of established companies, startups, inventors, etc. It is also subject to the advantages and disadvantages of scale.

Depending on the complexity of the problem, each of these subtasks may be further subdivided (Von Hippel, 1998). The complex problem, when discussed in the entrepreneurial context, favors the birth and development of crowdsourcing platforms that try to offer a solution to problems at each stage. Crowdsourcing has already made its mark in most entrepreneurial processes (Giudici et al., 2012; Szopa & Kopeć, 2016).

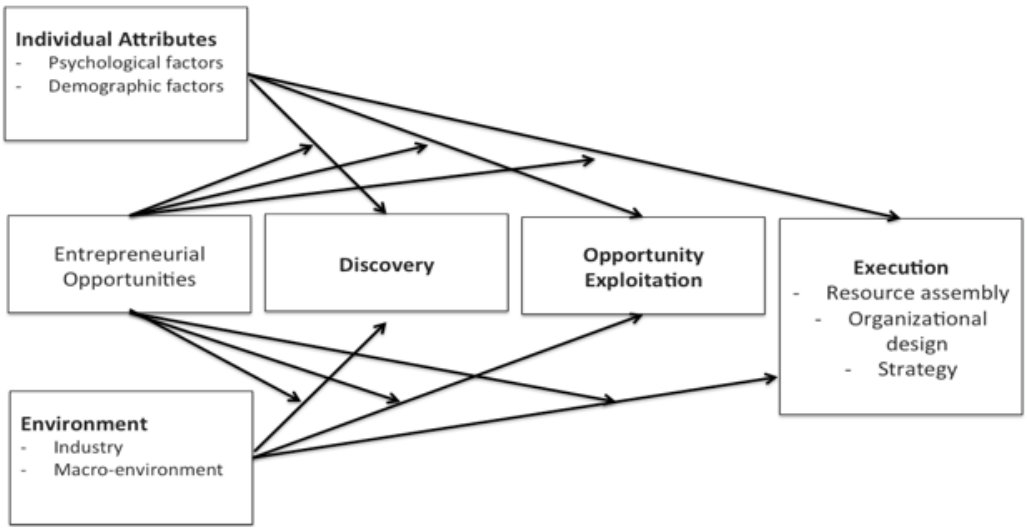


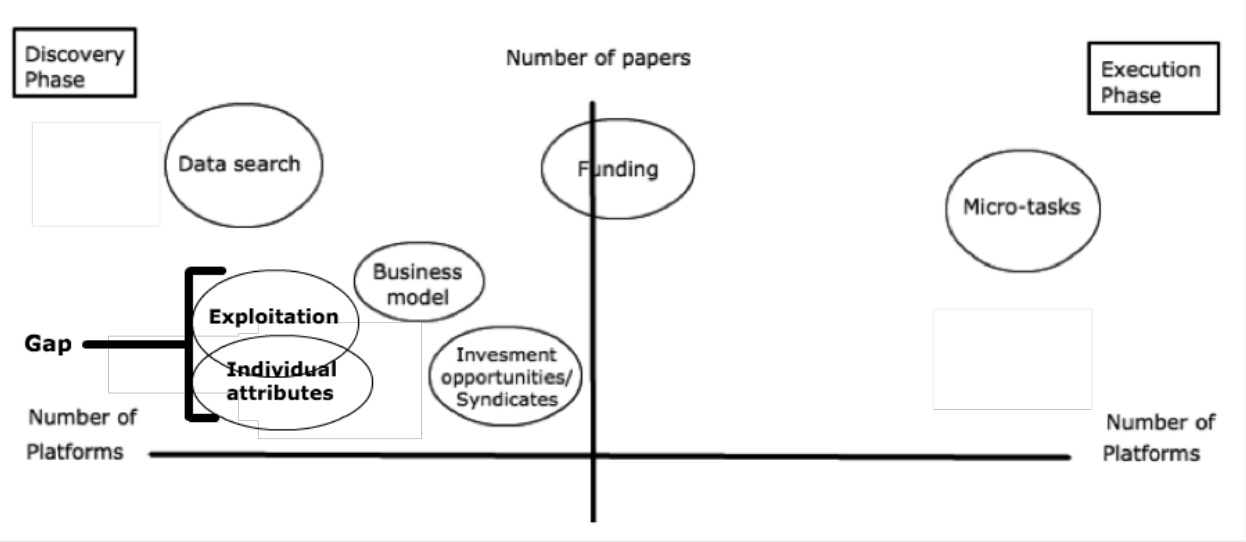
Figure 1: The entrepreneurial process

Source: Shane (2003)

While some work has been done linking entrepreneurship and crowdsourcing (Hetmank, 2014), a comprehensive study of crowdsourcing in the entrepreneurial framework is of merit. For this reason, we find that the optimal way to study how crowdsourcing may support the entrepreneurial model is by comparing existing research with crowdsourcing platforms used by entrepreneurs. By identifying the areas in which existing literature and practical examples overlap, it may be possible to gain an overall understanding about which fields have not yet been comprehensively covered by literature.

Crowdsourcing and the Entrepreneurial Model

From the perspective of the complex entrepreneurial process, existing literature has not fully studied the relationship of crowdsourcing to the market. It can be seen that while crowdsourcing platforms have become a common practice in the context of entrepreneurship, there is little research on how crowdsourcing supports crowd-investors to discover and evaluate individual attributes within entrepreneurial process. This work looks at existing crowdsourcing platforms and analyzes them utilizing a series of papers that have focused on the various phases of the entrepreneurial process. As the diagram below illustrates, there are certain areas that remain underexplored by existing literature.



Phase of the Entrepreneurial Model	Papers	Platforms	Gap
Discovery of opportunities	+	+	-
Exploitation of opportunities	-	+	+
Execution of opportunities	+	+	-
Individual attributes	-	+	+

Figure 2: Gaps between literature and the market

Source: Author's elaboration based on the analysis of literature about "crowdsourcing and entrepreneurship" on Google Scholar and ISI Web of Science. +/- assigned by calculating the difference between papers and platforms.
When the difference between platforms and papers > 60% then +, otherwise -

List of existing crowdsourcing platforms in Appendix (list not exhaustive)

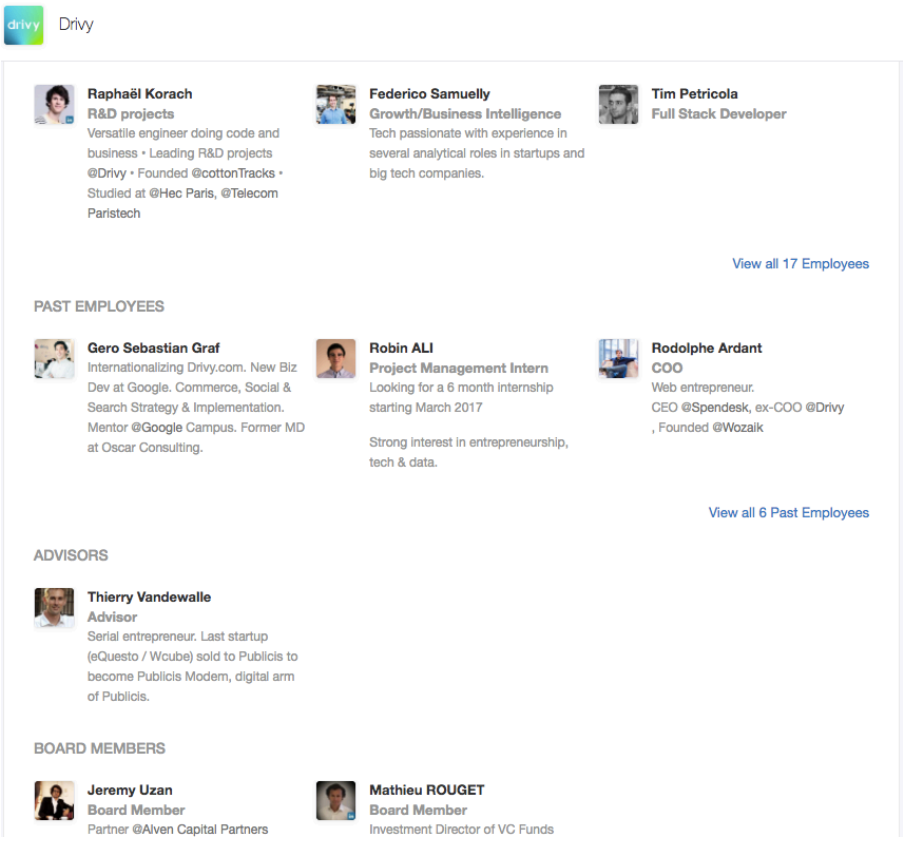


Figure 3: Individual attributes as they appear on AngelList (Company: Drivy)

Source: AngelList

The Individual Attributes & Exploitation Gap

There are several crowdsourcing platforms that support the individual's attributes phase by helping teams to find co-workers and share with investors the information related to qualities of the teams thus formed (Prill et al., 2011; Retelny et al., 2014). CoFoundersLab, Founder2Be, FounderDating or AngelList are few examples of platforms that bring investors and entrepreneurs together. The importance of individual attributes on entrepreneurship has been studied in detail (Ray, 1993; Farmer, Yao, & Kung, Mcintyre, 2011). However, at present, no study investigates the role of crowdfunding platforms in developing and aiding the individual attributes phase of entrepreneurship. Looking at the difference between existing literature and crowdsourcing platforms, it can be seen that there is a gap within the discovery phase. There are several platforms helping entrepreneurs and investors to reduce information asymmetries and to gain deep insights

about team characteristics (skills, personality etc.), yet, in these areas crowdsourcing is still a largely unexplored field where further research can contribute to the literature around the subject.

Besides individual attributes, another area that is still not covered by literature is how crowd-investors can identify and exploit in the best possible way these attributes. As we will see in the following chapters, syndicated crowdfunding platforms like AngelList are new in helping investors to identify startups with the best individual attributes and invest in them with the help of lead investors.

If we study how crowdsourcing facilitates the solution to complex problems that an entrepreneur encounters at various stages of the entrepreneurial model, we can affirm that crowdsourcing offers support to the entrepreneurial process as a whole. This assertion is made based on the fact that crowdsourcing is a practical application that successfully serves the needs of entrepreneurs at various stages and in the solution of complex problems (Tran-Than et al., 2014). Crowdsourcing may be used successfully by entrepreneurs during the different phases of the entrepreneurial model, including the discovery of opportunity phase, the individual attributes phase, the exploitation of opportunities phase and the execution phase.

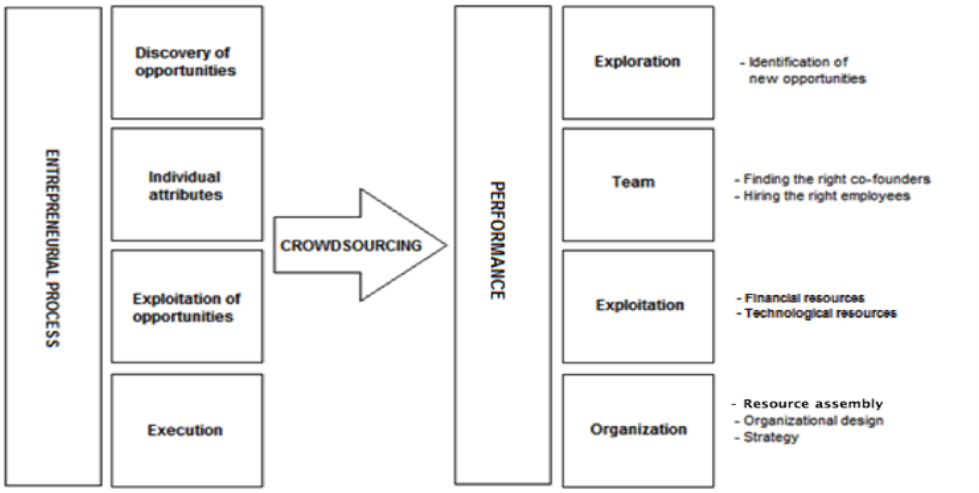


Figure 3: Crowdsourcing applications within the entrepreneurial model

Source: Author's elaboration

Since opportunity identification is the first and most human centric stage of the entrepreneurial process, it is rational to assume that crowdsourcing would help to facilitate this process. The utilization of crowdsourcing allows entrepreneurs to employ the collective intelligence of a large number of participants (Woolley et al., 2010). Moreover, crowdsourcing provides a useful alternative to the use of employees in this process (Ford et al., 2015). Whereas the employees of a given organization may be limited to certain demographics, a company can benefit from the diversity of opinions, ideas and worldview that a varied group of voices can bring (Page, 2008). Crowdsourcing aids the process of brainstorming. This process has been dubbed *crowdstorming* (Nucciarelli, 2014), whereby the collective intelligence of the crowd is incentivized to generate ideas for the exploration of opportunity. Rewarding the most creative *brainstormers* often leads to the best ideas. This process can be implemented through selective or integrative crowdsourcing. In the latter case, participants are incentivized to work with one another on the production of ideas by drawing from their individual skills and experiences (Organisciak, 2008).

The brainstorming process can be implemented to incentivize participants to provide a proof of concept for ideas and ways of executing them. The cognitive capabilities of any single individual are limited in addressing the complex and rapidly-changing business environment. It can be beneficial to address this problem through the use of collective intelligence or trial-and-error. The latter, sometimes known as *tinkering* is used in complex settings to objectively discern bad ideas from the seemingly good ones (Ciborra, 1992). Reputed business consultancies benefit from experienced professionals and specialized data-gathering tools that allow them to consistently provide profitable solutions for business growth. However, when contrasting this to a successful crowdsourcing initiative, the resources pale in comparison. By taking advantage of the resources and intelligence of the collective, the opportunity for successful idea generation and probability of positive ROI are maximized (Djellassi and Decoopman, 2013), while the risk of sunk-cost is minimized (Marjanovic et al., 2012). More importantly, the cost of rewarding only the best ideas tends to be significantly lower than the cost of hiring a consultancy (Bishop, 2009).

One of the most challenging stages in the entrepreneurial process is the execution of opportunities. While there is large scope for opportunities, the key challenge for an entrepreneur or organization is to successfully execute these chances. This is best accomplished when indicators of success can be obtained prior to investment, particularly when large amounts of capital are at stake. Once

obtained, indicators of success can provide confidence in the execution of a strategy. This process may be compared to the beta-testing and fail-fast process employed in the lean-startup model of online businesses (Kohavi et al., 2009). When the results of a beta-test indicate that execution of a proposed idea is likely to fail, the entrepreneur benefits from the ability to minimize loss and focus on other opportunities (Schwartz et al., 2005). In considering the role of human resources in the entrepreneurial process, Buettner (2015) detailed existing literature on the subject of crowdsourcing. From the perspective of human resources management (HRM), he pointed out that crowdsourcing offers a number of benefits to the process of workforce planning. One of the biggest benefits for using crowdsourcing, as opposed to more conventional forms of innovation, is the flexibility that it offers in respect to the skill-sets needed for urgent tasks (Buettner, 2015). Without the restrictions that a traditional employer-employee arrangement imposes onto human resources, businesses have the opportunity to gather help from on-demand participants. These participants have the ability to work together from across time zones, to handle sub-task activity, and to complete work with short notice (Kittur et al., 2008). When given the chance to tap into the skill-sets of the crowd, businesses are not restricted to the limited abilities of their employees (Buettner, 2015).

Within the context of this paper, exploitation of opportunities is synonym of access to opportunities. Crowdfunding is the most cited example: it provides entrepreneurs access to financial resources with greater ease when compared to traditional investors (Manchanda & Muralidharan, 2014). The exploitation process can be helped greatly by the use of crowdsourcing, which allows entrepreneurs to gather indexical data from both existing and potential customers. One from of data acquisition, known as *crowdsensing*, obtains information directly from the mobile devices of user groups (Ganti et al, 2011). This provides the entrepreneur with information that can direct marketing and investment efforts, enabling the entrepreneur to get access to a larger pool of potential customers. Current literature has limited research into the relationship between crowdsourcing and the exploitation of opportunities. While the difficulties in the opportunity exploitation phase are widely studied, few have offered solutions make use of crowdsourcing. Limited access to human-intelligence resources and man-hours (Halal, 2006), the inefficient obstruction of bureaucracy (McGill et al., 1992) and the inability to meet deadlines (Ahsan and Gunawan, 2010) are all problems potentially faced by entrepreneurs that may be solved by savvy use of crowdsourcing. The resources provided by crowdsourcing are far more diverse and flexible

than other options. While coordination can still cause problems within integrative projects (Kittur & Kraut, 2008), crowdsourcing allows the exploitation stage to be moved through smoothly without bureaucratic or administrative interruption. Incentives can be put into place that promote high-quality and time-sensitive work.

In addition to allowing entrepreneurs access to information and resources in a fast and cost effective manner, crowdsourcing is often used to mitigate any shortcomings an individual entrepreneur may have. For example, crowdsourcing is often used to overcome an entrepreneur's skill deficit as crowdsourcing platforms allow access to a pool of skilled experts from across the globe (Schenk & Guittard, 2011). Similarly, crowdsourcing can be used to overcome any information asymmetry an entrepreneur may face while setting up an enterprise. Crowds have been effectively used to collect data, thereby providing the entrepreneur with more useful information (Okolloh, 2009).

Conclusions

The entrepreneurial process is a complicated endeavor which presents entrepreneurs with a series of complex problems to solve in order to turn risky opportunities into successful executions. It is apparent, for many reasons, that crowdsourcing is a valuable tool which can help entrepreneurs to handle these complex problems in an efficient manner (Ambani, 2016). If used correctly, crowdsourcing can help a company to find investors, evaluate the attributes of their team, and provide them with an intelligent, diverse and inexpensive group of temporary workers. It is evident that crowdsourcing platforms like AngelList have provided a strong alternative to traditional forms of supporting the entrepreneurial process (Fleming & Sorenson, 2016).

As illustrated in this paper, academic literature has given us a number of ways to understand the relationship between crowdsourcing and the complex problems faced in some phases of the entrepreneurial model. Unfortunately, this literature has often left out practical information concerning the ways in which crowdsourcing could be utilized to solve problems throughout the entire entrepreneurial model. The ways in which crowdsourcing can be used by entrepreneurs and investors to identify people with the right individual attributes has not been sufficiently unpacked

by writers dealing with the topic.

The influence of these platforms on allowing crowd-investors to identify the teams with the best individual attributes and invest in them is, however, significant. Online crowdsourcing can give an entrepreneur access to a global pool of talented participants, thus circumventing any shortage of skill the entrepreneur may have (Smith, Manesh & Alshaikh, 2013). Similarly, the effectiveness of crowdsourcing information has also been illustrated (Lofi, Selke, & Balke, 2012), sometimes under crisis situations (Horita et al., 2013). This capability of the crowd can be harnessed to overcome information asymmetry in an entrepreneurial ecosystem. Platforms like AngelList help investors to identify individual attributes that match with their values and expectations. For investors, when looking for an investment opportunity, it is crucial to get as much information about teams as possible and minimize risks. How these risks can be mitigated by providing access to a better way to view these individual attributes of founders and invest in them is crucial. Current literature did not offer a valid solution to the information asymmetries for newly founded companies raising investments. The market moved faster than research and developed innovative platforms such as AngelList that help crowdinvestors to identify and invest in the teams with the best individual attributes through syndicates, regardless of geographical distance.

This research aims at providing a better understanding of crowdsourcing form within an entrepreneurial framework, so that it can be better optimized to meet the needs of any enterprise. If future researchers can aim at providing entrepreneurs with a more solid model for using crowdsourcing as a tool in every stage of their process, entrepreneurs around the world and society could benefit as a whole.

Appendix

Crowdsourcing projects and their applicability to the entrepreneurial process

Crowdsourcing Platform	Entrepreneurial Phase	Business Application	Sector
Angel	Individual attributes, Exploitation	Investments	Entrepreneurship
Republic	Individual attributes, Exploitation	Investments	Entrepreneurship
Amazon Mechanical Turk	Execution	Freelancers	Work
AED4	Execution	Map resources	Health
AHHHA	Discovery	Idea generation	Ideas
Alertaphone	Execution	Customer support	Repairs
americanairmuseum.com	Execution	Information	Images
Answer Underground	Execution	Information/collaboration	Education/ Mentoring
Arcbazar	Execution	Freelancers	Architecture
Article One Partners	Discovery	IP protection/innovation	Patents
ARTigo	Execution	Content/organization	Images
AskYourUsers	Execution	Freelancers	Knowledge
Audiodraft	Execution	Audio/content	Audio
Australian Historic Newspapers	Execution	Translations	Texts
AwesomeBox	Execution	Product design	Gift
Barnacle	Execution	Logistics	Logistics
Beansight	Execution	Strategy	Predictions/Strategy
Berkeley Open System for Skill Aggregation (BOSSA)	Discovery	Knowledge sharing	Computing
Betaville	Discovery	Planning/ Development	Testing
Blogmutt	Execution	Content/marketing	Blogging
Boost Media	Execution	Advertising	Advertising
Bugcrowd	Execution	Cyber security/testing	Cyber Security
BusinessLeads	Execution	Business development	Advertising
Cad Crowd	Execution	Freelancers	Product Design/Architecture
California Digital Newspaper Collection	Execution	Text correction	Texts
CareerVillage	Execution	Advice	Mentoring
CaseHub	Execution	Legal	Legal
Casetext	Execution	Legal	Legal
Checkio	Indivdual attributes	Coding	Learning/ Coding
Chicago History Museum	Execution	Content/demand	Texts
Cisco Systems Inc.	Discovery	Business planning	Business plan
CitySourced	Discovery	Monitoring/ quality	Civic
CloudFactory	Execution	Freelancers/ User experience	Product design/UI

Cloverpop	Execution	Strategy	Decision making
Cocontest	Execution	Interior design	Interior design
Compass	Discovery	Market data	Analytics
Creative Allies	Execution	Product design	Design
Crowd-Sourced Assessment of Technical Skills (C-SATS), Inc.	Team	Skill testing	Skills
Crowdbase	Discovery	Knowledge	Knowledge
CrowdDD	Execution	Due diligence	Due diligence
Crowdera	Exploitation	Funding	Fundraising
CrowdFlower	Execution	Freelancers	Work
Crowdfynd	Execution	Information search	Search
Crowdmark	Execution	Rating	Education/ Grading
CrowdMed	Execution	Skilled workforce	Health
Crowdsite	Execution	Design	Design
CrowdSource	Execution	Freelancers	Work
Crowdspring	Execution	Logo, graphic design, naming	Design
CustEx	Execution	Product design	Product Design
Daily Delphi	Execution	Strategy/finance	Finance
Dead Cell Zones	Discovery	Monitoring/ quality	Phone
Dell IdeaStorm	Discovery	Idea generation	Ideas
Desall	Execution	Product design	Product Design
DesignContest	Execution	Design	Design
DesignCrowd	Execution	Design	Design
Digital Folio	Discovery	Retail price intelligence	Pricing
Digsy	Execution	Sales	Sales/ Real Estate
Distributed Proofreaders	Execution	Text correction	Texts
DOZ	Execution	Marketing	Marketing
Drilling Maps	Discovery	Monitoring/ dangers	Security
dscout	Execution	Product design	Ideas/Product
Duolingo	Execution	Translations	Translation
Emporis	Execution	Data acquisition	Data
Estimize	Execution	Finance	Finance
Facebook	Execution	Translations	Texts
Federal Communications Commission	Discovery	Idea generation	Ideas
Feedback Roulette	Execution	Product design	Feedback
Fitmob	Execution	One pass for all	Fitness
Fixya	Execution	Support/ Q&A	Help
Flightfox	Discovery	Find best price	Price search
Freelancer.com	Execution	Freelancers	Work
FundedByMe	Exploitation	Funding	Funding

Gather	Execution	Planning/ Organization	Organisation
General Electric	Discovery	Idea generation	Ideas
Gengo	Execution	Translations	Translations
GeniusRocket	Execution	Advertising	Advertising
Get a Slogan	Execution	Advertising	Creativity
Gigwalk	Execution	Freelancers/mobile	Sales
Goldcorp	Execution	Data acquisition	Data
Google Image Labeler	Execution	Organization	Images
Google Translate The Google Translate Community	Execution	Translations	Translation
Gooseberry Patch	Execution	Content	Recipes
Gradible	Execution	Loan evaluation	Funding/ Education
Herox	Discovery	Idea generation	Ideas
Humanoid	Execution	Freelancers	Work
Hylo	Discovery	Creation of new ventures	Skills, Ideas, Resources
IBM	Discovery	Idea generation	Idea
Iconfinder	Execution	Icons/Images	Design
ImageBrief	Execution	Images/photographs	Images
ImageBrief	Execution	Images/photographs	Images
InfoArmy	Execution	Data acquisition	Business data
InnoCentive	Discovery	Research&Development	Health
Innosabi	Discovery	Crowdsourcing management	Custom
Innovation Exchange	Discovery	-	Innovation
Jade Magnet	Execution	Design/logos	Design
Jeeran	Discovery	Reviews	User reviews
JobRangers	Indivdual attributes	Recruting	Job Placement/HR
Jotengine	Execution	Transcriptions	Transcription
Kaggle	Discovery	Data acquisition	Data
Kaizen Platform	Execution	Product design	Product Design
Khan Academy	Indivdual attributes	Education/Training	Education
Kibin	Execution	Quality control	Proof reading
L'Oreal	Execution	Advertising	Advertising
Lawfully	Execution	Legal	Legal
Leadgenius	Execution	Sales	Sales & Marketing
LegalAdvice	Execution	NA	Legal Advice
LEGO Design byME	Execution	Product design	Design
Lendify	Exploitation	Funding	Financial/Lending
Life in a Day	Execution	Content/Product	Film
Local Motors	Execution	Product design/development	Cars
LocaWoka	Execution	Freelancers	Work

Mathesia	Execution	Mathematics/Problem solving	Mathematics
Mentormob	Indivdual attributes	Education/Training	Learning
Metadata Games	Execution	Organization/Classification	Content
Microtask	Execution	Freelancers	Work
Microtask	Execution	Freelancers	Work
Mindsumo	Discovery	Idea generation/mini-internships	Mini-internships
Mob4Hire	Execution	Testing/prototyping	Testing/prototyping
Mobbr	Execution	Freelancers	Work
My Starbucks Idea	Discovery	Idea generation	Ideas
MyCrowd QA	Execution	Testing	Testing
Netflix Prize	Discovery	Product design	Algorithm
OpenLabel	Discovery	Product information	Consumer information
Oximity	Discovery	Information	News
Pabst Brewing Company	Exploitation	Funding	Funding
Paper.li	Execution	Content	News
Path	Execution	Translations	Translation
Pepsi	Execution	Product design	Design
Pingwell	Discovery	Price comparison	Price comparison
Planet Hunters	Execution	Data acquisition	Data
Promoki	Execution	Design	Advertising/Videos/Images
Prova	Execution	Design/creative	Design/Advertising
Quirky	Execution	Product design	Ideas
Quotefish	Execution	Freelancers	Work
Raiseworks	Exploitation	Lending	Lending
RecruitLoop	Indivdual attributes	Recruting	Recruiting
Red Clay	Execution	Freelancers/product design	Product Design
RocketClub	Execution	Product design/marketing	Product Design
SBV IMPROVER	Execution	Data acquisition	Data
ScooprMedia	Execution	Marketing	Advertising
Scripted	Execution	Content/marketing	Content
SeeClickFix	Execution	Monitoring/problem signaling	Emergeny
Show us a better way	Discovery	Idea generation	Ideas
SL8Z	Indivdual attributes	Recruiting	Recruiting
Smartling	Execution	Translations	Translation
Smartsheet	Execution	Team collaboration/organization	Collaboration
SmartShoot	Execution	Images/photographs	Images
Snapwire	Execution	Images/photographs	Images
SoMedia Networks	Execution	Videos	Videos

SomePitching	Discovery	Idea generation	Ideas
Spare5	Execution	Freelancers/mobile/micro-tasks	Mobile targeted work
Springleap	Execution	Advertising	Advertising
Squadhelp	Execution	Branding/design/marketing	Branding/design/marketing
SquadRun	Execution	Freelancers/mobile	Work
Student of Fortune	Execution	Tutoring	Tutoring
Stylyt	Execution	Product design	Fashion
Synack	Execution	Cyber security/monitoring	Cyber Security
t-Art	Execution	Product design	Product Design
The Gateway to Astronaut Photography of Earth - Image Detective	Execution	Data acquisition	Data
The Great War Archive,[51]	Execution	Data acquisition	History
The Infinity: The Quest for Earth project	Execution	Design/videogame	Prototypes
The Vision Lab	Execution	Strategy/Decision-making	Product Innovation/employee
Threadless	Execution	Product design	Creativity
Tipalti	Execution	Payments	Payments
tldr.io	Execution	Content	Information
Torneo de Ideas	Execution	Design, branding, advertising	Design
Transifex	Execution	Translations	Translation
TrustRadius	Discovery	Reviews	Software reviews
TV by the People	Execution	Entertainment	Entertainment
Unbranded Designs	Execution	Product design	Product Design
Unilever	Discovery	Idea generation	Ideas/Advertising
Upwork	Execution	Freelancers	Work
Userfarm	Execution	Videos	Videos/Content
Ushahidi	Execution	Data	Data
uTest	Execution	Testing	Testing
Vidsy	Execution	Content	Advertising
Waggl	Execution	Employee communication	Employee feedback
Waze	Execution	Information	Traffic
Wazoku	Execution	Team collaboration/organization	Ideas
Whalepath	Discovery	Business Information	Business intelligence
Wikipedia	Execution	Information	Information
Wishabi	Discovery	Offers search	Sales & Marketing
WorkHub	Execution	Freelancers/micro	Work
X-Prize	Discovery	Idea generation	Ideas
YoCrowd	Execution	Storytelling/advertising	Marketing
Zooppa	Execution	Design/ Creativity	Creativity

Not exhaustive list of crowdsourcing project of the last years (available upon request)

References

Afuah, A., & Tucci, C. L. (2012). Crowdsourcing as a solution to distant search. Academy of Management Review, 37(3), 355-375.

Ahmad, Z. S., & Xavier, S. R. (2012). Entrepreneurial environments and growth: evidence from Malaysia GEM data. Journal of Chinese Entrepreneurship, 4(1), 50-69.

Ahsan, K., & Gunawan, I. (2010). Analysis of cost and schedule performance of international development projects. International Journal of Project Management, 28(1), 68-78.

Alvarez, C., & Urbano, D. (2011). Environmental factors and entrepreneurial activity in Latin America.

Ambani, P. (2016). Crowdsourcing New Tools to Start Lean and Succeed in Entrepreneurship: Entrepreneurship in the Crowd Economy. Crowdfunding for Sustainable Entrepreneurship and Innovation, 37.

Bayus, B. L. (2013). Crowdsourcing new product ideas over time: An analysis of the Dell IdeaStorm community. Management science, 59(1), 226-244.

Bhave, M. P. (1994). A process model of entrepreneurial venture creation. Journal of business venturing, 9(3), 223-242.

Bishop, M. (2009). The total economic impact of InnoCentive challenges. Single company case study. Forrester Consulting.

Bosma, N., De Wit, G., & Carree, M. (2005). Modelling entrepreneurship: Unifying the equilibrium and entry/exit approach. Small Business Economics, 25(1), 35-48.

Bruyat, C., & Julien, P. A. (2001). Defining the field of research in entrepreneurship. Journal of business venturing, 16(2), 165-180.

Buettner, R. (2015, January). A systematic literature review of crowdsourcing research from a human resource management perspective. In System Sciences (HICSS), 2015 48th Hawaii International Conference on IEEE (pp. 4609-4618).

Chi, M. T., Glaser, R., & Farr, M. J. (2014). The nature of expertise. Psychology Press.

Ciborra, C. U. (1992). From thinking to tinkering: the grassroots of strategic information systems. The information society, 8(4), 297-309.

Djelassi, S., & Decoopman, I. (2013). Customers' participation in product development through crowdsourcing: Issues and implications. Industrial Marketing Management, 42(5), 683-692.

Farmer, S. M., Yao, X., & Kung-Mcintyre, K. (2011). The behavioral impact of entrepreneur identity aspiration and prior entrepreneurial experience. Entrepreneurship Theory and practice, 35(2), 245-273.

Fleming, L., & Sorenson, O. (2016). Financing by and for the Masses. California Management Review, 58(2), 5-19.

Ford, R. C., Richard, B., & Ciuchta, M. P. (2015). Crowdsourcing: A new way of employing non-employees? Business Horizons, 58(4), 377-388.

Ganti, R. K., Ye, F., & Lei, H. (2011). Mobile crowdsensing: current state and future challenges. IEEE Communications Magazine, 49(11).

Gatautis, R., & Vitkauskaite, E. (2014). Crowdsourcing application in marketing activities. Procedia-Social and Behavioral Sciences, 110, 1243-1250.

Giudici, G., Nava, R., Rossi Lamastra, C., & Verecondo, C. (2012). Crowdfunding: The new frontier for financing entrepreneurship?
Goldenberg, J., Libai, B., & Muller, E. (2001). Talk of the network: A complex systems look at the underlying process of word-of-mouth. Marketing letters, 12(3), 211-223.

Halal, W. E. (2006). Organizational intelligence. What is it, and how can Managers use it? Strategy & Business, Global Commercial Consulting.

Hayek, F. A. (1945). The use of knowledge in society. American Economic review, n. 35.

Hetmank, L. (2014). A synopsis of enterprise crowdsourcing literature. AIS Electronic Library. Available at < http://aisel.aisnet.org/ecis2014/proceedings/track17/10/>. Accessed on 8th February, 2017.

Horita, F. E. A., Degrossi, L. C., de Assis, L. F. G., Zipf, A., & de Albuquerque, J. P. (2013). The use of volunteered geographic information (VGI) and crowdsourcing in disaster management: a systematic literature review. AIS Digital Library. Available at < aisel.aisnet.org/amcis2013/eGovernment/GeneralPresentations/4/> Accessed on 7th February, 2016.

Kirzner, I. M. (1973). Competition and entrepreneurship. University of Chicago press.

Kittur, A., & Kraut, R. E. (2008, November). Harnessing the wisdom of crowds in wikipedia: quality through coordination. In Proceedings of the 2008 ACM conference on Computer supported cooperative work (pp. 37-46). ACM.

Kittur, A., Chi, E. H., & Suh, B. (2008, April). Crowdsourcing user studies with Mechanical Turk. In Proceedings of the SIGCHI conference on human factors in computing systems (pp. 453-456). ACM.

Kittur, A., Smus, B., Khamkar, S., & Kraut, R. E. (2011, October). Crowdforge: Crowdsourcing complex work. In Proceedings of the 24th annual ACM symposium on User interface software and technology (pp. 43-52). ACM.

Kohavi, R., Crook, T., Longbotham, R., Frasca, B., Henne, R., Ferres, J. L., & Melamed, T. (2009). Online experimentation at Microsoft. Data Mining Case Studies, 11.

Krueger, N. F., Reilly, M. D., & Carsrud, A. L. (2000). Competing models of entrepreneurial intentions. Journal of business venturing, 15(5), 411-432.

Lakhani, K. R., Jeppesen, L. B., Lohse, P. A., & Panetta, J. A. (2007). The value of openess in scientific problem solving (pp. 07-50). Division of Research, Harvard Business School.

Lea, B. R., Yu, W. B., Maguluru, N., & Nichols, M. (2006). Enhancing business networks using social network based virtual communities. Industrial Management & Data Systems, 106(1), 121-138.

Littunen, H. (2000). Entrepreneurship and the characteristics of the entrepreneurial personality. International Journal of Entrepreneurial Behavior & Research, 6(6), 295-310.

Lofi, C., Selke, J., & Balke, W. T. (2012). Information extraction meets crowdsourcing: a promising couple. Datenbank-Spektrum, 12(2), 109-120.

Manchanda, K., & Muralidharan, P. (2014, January). Crowdfunding: a new paradigm in start-up financing. In Global Conference on Business and Finance Proceedings (Vol. 9, No. 1, pp. 369-374).

Marjanovic, S., Fry, C., & Chataway, J. (2012). Crowdsourcing based business models: In search of evidence for innovation 2.0. Science and Public Policy, 39(3), 318-332.

McGill, M. E., Slocum, J. W., & Lei, D. (1992). Management practices in learning organizations. Organizational dynamics, 21(1), 5-17.

Minniti, M., & Bygrave, W. (2001). A dynamic model of entrepreneurial learning. Entrepreneurship: Theory and practice, 25(3), 5-5.

Moore, J. F. (1993). Predators and prey: a new ecology of competition. Harvard business review, 71(3), 75-83.

Nicolaou, N., & Shane, S. (2010). Entrepreneurship and occupational choice: Genetic and environmental influences. Journal of Economic Behavior & Organization, 76(1), 3-14.

Nucciarelli, A. (2014). Crowdstorm: the future of innovation, ideas, and problem solving. Taylor and Francis.

Okolloh, O. (2009). Ushahidi, or 'testimony': Web 2.0 tools for crowdsourcing crisis information. Participatory learning and action, 59(1), 65-70.

Organisciak, P. (2008). Motivation of Crowds: The Incentives That Make Crowdsourcing Work «Crowdstorming.

Ozgen, E., & Baron, R. A. (2007). Social sources of information in opportunity recognition: Effects of mentors, industry networks, and professional forums. Journal of business venturing, 22(2), 174-192.

Page, S. E. (2008). The difference: How the power of diversity creates better groups, firms, schools, and societies. Princeton University Press.

Prill, R. J., Saez-Rodriguez, J., Alexopoulos, L. G., Sorger, P. K., & Stolovitzky, G. (2011). Crowdsourcing network inference: the DREAM predictive signaling network challenge. Science signaling, 4(189), mr7.

Ray, D. M. (1993). Understanding the entrepreneur: entrepreneurial attributes, experience and skills. Entrepreneurship & Regional Development, 5(4), 345-358.

Retelny, D., Robaszkiewicz, S., To, A., Lasecki, W. S., Patel, J., Rahmati, N., & Bernstein, M. S. (2014, October). Expert crowdsourcing with flash teams. In Proceedings of the 27th annual ACM symposium on User interface software and technology (pp. 75-85). ACM.

Salim, A. R. (2005). Modelling entrepreneurship in small-scale enterprises. Applied Economics Letters, 12(1), 51-57.

Schenk, E., & Guittard, C. (2011). Towards a characterization of crowdsourcing practices. Journal of Innovation Economics & Management, (1), 93-107.

Schwartz, R. G., Teach, R. D., & Birch, N. J. (2005). A longitudinal study of entrepreneurial firms opportunity recognition and product development management strategies: implications by firm type. International Journal of Entrepreneurial Behavior & Research, 11(4), 315-329.

Shane, S. A. (2003). A general theory of entrepreneurship: The individual-opportunity nexus. Edward Elgar Publishing.

Smith, D., Manesh, M. M. G., & Alshaikh, A. (2013). How can entrepreneurs motivate crowdsourcing participants?. Technology Innovation Management Review, 3(2).

Staffelbach, M., Sempolinski, P., Kijewski-Correa, T., Thain, D., Wei, D., Kareem, A., & Madey, G. (2015). Lessons Learned from Crowdsourcing Complex Engineering Tasks. PloS one, 10(9), e0134978.

Stevenson, H. H. (1983). A perspective on entrepreneurship. Harvard Business School Background Note. 384-131.

Szopa, A., & Kopeć, K. D. (2016). Strategic Crowdsourcing as an Emerging Form of Global Entrepreneurship. Handbook of Research on Entrepreneurship in the Contemporary Knowledge-Based Global Economy, 244-259.

Tran-Thanh, L., Stein, S., Rogers, A., & Jennings, N. R. (2014). Efficient crowdsourcing of unknown experts using bounded multi-armed bandits. Artificial Intelligence, 214, 89-111.

Von Hippel, E. (1998). Economics of product development by users: The impact of "sticky" local information. Management science, 44(5), 629-644.

Waldner, F., & Poetz, M. K. (2015). Crowdsourcing Business Model Innovation. In The DRUID Society Conference 2015.

Woolley, A. W., Chabris, C. F., Pentland, A., Hashmi, N., & Malone, T. W. (2010). Evidence for a collective intelligence factor in the performance of human groups. Science, 330(6004), 686-688.

PART II

Crowdsourcing and Performance of Online Syndicates

Abstract

This paper discusses whether crowdsourcing helps investors to take better decisions by investing in startups that have a better performance. In essence, this research assesses whether crowdsourcing enables to invest in companies that perform better than those backed by traditional investors. This is achieved by assessing syndicate investments on AngelList, a leading crowdsourcing platform, in comparison with investments done through traditional investment methods. The research attempts to understand the ability of crowd-investors to identify and invest in better performing companies. In order to test whether companies that raised funding through syndicates perform better than those who raised investments from traditional investors, chronological investment paths of the companies listed on AngelList on 2014 are studied and their performance in 2016 is analyzed. It is observed that, through syndicates, crowd-investors are better at discovering and accessing new opportunities than traditional investors. Given the ability to discover and access investment opportunities earlier than traditional investors, syndicates are able to make greater returns on investments.

Introduction

In their 2013 paper entitled, "Some Simple Economics of Crowdfunding", Agrawal, Catalini & Goldfarb (2014) define crowdfunding as the opportunity for "raising capital from many people through an online platform". The practice of crowdfunding, made possible by advancements in technology over the past two decades (Howe, 2006) has provided entrepreneurs with new options for finding investors, and given investors the information necessary to invest in companies they otherwise might not (Zhao & Zhu, 2014).

Angel investing, in particular, offers investors a new method for finding new opportunities

(Wiltbank et al., 2009,). Common online crowdfunding platforms Kickstarter and Indiegogo, allow a crowd of investors to raise funds for companies. In these cases, the investors are rewarded with private gains such as early access to products, subsidized products etc (Brown & Davies, 2016). Though similar in concept, "equity crowdfunding" enables the entrepreneur to raise capital online through accredited investors (the "crowd"), and offers investors a wide range of business opportunities (Hornuf, & Schwienbacher, 2014). Equity crowdfunding is characterized by the fact that it provides investors with the chance to receive equity for the capital that they raised (Ahlers et al., 2015).

This method of investment has been beneficial for many of its practitioners. Entrepreneurs, of course, can easily become visible to investors that they may not have had access to in the past. It is inherently difficult for entrepreneurs to attract outside capital in the initial phase of company development. Crowdfunding has been a boon to such entrepreneurs (Schwienbacher& Larralde, 2010). Traditionally, investors have been wary about early-stage business enterprises and startup opportunities due to the risk involved and the lack of information available concerning the business (Zhao, Zhang, & Wang, 2015). Because investors were not given access to sufficient information about the venture, they are often unable to correctly evaluate the performance and value of the venture, making them less likely to invest. While crowdfunding has given entrepreneurs a wider audience of investors to advertise to, the problem of information asymmetry still exists (Belleflamme, Lambert, & Schwienbacher, 2014).

In traditional financing, venture capitalists have a number of common business practices at their disposal to assess the growth of their investment (Kuratko, 2016). Venture capital firms utilize monitoring, due diligence and stage-financing in order to track the success of their investments. By visiting businesses and receiving financial reports, the venture capitalist has the ability to closely evaluate the performance of their investment (Rajan, 2010). The effect of venture capitalists on investments have been well documented (Bernstein, Giroud, & Townsend, 2015).

In response, crowdfunding platforms have developed syndicates, similar to those used by venture capital firms, to allow an investor to pursue due diligence when tracking their business ventures (Coppey, 2016). Crowdfunding syndicates allow lead investors or investors with expertise to leverage their knowledge by raising further capital from the crowd. The crowd, though less experienced and less connected is likely to back the experienced investor (Kim & Viswanathan,

2014).

While some existing literature investigates the potential of crowdfunding syndicates in fostering cross-border investments through the internet, there seems to be a gap in research regarding the ability of syndicate investors and their backers (the crowd) to identify and invest in the best performing companies.

The **Investment Space as Complex Problem Setting**

The idea of information asymmetry stems from the work of economist and Nobel Prize recipient George Akerlof (Rosser Jr., 2003). In his research, focused on the used car market, Akerlof (1970) outlined the importance of information in financial transactions. The author uses an example from car retail industry to illustrate information asymmetry. The presence of bad cars in the retail market forces sellers to reduce the cost for cars in good condition (Agrawal, Catalini, and Goldfarb, 2016). The information regarding these cars is unevenly distributed between the seller and buyer. Therefore, prices of cars must be lowered in order to find people willing to buy them. This uneven distribution of information is considered to be information asymmetry. This asymmetrical relationship to information raises the risk-profile of any investment and therefore, reduces the incentive to participate (Healy & Palepu, 2001). The same relationship can be seen in entrepreneurial investments, as well. When investors do not have sufficient information about the venture, they probably won't be able to assess its value and are less likely to invest, particularly in early-stage ventures (Mason & Stark, 2004).

Agrawal, Catalini, and Goldfarb (2016) point out that, while syndicates offer entrepreneurs and investors many benefits in terms of expanded audience and flexibility, crowdfunding's relationship to information asymmetry can often be detrimental to the entrepreneurial process. On one hand, as illustrated above, a lack of information available to the investor often prevents them from taking part. At the same time, it is possible that early stage startups with potential may be classified as unviable by a syndicate due to lack of information, thus denying them the necessary financial support from investors and venture capitalists. In this case, information asymmetry skewed toward the investor can hinder investment flow and cause market failure. A strong crowdfunded project requires two parties to work in a mutually-beneficial manner.

Given this, our research questions are:

RQ 1: Are crowd-investors better in identifying (and investing in) opportunities that have a superior performance than traditional investors?

RQ 2: How do syndicate based investment processes influence performance of companies?

Crowdsourced Solutions to Complex Problem Settings

Syndicate structure and its incentive system appears to be an important development in the field of equity crowdfunding. The CEO of SyndicateRoom indicated that the syndicate system was able to raise more capital than non-syndicate formats in the UK, while AngelList has shown that syndicated deals have surpassed non-syndicated deals in the US (Agrawal, Catalini, and Goldfarb, 2016). Nearly 30% of venture capital investments in Europe were through syndicates as early as 2001 (Wright & Lockett, 2002).

Equity crowdfunding syndicates operate as a market with two sides, investors and entrepreneurs (Belleflamme, Lambert, & Schwienbacher, 2014). For instance, on AngelList, individual angel investors have an online syndicate profile with information about their investments. This information is used by potential backers to view potential investments (Ewing Marion Kauffman Foundation, 2016). These potential backers, upon deciding to join, pay the lead investor a carry of 5-20% per deal and a 5% membership fee to AngelList (Wan, 2016). In such a scenario, the minimum investment required to participate in equity investing is considerably smaller than that of traditional venture capital funds. Additionally, investors are allowed to choose their investments, giving them better control over the investment process. The structure of the syndicate was designed to address the challenge of information asymmetry and perform better than an average crowd (Deschler, 2013). Syndicates operate in a market system that employs divisions of labor. The lead investors perform due diligence and monitor the performance of the venture, rewarding entrepreneurs financially when performance is high and penalizing them when performance is low. As a result, entrepreneurs have the incentive to ensure high-quality performance results (Chen, Huang & Liu, 2016).

Equity crowdfunding syndicates operate as a market with two sides: investors and entrepreneurs. For instance, in AngelList, individual angel investors have an online syndicate

profiles with their information on investment. This information is especially helpful for backers. Backers refer to the accredited investors that intend to join and invest in the lead investor's syndicated deal, and pay the lead investor a carry. The carry tends to be 5-20% per deal, and a 5% to AngelList. Unlike venture capital funds, backers are allowed to choose the portfolio companies and backers are able to end their investment any time. Also, venture capital funds require considerably higher minimum investment compared to syndicated deals (Agrawal, Catalini, & Goldfarb, 2016).

The costs associated with lack of information can be broadly classified into three categories. First is the cost associated in collecting general information about the firm before investments are made. Given that the returns on early investment are often higher, it is important to identify potential investment opportunities at the earliest. Lack of information can make it more difficult for potential investors to fund startups, often leading to higher transaction cost. In addition, due to lack of information, investors are forced to monitor their potential investments, incurring a due diligence cost. The first two costs were relieved by solutions developed in venture capital firms. These firms, coupled with online platforms, provided visibility to companies, and allowed for some amount of information to be shared in terms of business plans and product ideas. However, venture capital firms did not address the difficulties associated with maintaining due diligence (Agrawal, Catalini, & Goldfarb, 2016). Syndicate crowdfunders were able to find a solution for the third problem by giving lead investors access to information and giving them incentives to leverage information of the venture. Lead investors channel their skills and experience toward the venture, simultaneously investing in their own reputation. This becomes a way to align the incentives of the lead investor and their backers with the entrepreneurs.

Existing literature presented evidence to support that syndicates reduce information asymmetry. Both syndicated and non-syndicated deals on AngelList allow users to geographically track the flow of capital through their system. As geographic proximity has been linked to information asymmetry (Hortacsu et al., 2009; Seasholes, & Zhu, 2010), this bias has been shown to exist in traditional venture capital firms (Cumming & Dai, 2010). It appears that a reduction in information asymmetry leads to companies gaining more geographically distant backers in syndicated deals compared to non-syndicated deals (Agrawal, Catalini, & Goldfarb, 2016). This reflects that the backers in syndicates rely on the lead investor to meet with the venture team and

monitor their performance. This finding is true in both cases; investors located outside of Silicon Valley and investing in a Silicon Valley venture and vice versa. Findings show that non-syndicate investors located in Silicon Valley account 43% of the capital raised toward ventures outside of Silicon Valley. This figure is greater for syndicate investors located in Silicon Valley, who account for 78% of the capital raised toward ventures outside of Silicon Valley (Agrawal, Catalini, & Goldfarb, 2016).

Existing research about crowdsourced syndicates importance of reduced information asymmetry in lowering the obstacles of distant investments and expanding the number of investors, leading to further market efficiency.

Syndicated Crowdfunding

Angel investment syndication had huge success in its first year of launching. Syndicated deals exceeded the number of non-syndicated deals (Agrawal, Catalini, & Goldfarb, 2016), representing 70% happening on this platform. It is reported that over $160M were invested through online syndicates in 2015 alone, which is a 53% growth when compared to 2014 (Coppey, 2016). There are obvious similarities between venture capital firms and online syndicates but, as mentioned earlier, there are advantages to the lower cost of online searching and transactions. While there is an existing argument that online syndication has already become a serious competitor to venture firms, changes in the structure of angel investment will guarantee this.

In the past, there were the constraints of a 99 investor limit and an average of $50,000 per investor per deal (Stebbings 2016), but Institutional investors are no longer required to have this. As the online syndicate market expands, these are offering competition to traditional "seed" and highly regarded 'Series A' venture capital firms that invest significant amounts in each startup. A leading online syndicate named Flight.vc has investments ranging from $1K to over $250K, per syndicate, with an average of $6.8k (Kerner, 2015). The investment of institutional capital into syndicates is challenging the concept of the 99 investor limit and extending the reach further into venture capital turf (Rusli, 2015). As described by Gil Penchina, a leading syndicate investor: "*What we are doing is just pushing venture capital further into later-stage rounds, into the larger check*

zone," (Stebbings, 2016; Coppey 2016). There are significant differences between venture capital firms and online syndicates at the early stages of rising capital. Venture capital firms largely rely on institutional investors compared to online syndicates reliance on crowdsourcing.

Recent changes will have a lasting effect on the way online syndicates are funded, leading to increased investment potential. The passing of Title III of the JOBS Act, for example, allows companies to raise investments of up to $1M from non-accredited investors (Schneider & Legland, 2016). These investors will be able to invest from $2k to $100k if they invest less than 5% of their income (if it is less than $100k), and 10% otherwise (Barnett, 2013). Angel markets, the first source of capital for companies in their early stages, would greatly benefit from this. By backing online syndicates, angels would see lower discovery and due diligence costs, benefiting from the lead investor's investment choices (Agrawal, Catalini, & Goldfarb, 2016). By investing limited capital in companies outside their geography or domain of expertise, it would be possible for them to reach a higher level of diversification (Sorenson & Stuart, 2008). Syndicate investments act as a mechanism to minimise the risk involved in this diversification by reducing the overall information asymmetry. Dustin Dolginow, manager of Maiden Lane, predicted that institutional capital and individuals will likely bring equal amounts of funds to syndicates in the near future (Venture Studio, 2016; Coppey 2016).

There are clear strengths to online syndicates. The risk of investment is shared among investors, and the opportunity to invest in a large number of diverse companies is available (Manigart et al., 2006). These platforms allow easy and speedy investments while outsourcing the hassles associated with administrative and legal management. Gil Penchina claims that he had never become a venture capitalist before launching his syndicate because he did not like "*lawyers, accountants, and Limited Partners*" (Stebbings, 2016; Coppey 2016). It is also much faster to raise funds online and through the crowd than it is to institute LPs. In some cases, it could only take half or a third of the time to raise funds online.

These syndicates however, are not without limitations. Online syndicates are not necessarily the ideal platform for all investors, especially accredited investors who are usually more comfortable with investing in companies that develop more accessible, consumer-facing products. Another potential drawback is the design of online syndicates, which does not provide any compensation to lead investors in the form of management fees (Pearce & Barnes, 2006). Additionally, it is not

always the case that angle investors are willing to invest a lot of their time ,especially on small investments.

The reputation of a venture capital firm is of paramound importance. The reputation and brand image of a firm can help startups attract funds. In addition, It helps in the recruitment and security of funds and IPO underwriters (Hsu, 2004), which encourages startup companies to sell shares at a lower price in exchange for reputable backers.
Online syndicates, often have to accommodate a large number of inexperienced backers, and often lack a successful track record. Although this might hinder their performance, emerging funds have solved this problem by leveraging their renewed value propositions in relation to established venture capital firms.

Some authors have offered practical advice to investors working in crowdsourcing for the first time (Sloane, 2011). While migrating to a syndicate investing platform, lead investors could continue using the same investment terms as when they were angel investing. Angels notably ask for less control rights than traditional venture capital firms (Ibrahim, 2008; Goldfarb et al., 2013). Furthermore, online syndicates do not need to abide by their Limited Partners (LPs) rules requiring that a minimum percentage of ownership be held in each of their portfolio companies. There is also increased flexibility in the negotiation downside protections. This flexibility can become another competitive edge. Online syndicates enjoy access to a very large network of accredited investors in addition to institutional money. This has facilitated access to individuals who share incentives to help these companies grow (Agrawal, Catalini, & Goldfarb, 2016).

Investment Paths

Before studying in detail the investment paths that a company can pursue, it is worth studying more in detail how investment processes work. By looking at existing research, It can be seen that syndicate investment firms are able to overcome the bias normally associated with angel investors. Over 86% of capital was invested by people located outside of the entrepreneur's home city. The average distance between entrepreneurs and investors was roughly 3,000 miles (Agrawal, Catalini, & Goldfarb, 2011). It is apparent in looking through the investment data that funding is weighted. 61% of all entrepreneurs using the same platform did not raise any funds while 0.7% of them raised about 73% of all capital moved on the site between 2006 and 2009. (Agrawal, Catalini, & Goldfarb, 2011). Inexperienced investors are often drawn to projects funded by experienced angel investors, leading to some degree of herding among backers. Projects are in danger of becoming overcrowded, particularly toward the end of their fundraising processes (Zhang and Liu, 2012). It is also seen that on one platform, investors were twice as likely to join projects which had reached 80% of its funding goal as opposed to those that had only been funded 20% of its goal (Agrawal, Catalini & Goldfarb, 2014). Other times, projects gain fewer new investors as they reach the midpoint of their goal. It is suggested that this is the result of a *bystander effect* perpetuated by investors who think that the target will be reached regardless of their involvement (Kuppusway & Bayus, 2015).

In order to perform our empirical analysis, we studied the possible investment paths that a company listed on AngelLit can pursue.

There are 8 main paths that a company fundraising on AngelList may pursue: *Path 1* represents a path in which capital raised purely through traditional forms of investments. *Path 2* represents capital raised mainly by traditional investors and in a later phase through crowdfunding. In *Path 3*, companies raise a minimal amount of investments from traditional investors and then two more rounds through the crowd. *Path 4* represents companies that raised funds exclusively through one or more crowdfunding campaigns. *Path 5* represents companies that raised a minimal amount of funds through crowdfunding and large amounts through traditional investment. *Path 6* is characterized by capital raised mainly through crowdfunding and to a minimal extent through traditional forms of investment. In *Path 7*, a company raises first capital from a traditional investor, then from the crowd and from a traditional investor. *Path 8* represents cases in which a

company raises an investment first from the crowd, then from a traditional investor and then from the crowd again. Table 1 provides a summary of the paths discussed.

Path 1	Traditional investment	Traditional investment	Traditional investment
Path 2	Traditional investment	Traditional investment	Crowdfunding
Path 3	Traditional investment	Crowdfunding	Crowdfunding
Path 4	Crowdfunding	Crowdfunding	Crowdfunding
Path 5	Crowdfunding	Traditional investment	Traditional investment
Path 6	Crowdfunding	Crowdfunding	Traditional investment
Path 7	Traditional investment	Crowdfunding	Traditional investment
Path 8	Crowdfunding	Traditional investment	Crowdfunding

Table 1: Paths involved in fundraising on AngelList

Source: Author's elaboration

By looking at the investment paths that an early stage venture can follow during its first years of activity, it may be possible to determine the impact of crowdsourcing on the performance quality of the new venture. We used for our study data extracted from AngelList and Mattermark. The AngelList database included complete data about 26,000 people and 2,370 companies who subscribed to the platform on 2014 or earlier. Mattermark´s data, which was extracted in 2016 includes information about performance of companies. The main variables we used to measure performance are Mattermark´s growthscore and mindshare score, two algorithms measuring developed by Mattermark Inc. measuring performance. The codebook with the detailed description of the extracted variables is visible in the appendix of the paper. In order to measure the effects of crowd diversity on performance we run three regressions.

Methodology

For the first analysis, about the effect of crowd sourcing on companies' investment performance, we used the kernel density (Figure 1) in order to show visually the distribution of companies' performances according to the type of investment. This type of graph helps to have an initial idea of the nature of the relationship between the type of investment and companies' performance. We also used the t-test (Table 1) in order to compare the mean of companies' characteristics. The t-test is appropriated to compare the mean of a continuous variable (as the growth score, the mindshare score or the employee growth) between two groups (here the group of companies raising funds through the crowd and the ones raising funds through traditional investors).

The descriptive statistics give us an idea about the likely relationship between investment type as well as investment path and companies performances. But this was just a correlation, which does not necessary imply causation. In order to analyze the causal effect of investment type and investment path on companies' performances, we perform an OLS regression. The OLS regression is adapted because the dependent variables (growth score, mindshare score and employee growth) are all continuous. Growth score and mindshare score are then normalized between 0 and 100 using the min-max approach.

Findings

Crowd Sourcing and Investment Performance: Empirical Evidence

The aim of this section is to empirically assess the effect of crowdsourcing on companies' investment performance. Crowdsourcing is measured in two ways. First, it is measured using a binary variable taking the value 0 for "Angel raised through crowd" (company that raised funding through AngelList) and 1 for "Angel companies" (company listed on AngelList that raised funding through traditional investors). It is also measured using a categorical variable taking eight values describing each the company's investment path, as shown in Figure 1.

As far as investment performance is concerned, it is measured using three indicators: the growth score, the mindshare score as well as the growth rate of the company's number of employees. In order to have a preliminary idea of the likely relationship between crowdsourcing and investment performance, we first of all present some descriptive statistics.

Descriptive statistics

On the matter of descriptive statistics, we describe companies' performance according to the types of investment. We first of all present the kernel density estimates of the growth score and the mindshare score (Figure 1) for the two types of companies ("angel raised through crowd" and "angel companies").

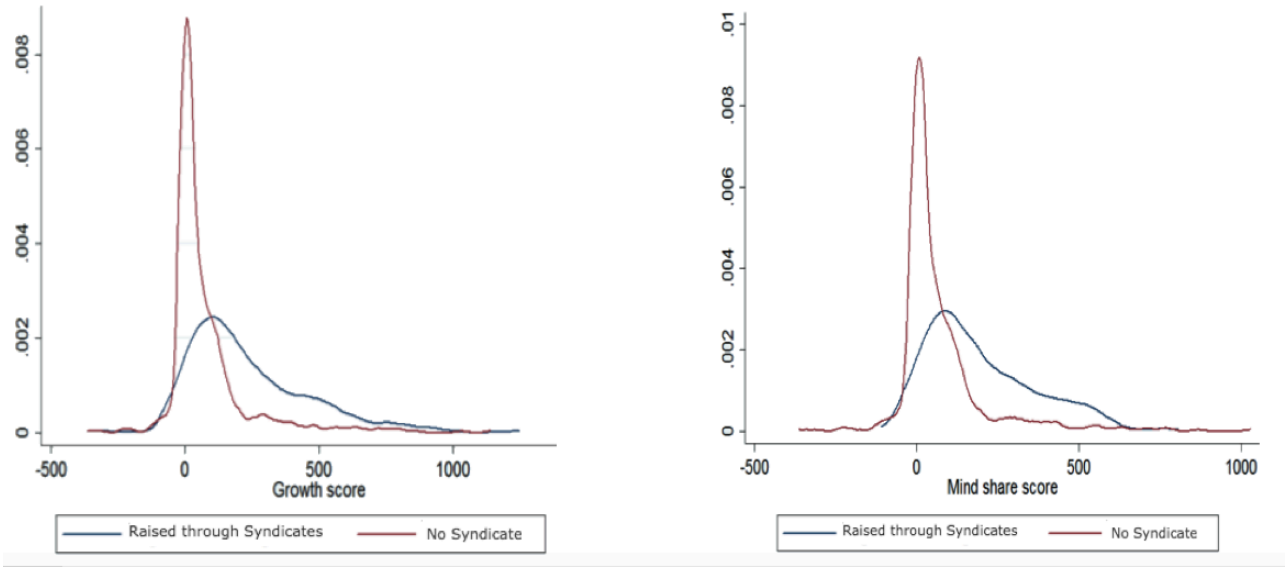


Figure 2: Kernel density estimates of growth score and mindshare score

Source: Author's computation based on surveyed data

The kernel densities clearly show that growth scores and mindshare scores are in general higher for companies raising funds through the crowd. Indeed, the density plots for

companies raising funds through the crowd tend to lie to the right of that of angel companies.

Evidence observed in Figure 1 is confirmed by Table 2 which reports a mean comparison of the performance of companies raising funds through crowd and angel companies. The first ones have higher growth score as well as mindshare score, and the difference is significant at the 1% level of significance. Moreover, employee growth rate is higher for the companies raising money through crowd, but the difference is not significant.

	Total sample (915)	**Raised through crowd company (204)**	**Angel Company (711)**	**Difference significance p-value**
Growth score	112.97 (6.12)	238.14 (15.80)	77.05 (5.79)	0.0000***
Mindshare score	127.36 (11.42)	196.49 (11.71)	69.12 (5.12)	0.0000***
Number of employees growth	3.93 (0.63)	4.37 (0.59)	3.70 (0.91)	0.6147

Table 2: Description of companies' performances according to the investment type

Source: Author's calculations based on surveyed data.

Note: Average is reported, with standard deviation in brackets.

The test for difference significance refers to the bilateral t-test of mean comparison. Significance levels: * $p<0.1$; ** $p<0.05$; *** $p<0.01$.

We also describe the performance of companies according to the investment path (Table 3). As shown in the table, the companies registering the better performances are those in *Path 2*, meaning that transiting from traditional investment to syndicate investors might improve companies' performance. Moreover, companies in *Path 6* are those registering the lower performances, suggesting that transiting from syndicate investors to traditional investment might have a negative effect on companies' performances.

	Path_1	Path_2	Path_3	Path_4	Path_5	Path_6	Path_7	Path_8
Growth score	297.30 (35.26)	394.64 (98.46)	272.86 (29.21)	222.84 (25.58)	345.73 (57.39)	208.42 (36.11)	319.30 (41.15)	272.98 (32.30)
Mindshare score	232.18 (24.20)	295.57 (21.65)	218.46 (20.40)	180.66 (18.26)	265.96 (36.87)	204.59 (23.82)	250.46 (27.33)	217.35 (22.47)
Employee growth	5.94 (143)	10.76 (4.39)	6.76 (1.67)	3.98 (0.78)	7.30 (2.39)	5.83 (1.56)	6.91 (1.59)	5.77 (1.33)

Table 3: Description of companies' performances according to the investment path

Note: Average is reported, with standard deviation in brackets.

Source: Author´s calculations based on surveyed data.

To sum up, from the descriptive analysis, there seems to exist a relationship between investment type as well as investment path and companies' performances. Growth scores and mindshare scores are in general higher for companies raising funds through the crowd. We did not find a correlation between investment type and employee growth. Moreover, as far as the investment path is concerned, transiting from traditional investment to syndicate investors is likely to improve companies' performance, while transiting from syndicate investors to traditional investment might negatively affect companies' performance.

Regression analysis

The descriptive statistics give us an idea about the likely relationship between investment type as well as investment path and companies performances. But this was just a correlation, which does not necessary imply causation. In order to analyze the causal effect of investment type and investment path on companies' performances, we perform an OLS regression. Three models are estimated, for each of our dependent variables (growth score, mindshare score and employee growth). Growth score and mindshare score are normalized between 0 and 100 using the min-max approach:

$$X_{normalized} = \frac{X - \min(X)}{\max(X) - \min(X)} * 100$$

The scores are normalized in order to reduce their scale, as they register higher values. The variables related to amounts of money are also converted in million USD, in order to reduce their scale, so that all variables in the models have comparable scales.

The results of the regressions are displayed in Table 4. The p-value of the Fisher test for models significance is less than 1%, meaning that all the three models are globally significant, and that the explanatory variables included explain variations of the companies' performances. In Equation 1, the dependent variable is the growth score. From the regression results, the variable related to the investment type is significant at the 1% level of significance. Being an *angel company* (company that raised capital from a traditional investor) decreases the growth score by 4.33 relatively to a company raising money through crowd. Regarding the investment path, three modalities are significant, namely path_2 (traditional-traditional-syndicate), path_5 (syndicate-traditional-traditional) and path_6 (syndicate-syndicate-traditional). It is worth mentioning that the modality path_1 (traditional-traditional-traditional) is used as the reference path. Path_2 is significant at the 1% level of significance, and has a positive coefficient: for a company, being in path_2 increases its growth score by 12.92 relatively to a company in path_1. Moreover, path_5 and path_6 are respectively significant at the 10% and 1% level of significance, and with negative coefficients. For a company, being in path_5 and path_6 decreases its growth score by 5.91 and 11.90 respectively, as compared to a company in path_1.

These results confirm the evidence observed in the descriptive analysis: transiting from traditional to syndicate investors has a positive effect on the growth score, while the effect of transiting from syndicate investors to traditional investment is negative.

Three of the control variables are significant all with positive coefficients: the number of employees (which is a proxy of company size), the total amount raised, and the market (companies for which the market is Saas perform better than the other companies).

Focusing on the second equation where the dependent variable is the mindshare score, we observe that the investment type is significant at the 1% level of significance with a negative coefficient: being an angel company decreases the mindshare score by 5.03 relatively to a company raising money through crowd. Regarding the investment path, two modalities are significant, notably path_2 (traditional-traditional-syndicate) and path_6 (syndicate-syndicate-traditional), all at the 1% level of significance. For a company, being in path_2 increases its mindshare score by 12.60 as compared to a company in path_1, while being in path_6 decreases the mindshare score by 13.59 relatively to a company in path_1. These results also confirm the evidence observed in the descriptive analysis: transiting from traditional to syndicate investors has a positive effect on the growth score, while the effect of transiting from syndicate investors to traditional investment is negative. Regarding the control variables, two of them are significant: the number of employees and the market, all with positive signs.

Finally, let us consider equation 3, where the dependent variable is the employee growth. In this regression, the main explanatory variables are not significant, and the only significant variable is the number of employees.

Variables	(1) Growth score	(2) Mindshare score	(3) Employees growth
Investment type: Angel comp	-4.33***	-5.03***	0.70
(Ref : Raised through Crowd)	(1.499)	(1.578)	(0.584)
path_2	12.92***	12.60***	3.22
	(3.358)	(3.024)	(2.017)
path_3	-0.40	0.88	3.85
	(3.752)	(3.769)	(2.361)
path_4	-2.44	-2.69	-0.94
	(2.682)	(2.455)	(1.015)
path_5	-5.95*	4.60	1.11
	(3.569)	(2.976)	(2.607)
path_6	-11.90***	-13.59***	-2.70
	(4.257)	(4.064)	(2.112)
path_7	-3.91	-1.97	-1.39
	(2.873)	(2.510)	(3.177)
path_8	-0.26	1.01	-2.70
	(4.552)	(4.620)	(2.502)
Number of employees	0.07***	0.04***	0.14***
	(0.008)	(0.009)	(0.043)
Total amount raised	0.32**	0.15	-0.20
	(0.126)	(0.092)	(0.191)
Location=New York City	0.66	0.41	-1.02
(Ref: Otherwise)	(1.436)	(1.573)	(0.821)
Market =Saas	3.09*	3.34*	1.87
(Ref : Otherwise)	(1.775)	(1.973)	(1.170)
Money provided by a backer	1.71	0.85	-0.70
(Ref: not provided by a backe	(1.918)	(1.858)	(1.181)
Syndicate investor	2.74	2.16	0.56
(Ref: Not a syndicate investor	(1.903)	(1.796)	(0.881)
Constant	30.97***	35.87***	-0.89
	(1.460)	(1.537)	(0.981)
Observations	578	579	556
Fisher Stat for model significa	16.19	11.62	7.53
Prob>F	0.000	0.0000	0.0000
R-squared	0.42	0.27	0.71
Adj. R-squared	0.40	0.25	0.70

Robust standard errors in parentheses
Significance levels: * p<0.1; ** p<0.05; *** p<0.01

Table 4: Estimates of the effect of investment type and investment path on companies' performances

Source: Author's calculations based on surveyed data

Discussion & Conclusions

The goal of this study was to understand whether crowd-investor are better able to identify opportunities with a superior performance than traditional investors. After reviewing existing research about syndicate investors and their mechanisms we developed eight possible investment paths that an early-stage company can pursue. We used AngelList´s data in order to study how these different investments combining crowdsourced investments with traditional investments impact company´s performance in the medium/long-term. Through our empirical analysis we could observe that transiting from traditional to syndicate investors has a positive effect on company´s growth, while the effect of transiting from syndicate investors to traditional investment is negative. Our study suggests that crowd-investors may be able to invest in early-stage companies that have a better performance in the medium/long-term. Furthermore, our empirical analysis has shown that companies transiting from a traditional investor to a crowdfunded investment (*Path 2*) have a better performance .

The adopted model was chosen due to the fact that some missing values within the AngelList database did not allow us to track the exact data for all syndicate investors. For traditional investors these problems did not subsist and it was possible to observe the exact day in which the investment took place. Another solution we tried to adopt to solve these limitations was to assign a threshold to investments in order to define whether the investment was prevailingly from a syndicate or traditional investor (<40% syndicate investor = traditional investment, >40%, <60% = mixed, >60% syndicate investor). We tried to build a model using this method but due to the fact that the dates on AngelList were not always exact and trustworthy, we decided to use an alternative one. Despite being very complete, the AngelList database had further limitations due to missing variables. This problem could be fixed in future by integrating within the AngelList database data from Crunchbase (www.crunchbase.com), an intelligence platform where data is more curated (on AngelList only data voluntarily integrated by users is visible, on Crunchbase data can be inserted also by third parties).

References

Agrawal, A. K., Catalini, C., & Goldfarb, A. (2011). *The geography of crowdfunding* (No. w16820). National bureau of economic research.

Agrawal, A., Catalini, C., & Goldfarb, A. (2014). Some simple economics of crowdfunding. *Innovation Policy and the Economy*, *14*(1), 63-97.

Agrawal, A., Catalini, C., & Goldfarb, A. (2016). Are syndicates the killer app of equity crowdfunding?. *California management review*, *58*(2), 111-124.

Ahlers, G. K., Cumming, D., Günther, C., & Schweizer, D. (2015). Signaling in equity crowdfunding. *Entrepreneurship Theory and Practice*, *39*(4), 955-980.

Akerlof, G. A. (1970). The market for" lemons": Quality uncertainty and the market mechanism. *The quarterly journal of economics*, 488-500.

Barnett, C. (2013). JOBS act title III: Investment being democratized, moving online. *Forbes. Online. Available at.* <forbes.com/sites/chancebarnett/2013/10/23/sec-jobs-act-title-iii-investment-being-democratized-moving-online/#1cf5378b33a3>

Belleflamme, P., Lambert, T., & Schwienbacher, A. (2014). Crowdfunding: Tapping the right crowd. *Journal of business venturing*, *29*(5), 585-609.

Brown, D. C., & Davies, S. W. (2016). Equity Crowdfunding: Harnessing the Wisdom of the Crowd.

Chen, L., Huang, Z., & Liu, D. (2016). Pure and hybrid crowds in crowdfunding markets. *Financial Innovation*, *2*(1), 19.

Coppey, L. (2016). *From value-added VCs to equity crowdfunding syndicates: the new platforms of the venture capital industry* (Doctoral dissertation, Massachusetts Institute of Technology).

Cumming, D., & Dai, N. (2010). Local bias in venture capital investments. *Journal of Empirical Finance*, *17*(3), 362-380.

Deschler GD (2013) Wisdom of the intermediary crowd: what the proposed rules mean for ambitious crowdfunding intermediaries. Saint Louis Univ Law J 58:1145–1187

Ewing Marion Kauffman Foundation, Changing Capital: Emerging Trends in Entrepreneurial Finance (October 24, 2016). Available at SSRN: https://ssrn.com/abstract=2859883

Feld, B. (2016). Ending Our FG Angels Experiment-Feld Thoughts. *Retrieved February*, *16*, 2016.

Goldfarb, B. D., Hoberg, G., Kirsch, D., & Triantis, A. J. (2013). Are angels different? An analysis of early venture financing. Robert H. Smith School Research Paper No. RHS 06-072. Available at SSRN: https://ssrn.com/abstract=1024186 or http://dx.doi.org/10.2139/ssrn.1024186

Healy, P. M., & Palepu, K. G. (2001). Information asymmetry, corporate disclosure, and the capital markets: A review of the empirical disclosure literature. *Journal of accounting and economics*, *31*(1), 405-440.

Hornuf, L., & Schwienbacher, A. (2014). Crowdinvesting–Angel Investing for the masses?. Handbook of Research on Venture Capital: Volume 3. Business Angels, Forthcoming. Available at SSRN: https://ssrn.com/abstract=2401515

Hortaçsu, A., Martínez-Jerez, F., & Douglas, J. (2009). The geography of trade in online transactions: Evidence from eBay and mercadolibre. *American Economic Journal: Microeconomics*, *1*(1), 53-74.

Howe, J. (2006). The rise of crowdsourcing. Wired magazine, 14(6), 1-4.

Hsu, D. H. (2004). What do entrepreneurs pay for venture capital affiliation?. *The Journal of Finance*, *59*(4), 1805-1844.

Ibrahim, D. M. (2008). The (not so) puzzling behavior of angel investors. *Vand. L. Rev.*, *61*, 1405.

Kerner, L. (2015). The Rise of Flight VC. Retrieved February 26, 2016, from https://medium.com/@loukerner/the-rise-of-flight-vc-cce8fe939f5c#.aggfhel0w

Kim, K., & Viswanathan, S. (2014, August). The experts in the crowd: The role of reputable investors in a crowdfunding market. In *The 41st Research Conference on Communication, Information and Internet Policy*.

Kuppuswamy, V., & Bayus, B. L. (2015). Crowdfunding creative ideas: The dynamics of project backers in Kickstarter.

Kuratko, D. F. (2016). *Entrepreneurship: Theory, process, and practice*. Cengage Learning.

Legland, M. P., & Schneider, D. T. Can Equity Crowdfunding Crowd-Out Other Alternative Sources of Finance?.

Manigart, S., Lockett, A., Meuleman, M., Wright, M., Landström, H., Bruining, H., & Hommel, U. (2006). Venture capitalists' decision to syndicate. *Entrepreneurship Theory and Practice*, *30*(2), 131-153.

Mason, C., & Stark, M. (2004). What do investors look for in a business plan? A comparison of the investment criteria of bankers, venture capitalists and business angels. *International small business journal*, *22*(3), 227-248

Pearce, R., & Barnes, S. (2006). Chapter 5, *Raising venture capital*. John Wiley & Sons.
Rajan, A. T. (2010). Venture capital and efficiency of portfolio companies. *IIMB Management Review*, *22*(4), 186-197.

Rosser Jr, J. B. (2003). A Nobel prize for asymmetric information: the economic contributions of George Akerlof, Michael Spence and Joseph Stiglitz. *Review of Political Economy*, *15*(1), 3-21.

Rusli E.M., 2015. The Venture Capital Club Gets Less Exclusive The Wallstreet Journal. Available at < wsj.com/articles/crowd-sites-let-startups-tap-small-investors-cash-1423446571 >. Accessed on 7th February, 2016.

Schwienbacher, A., & Larralde, B. (2010). Crowdfunding of small entrepreneurial ventures.

Seasholes, M. S., & Zhu, N. (2010). Individual investors and local bias. *The Journal of Finance*, *65*(5), 1987-2010.

Sloane, P. (2011). *A guide to open innovation and Crowdsourcing: Advice from Leading Experts in the Field*. Kogan Page Publishers.

Sorenson, O., & Stuart, T. E. (2008). Bringing the context back in: Settings and the search for syndicate partners in venture capital investment networks. *Administrative Science Quarterly*, *53*(2), 266-294.

Stebbings, H. (2016). 20 VC 044: Dominating AngelList Syndicates with Doug Scott. Retrieved February , 2017, from http://www.thetwentyminutevc.com/dougscott/

Venture Studio. (2016). Ep 16 - Dustin Dolginow - Maiden Lane Ventures. Retrieved March 3, 2016, from https://soundcloud.com/venture-studio/ep-16-dustin-dolginow-maiden-lane-ventures.

Wan, A. (2016). Syndication is the What, Crowdfunding is the How. Crowdfund Insider. Available at <crowdfundinsider.com/2016/08/88621-syndication-is-the-what-crowdfunding-is-the-how/ >. Accessed on 7th February, 2017.

Wiltbank, R., Read, S., Dew, N., & Sarasvathy, S. D. (2009). Prediction and control under uncertainty: Outcomes in angel investing. *Journal of Business Venturing*, *24*(2), 116-133.

Wright, M., & Lockett, A. (2002). Structure and management of syndicated venture capital investments. *The Journal of Private Equity*, *5*(4), 72-83.

Zhao, X., Zhang, W., & Wang, J. (2015, September). Risk-hedged venture capital investment recommendation. In *Proceedings of the 9th ACM Conference on Recommender Systems* (pp. 75-82). ACM.

Zhao, Y., & Zhu, Q. (2014). Evaluation on crowdsourcing research: Current status and future direction. Information Systems Frontiers, 16(3), 417-434.

PART III

Crowd Size, Diversity and Performance of Complex Decision-Making Processes

Abstract

Previous research has shown that crowds represent an important support to companies raising investments and investors searching for investment opportunities with a positive performance. Advances in telecommunication and the advent of internet based crowdfunding platforms have given rise to a number of online syndicates and individual investors who support companies through online platforms. Crowdfunding platforms raised over $34 Billion in 2016 (Chen, 2016). Despite its economic significance, there is an important gap in the academic understanding of the crowdfunding ecosystem. A thorough understanding of crowdfunding, and the behavior of investor crowds is therefore, of great importance. It has been shown that characteristics of the crowd such as size and composition can have a significant impact on crowdfunding initiatives. How do crowd size and diversity impact the ability of investors to invest in the companies that perform best remains unexplored by literature? Through this paper we aim to contribute to existing literature by doing research about the consequences of crowd size and diversity on investment performance. By studying data extracted from AngelList, the world´s leading crowdfunding platform for tech startups, we analyze how crowd size and diversity impact performance of companies up to two years after raising capital.

Introduction

In his book The Wisdom of Crowds (2005) James Surowiecki advocates for the concept that "the many are smarter than the few". This idea has been extremely influential on newer forms of human organization and is representative of a present moment in which the group is privileged over the individual. In the workplace, for example, crowds are often employed to program

software, design brands or solve complicated statistical issues. For example, Ponzanelli et al., (2013) discusses how crowd knowledge is used to address common software related issues, while Stol and Fitzgerald (2014) study the process of crowdsourcing from the perspective of both the companies employing the technique and the customers. Both these studies attest to the viability of crowdsourcing approach in software development.

Another study by Von Hippel (2005) studies user ended innovation, where the author compares the expertise of a user in identifying key product improvements. He argues that though the users may not be experts in the field, their inputs and suggestions have radically improved existing hardware and software products. A similar study by Poetz & Schreier (2012) on new product development concludes that while ideas sourced from consumers are often ranked low in terms of feasibility, they are more novel and have higher utility than those proposed by experts in the field. It concludes that under the right circumstances, crowds of customers can be a source of innovative product ideas that can greatly aid a company's progress.

Whitla (2009) studied how marketing and business related tasks such as advertising, promotion, and market research can be completed by companies through the use of crowdsourcing. This study highlights the cost and time benefit of employing a crowd over a dedicated work force, and finds that this method can offer great benefits to small, resource scarce businesses. The study also discusses the ethical aspects of utilizing crowd-based knowledge. Similarly, Ordanin et al., (2011) studies crowd-investing (or crowdfunding) through a qualitative analysis of three crowdfunded initiatives. The study tries to identify why customers turn into investors, and why a company would prefer to be crowdfunded. Similarly, many jobs that once required a single dedicated employee are now being sourced from entire groups working together to complete these tasks. Despite being an important area of research, there is still very little understanding regarding the functioning of crowds. Their structure, size and diversity are all factors that can potentially influence their performance.

The studies that have been carried out in this field often produce contradicting results. For example, it has been argued that an increase in crowd size can improve performance as more individuals are now available to contribute to the task (Cummings et al., 2013). At the same time, it is more difficult to coordinate larger crowds. This has been linked to a decrease in crowd

performance (Alnuaimi,et al., 2010). Similarly, crowd diversity has been shown to have both positive and negative effects on crowd performance (Williams & O'Reilly, 1998). There is clearly a need to study these factors in greater detail.

To gain better insights into the effects that these characteristics have on the ability of taking complex decisions with the support of the crowd, we conducted a study on the performance of syndicate investments done through AngelList. We collected data about all companies that were supported by syndicates and their backers in 2014 and studied how they performed in 2016. Not surprisingly, we found that the size, diversity and performance quality are interrelated. As Roberto & Romeo (2016) suggest, large crowd size and higher diversity can lead to higher performance quality. However, we also found that small crowds with less diversity often outperformed more diverse crowds of the same size. Throughout this paper, we'll present the argument that size may be associated with better performance in more diverse crowds but not so in less diverse crowds

Crowd Size and Diversity

Various academics have offered conflicting opinions on the relationship between crowd size and performance. One view argues that larger crowd sizes will always perform better, as a larger number of members tend to decrease the overall error (Cummings et al., 2013). Group tasks can be outsourced to more people, thus working time would be more efficient. A larger crowd can thus be linked to time saving. However, it is often argued that larger crowds are more difficult to coordinate and manage, making interaction more complex. This in turn can lead to sub standard group performance (Kittur & Kraut, 2008). The effect of crowd size on performance is therefore, a complicated one, and needs to be investigated further.

Diversity has an equally complex relationship to performance quality. While diversity provides a group with a broader skill set and wider range of knowledge, it often proves to create conflict among its participants. The group's members, after all, are individuals with differing opinions about what it means to be a part of a group. Wider diversity, like larger crowds, does not always lead higher group performance.

American sociologists Oliver and Marwell, in their research (Oliver et al., 1985; Oliver and

Maxwell, 1988; Maxwell et al., 1988) worked toward an understanding of this complicated issue. The first paper studies the concept of critical mass in a crowd, and analyses the conditions under which critical mass can lead to productive action. The second work investigates the effect of size of group on its productivity, while the third paper introduces the effects of networking within the group on the overall productivity of the crowd. Using a mathematical model to look at the correlation between size and diversity in the context of critical mass needed for public goods, they found that diverse groups can often achieve the same level of collective action than larger, homogenous groups. Building on a similar assertion, we argue that to fully understand the effects of size and diversity on performance, both characteristics must be equally considered. In other words, the effects of crowd size cannot be taken into account without an examination of the effects of diversity and vice versa. In order to do so, it is essential to understand the literature that is already available in this field.

Since the late 1980s, studies on crowd characteristics and crowd productivity have advanced to a great extent. There are a number of papers investigating the effectiveness of crowds when it comes to performing complex tasks. For example, research by Bray et al., (2008) demonstrates how the collective intelligence of a group can in fact, provide better decisions than that of an individual. In their study, Roberto & Romero (2015) developed a crowd performance algorithm which captures the majority views and the views of minorities. It was seen that diversity tends to decrease overall error in decision-making (Robert & Romero, 2015).

Another work by the same team (Robert & Romero, 2015) studies the effect of crowd size and diversity on crowd performance. This extensive study uses over four thousand articles in the wiki-project film community as data samples. These articles included the work of nearly 350,000 editors from diverse backgrounds. The workload diversity of editors were assessed by considering the multitude of edits they have carried out within Wikipedia community, and crowd size was quantified as the log of number of editors per article. Linear regression analysis was used to study the relationship between various factors and productivity. It was seen that if an increase in crowd size is accompanied by a corresponding increase in diversity, the performance of the crowd also improves. This study further cemented the argument that diversity and crowd size cannot be treated as independent factors when studying their effect on crowd performance. The study also argues that while diversity in general is beneficial to a crowd, diversity may have more negative

effects in smaller groups as diverse individuals often find it difficult to collaborate productively. This finding is in agreement with O'Reilly et al. (1989) whose study involved forming 20 working units and quantifying their work performance. It was seen that diversity in these relatively small groups resulted in low levels of social integration. This in turn led to a low performance. The study also identified that workers who are distant from the group average were more likely to leave the collective. Similar results were also obtained by Larson et al. (1996) who studied small groups of less than 6 individuals. This study also highlights the influence a group leader can have on the decision making process.

The positive influence of crowd diversity, especially in larger crowd has been illustrated by multiple researchers. Page (2007) argues that a higher degree of diversity can foster creativity, thereby improving crowd performance. An academic review of this work was carried out by Ioannides (2010). The review found that page's arguments were of merit, though there is a need for further research on this topic. A similar argument is made by Robert, (2013) while studying the impact of diverse, often virtual teams, on traditional management roles. This study also introduces the concept of shared leadership as an alternative to the traditional leadership approach as a viable and effective alternative to managing diverse teams.

It can be summarized from existing literature that both crowd size and diversity can have conflicting effects on crowd performance. For example, it can be argued that an increase in crowd size would lead to better performance as the errors in judgment will be decreased by a large number of people contributing to the decision-making. However, it can also be stated that an increase in crowd size can lead to significant management and coordination problems. There is also a higher cost penalty incurred in managing a larger crowd. This in turn can make larger crowds less desirable and less productive.

Crowd diversity is also shown to have an influence on crowd performance. Diverse crowds are shown to be less productive in small group sizes. Diverse individuals often find it difficult to collaborate effectively in small groups, leading to a less productive crowd. At the same time, various studies have shown that crowd diversity can have an adverse effect if the size of the crowd is large. As stated earlier, when diversity increases, crowds have access to a broader range of knowledge and skills. In addition, larger crowds are likely to dilute the negative effects of

diversity which often materialize when individuals of different backgrounds and beliefs are forced to work together. In larger crowds, however, individuals are more likely to work among others similar to themselves, thereby eliminating the conflict created by crowd diversity. Since the focus of the work presented is on crowdfunding, the next section presents the literature available that correlates crowd characteristics to crowdfunding initiatives and syndicate investment groups.

Given this, our research question is: *how do crowd size and diversity influence the ability of investors to take the best performing investment decisions?*

Size and Diversity in Syndicated Crowdfunding

The advancement of technology and colloquial use of the internet have influenced every aspect of business over the past two decades. Internet has led to fast and less expensive modes of transaction, providing the general public with new options for financial investment. Entrepreneurs have benefited greatly from these developments, particularly in the case of crowdfunding. Defined as the opportunity for "raising capital from many people through an online platform" (Agrawal, Catalini & Goldfarb, 2014), crowdfunding has become a common form of raising investment. Given the rising importance of crowdfunding, it is important to understand how crowd size and diversity can impact the performance of a crowdfunded startup. However, there is very little research linking the performance of crowdfunded project and the size and diversity of the crowd involved.

Crowd Size and Diversity

Some research on online crowdsourcing can be a rational starting point when trying to understand the effect of crowdsize on crowdfunded projects. Crowdfunding has been shown to be effective partly because it is a collection of individuals with similar interests. Large group sizes have been linked to greater motivation to participate and greater productivity. Support from a large number of unrelated people often makes the entrepreneur more confident, leading to greater motivation and greater success (Kollock, 1999). However, crowdfunding platforms also make entrepreneurial failures more visible, thereby deterring a larger number of people from participating in future ventures (Harburg et al., 2015). The effect of social media following on crowd funding has also

been studied. It was seen that a larger social media presence translates to credibility and therefore, better funding (Moissevev, 2013). This social media following, however, is mostly based on the contacts the entrepreneur has made online, making a well-connected entrepreneur more likely to raise funds via online platforms.

It can clearly be seen that there is little research exploring the effect of crowd size on the performance of an enterprise in the context of syndicated crowdfunding. Given the significant rise in crowdfunding investments through online syndicates and non-syndicated platforms, it is essential to understand these effects. Therefore, in this paper, the following hypothesis will be explored:

Hypothesis 1: *Numbers drive performance: the larger the investment crowd, the more likely an investment performs well.*

Crowd Diversity and Syndicates

The second crowd characteristic to be studied in relation to online crowdfunding platforms and online investment syndicates is crowd diversity. Crowd diversity is also shown to have an influence on crowd performance. Multiple factors such as geographic distance, education levels of investors, social connectivity of the entrepreneurs etc. are factors in determining crowd diversity. It should be noted that each of these factors have been explored by multiple authors, often giving contradicting results. For example, it has been argued that lower geographic distance has a positive effect on investor mentality (Mendes-Da-Silva et al., 2016). Other authors have attributed this effect to the entrepreneur's social circle and argued that geographic separation plays no role in influencing investor mentality (Agrawal, Catalini, & Goldfarb, 2015). The ambiguity involved in the effect of these factors is further complicated by the effect of crowd diversity itself.

Diverse crowds are shown to be less productive in small group sizes. Diverse individuals often find it difficult to collaborate effectively in small groups, leading to a less productive crowd. At the same time, various studies have shown that crowd diversity can have an adverse effect if the size of the crowd is large. As stated earlier, when diversity increases, crowds have access to a broader range of knowledge and skills. In addition, larger crowds are likely to dilute the negative effects of diversity that often materialize when individuals of different backgrounds and beliefs are

obligated to work together. In larger crowds, however, individuals are more likely to work among others similar to themselves, thereby eliminating the conflict created by crowd diversity. This complex relationship has been studied by researchers to some extend (Boudreau & Lakhani, 2013; Kandasamy et al., 2012), however, there is very little work available that links crowd diversity to the performance of online investors and investment syndicates. In the light of this gap in literature, this research proposes the following hypothesis for study:

Hypothesis 2: *Diversity drives performance: the more diverse a crowd is, the more likely an investment performs well.*

Another effect of crowd diversity is that it can result in *mutual confusion* or *joint myopia* (Knudsen & Srikanth, 2014). In large and diverse crowds, coordination becomes a significant problem. This leads to individuals making relatively independent decisions, without being able to judge the impact of their decisions on the overall investment ecosystem (Puranam and Swamy, 2010). This effect, named mutual confusion, can be reduced to a great extend by promoting communication within the group. It has been shown that with increased communication among members of the crowd (as enabled by most online platforms), individuals tend to be reluctant in exploring all options available in the crowdsourcing space. In essence, as individual backers of syndicates become more aware of each other's preferences, it is more likely that they will make choices that are mutually acceptable. This in turn would lead to some investment opportunities being overlooked in favor of other more socially acceptable options.

There is very little research on the mutually dependent effects of mutual confusion and joint myopia in crowdsourcing. Despite being important factors in crowd behavior on existing online crowdsourcing platforms, this area has not been explored by literature exhaustively.

Hypothesis 3**:** *Too much diversity leads at a certain point to mutual confusion/ joint myopia.*

These three hypotheses, in combination, will aid in better understanding the effects of crowd size and crowd diversity on the performance of syndicate investors and their crowd of backers. In conjunction, they will help answer our research question.

Data and Methodology

We used for our study data extracted from AngelList and Mattermark. The AngelList database included information about 26,000 people and 2,370 companies who subscribed to the platform on 2014 or earlier. Mattermark´s data, which was extracted and updated by October 2016 includes data about performance of companies listed on AngelList. One of the main variables we used to measure companies performance was an algorithm created by Mattermark named *growth score* (https://mattermark.com/tag/growth-score). The *growth score* takes into consideration a wide variety of variables and was used in combination with further variables in order to measure company´s performance. The codebook with the detailed description of the variables available in our database is visible in the appendix of the paper.

In order to measure the effects of crowd size and diversity on performance we ran different regressions and econometric tests. Due to the fact that AngelList´s database is based on information shared voluntarily by its members, some variables were missing or were not delivering fully trustworthy empirical results. For the analysis, due to the fact that more data related to syndicates characteristics were not available, the methodology used was imposed by data availability. After testing all possible empirical means to measure the effects of crowd size and diversity on performance, we came to the conclusion that the non-parametric regression was the best way to study of the relationship between the variables. The non-parametric regression does not make any assumption about the distribution followed by the variables. This analysis however provides us with an idea of the relationship between the analyzed variables.

Findings & Discussion

The aim of this section is to empirically assess the relationship between the number of backers held by the syndicate investors and the performance of companies in which the syndicates invested. We first of all present the distribution of the number of backers across syndicate investors (Figure 1). As shown in the Figure, the majority of the syndicate investors (69%) do not have a backer, while 15% of them have 13 backers. The most probable reason why this distribution is skewed is given by the fact that when the data was collected, syndicates were still an emerging phenomenon and many syndicates registered on AngelList had joined the platform only recently. Also the limited amount of backers per syndicate can be explained by the fact that the *syndicates feature* was launched by AngelList only shortly before the database was created. Another thing that must be taken into consideration is that syndicates were available exclusively in the U.S. Most of the papers studying syndicates on AngelList used more recent data that not always takes into consideration a time span of two years (the AngelList database was downloaded in 2014, the Mattermark database 2016).

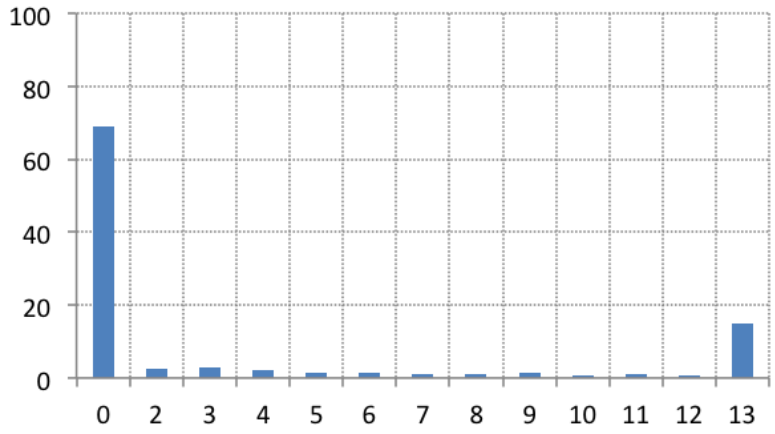


Figure 1: Distribution of the number of backers across syndicate investors (in %)

Source: Author's computation based on surveyed data

Table 1 displays the average companies' performance according to the number of backers held by the syndicate investor. It is evident from the Table that performance might increase with the number of backers, but too many backers lead to lower performance.

Growth score tends to decrease as the number of backers increases, and this trend is visible in Figure 2. However, Mindshare score and number of employees display a U relationship with the number of backers, suggesting that having a low number of backers may decrease performance (as measured by mindshare score and the number of employees), and that having a high number of backers increases performance. This trend is visible in Figures 3 and 4 respectively. This tendency tells us that below a given threshold, increasing the number of backers does not necessarily lead to investments in companies with a higher performance.

Number of backers	**Growthscore**		**Mindshare score**		**Number of employees**	
	Mean	**Std**	**Mean**	**Std**	**Mean**	**Std**
0	205.02	196.78	159.31	129.47	44.14	64.95
2	125	178.44	147	127.91	13	11.54
3	180.99	176.78	129.37	107.43	36.84	55.42
4	273.36	211.18	132.28	150.37	23.71	22.02
5	280.5	174.82	99	44.93	27.33	21.55
6	105.8	220.02	135.08	172.39	7.6	8.56
7	29.33	50.81	128.5	172.78	0.17	0.29
8	201	196.57	192.93	121.56	38.5	0.71
9	165.12	158.33	168.08	141.68	30.5	14.15
10	93.5	44.55	62.4	0	25.5	17.68
11	281.67	111.43	110.17	114.19	78.33	62.93
12	436	0	540	0	156	0
13	174.96	192.63	155.04	166.98	43.47027	57.45
Total	**196.28**	**193.03**	**156.69**	**137.44**	**41.7**	**59.97**

Table 1: Average companies' performance by the number of backers held by syndicate investors

Source: Author's computation based on surveyed data

Between 5 and 10 backers we can see an inverted U-shaped curve indicating that between 6 and 8 backers companies have an increasing performance while as the number increases, performance gradually declines.

If we look at the mindshare performance we can observe that as the number of backers increases the mindshare score grows, indicating that a larger amount of backers contributes to a better performance.

Finally, if we look at the relationship between the amount of backers and the *employeecount,* a variable provided by Mattermark measuring employee growth, we can observe that as the amount of backers increases, the performance of companies decreases.

```
. tabstat growth_score, by(nbackers) stat (me sd
```

Summary for variables: growth_score
by categories of: nbackers

nbackers	mean	sd
0	205.0237	196.7826
2	125	178.4454
3	180.9939	176.7796
4	273.3571	211.1794
5	280.5	174.8196
6	105.8	220.0255
7	29.33333	50.80682
8	201	196.5757
9	165.125	158.329
10	93.5	44.54773
11	281.6667	111.4286
12	436	0
13	174.9573	192.6484
Total	196.2837	193.0359

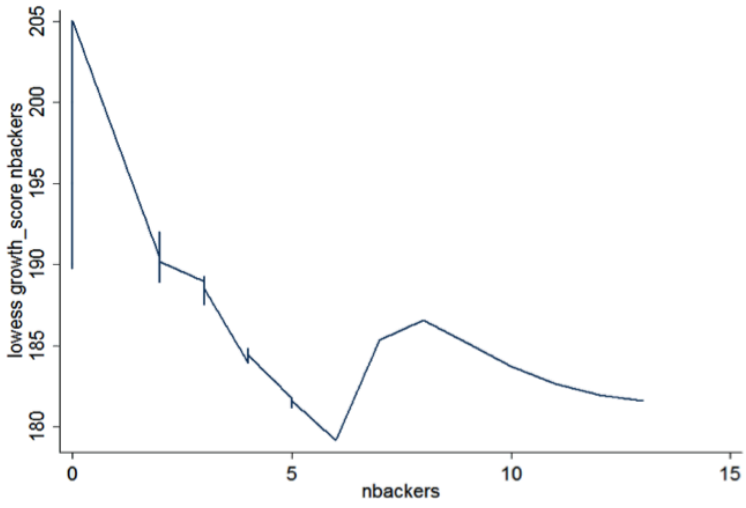


Figure 2: Backers size and Growth score

Source: Author's computation based on surveyed data

Summary for variables: mind_share_score
by categories of: nbackers

nbackers	mean	sd
0	159.3133	129.4754
2	147	127.9156
3	129.375	107.4348
4	132.2778	150.3743
5	99	44.92957
6	135.0833	172.3943
7	128.5	172.7802
8	192.9333	121.5642
9	168.0833	141.6822
10	62.4	.
11	110.1667	114.1932
12	540	.
13	155.0433	166.9848
Total	156.6923	137.4456

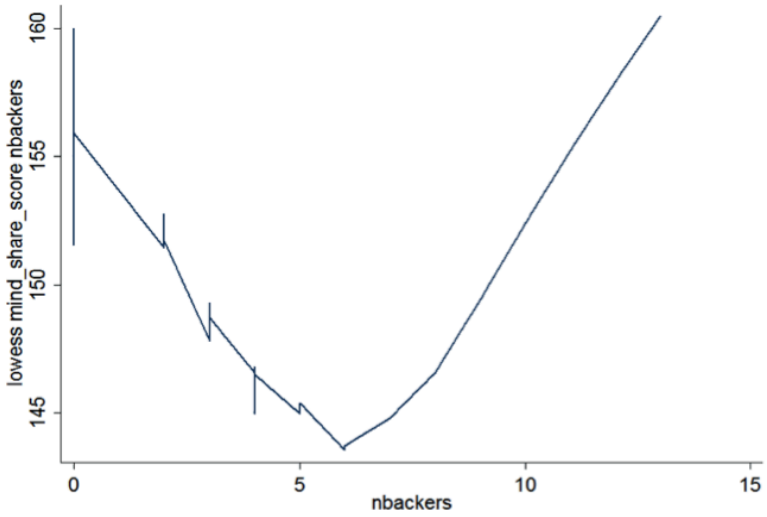


Figure 3: Backers size and Mindshare score

Source: Author's computation based on surveyed data

Data regarding location of backers was limited due to the fact that a significant of investors did not share their location. However, we decided to run different regressions in order to observe any valuable outcome:

Regression 1:

Dependent Variable: *growth score*

Results show that three of the independent variables have a statistically significant impact on *growth score* at the 5% confidence level. *Total raised* is statistically significant at the 1% level (p=0.000). One million dollar increase in the *total raised* is associated with an increase in *growth score* by 5.91. *Last funding amount* is statistically significant at the 1% level (p=0.000). One million dollar increase in *last funding amount* is associated with 4.37 increase in the *growth score*. *MARKET_2* is also statistically significant at the 5% level (p=0.015). SaaS Market is expected to increase the *growth score* by 109.3, compared to other

markets. Findings also show that *type* (Angel raised through crowd vs. Angel companies) has no statistically significant impact on *growth score* (p=0.774).

Regression 2:

Dependent Variable: *mindshare score*

Findings show that *MARKET_2* has a statistically significant impact on *mindshare score* at the 1% level (p=0.006). SaaS market is associated with 94.6 increase in the *mindshare score*, compared to other markets. *Total raised* is statistically significant at the 5% level (p=0.02). One million dollar increase in the *total raised* is associated with an increase in *mindshare score* by 2.82. *Last funding amount* is also statistically significant at the 5% level (p=0.017). One million dollar increase in *last funding amount* is associated with 1.96 increase in the *mindshare score*. Findings also show that *type* (Angel raised through crowd vs. Angel companies) has no statistically significant impact on *mindshare score* (p=0.361)

Regression 3:

Dependent Variable: *mindshare score*

Findings show that *MARKET_5* has a statistically significant impact on *mindshare score* at the 10% level (p=0.068). Digital Media market is associated with 117.9 increase in the *mindshare score*, compared to other markets. *Total raised* is statistically significant at the 5% level (p=0.031). One million dollar increase in the *total raised* is associated with an increase in *mindshare score* by 2.64. *Last funding amount* is also statistically significant at the 5% level (p=0.032). One million dollar increase in *last funding amount* is associated with 1.77 increase in the *mindshare score*. Findings also show that *type* (Angel raised through crowd vs. Angel companies) has no statistically significant impact on *mindshare score* (p=0.191).

Regression 4:

Dependent Variable: *employee count*

Results show that *total raised* is statistically significant at the 1% level (p=0.008). One million dollar increase in the *total raised* is associated with an increase in *employee count* by 1.79. *Last funding amount* is statistically significant at the 1% level (p=0.000). One million dollar increase in *last funding amount* is associated with 3.08 increase in the *employee count*.

Type has a statistically significant effect on *employee count* at the 1% level (p=0.005). Angel companies have higher impact on *employee count* than Angel raised through crowd by 38.78.

Regression 5:

Dependent Variable: *employee count*

Results show that *employees* is statistically significant at the 10% level (p=0.054). An increase of one employee is associated with an increase in *employee count* by 2.268. *Total raised* is statistically significant at the 10% level (p=0.063). One million dollar increase in the *total raised* is associated with an increase in *employee count* by 1.20. *Last funding amount* is statistically significant at the 1% level (p=0.000). One million dollar increase in *last funding amount* is associated with 2.96 increase in the *employee count*. *LOCATION_3* is statistically significant at the 1% level (p=0.000). Having London as the location increases the *employee count* by about 179.1, compared to other locations. *Type* has a statistically significant effect on *employee count* at the 5% level (p=0.02). Angel companies have higher impact on *employee count* than Angel raised through crowd by 30.69.

Regressions using Interaction terms:

These regressions interaction terms between two variables: *MARKET* and *LOCATION.* The interaction term allows us to see the combined effect of both variables together on the dependent variable.

Regression 6:

Dependent Variable: *growth score*

Results show that *total raised* is statistically significant at the 1% level (p=0.000). One million dollar increase in the *total raised* is associated with an increase in *growth score* by 5.92. *Last funding amount* is statistically significant at the 1% level (p=0.000). One million dollar increase in *last funding amount* is associated with 4.30 increase in the *growth score*. *MARKET_2_LOCATION_1* is also statistically significant at the 5% level (p=0.024). SaaS Market in San Francisco is expected to increase the *growth score* by 147.3, compared to other markets in other locations. Findings also show that *type* (Angel raised through crowd vs. Angel companies) has no statistically significant impact on *growth score* (p=0.723).

Regression 7:

Dependent Variable: *mindshare score*

Findings show that *total raised* is statistically significant at the 5% level (p=0.019). One million dollar increase in the *total raised* is associated with an increase in *mindshare score* by 2.83. *Last funding amount* is also statistically significant at the 5% level (p=0.019). One million dollar increase in *last funding amount* is associated with 1.92 increase in the *mindshare score*. *MARKET_2_LOCATION_1* has a statistically significant impact on *mindshare score* at the 1% level (p=0.003). SaaS market in San Francisco is associated with about 150 increase in the *mindshare score,* compared to other markets in other locations. Findings also show that *type* (Angel raised through crowd vs. Angel companies) has no statistically significant impact on *mindshare score* (p=0.431).

Regression 8:

Dependent Variable: *mindshare score*

Findings show that *total raised* is statistically significant at the 5% level (p=0.038). One million dollar increase in the *total raised* is associated with an increase in *mindshare score* by 2.54. *Last funding amount* is also statistically significant at the 5% level (p=0.03). One million dollar increase in *last funding amount* is associated with 1.79 increase in the *mindshare score*. *MARKET_5_LOCATION_1* has a statistically significant impact on *mindshare score* at the 5% level (p=0.042). Digital Media market in San Francisco is associated with about 198.4 increase in the *mindshare score,* compared to other markets in other locations. Findings also show that *type* (Angel raised through crowd vs. Angel companies) has no statistically significant impact on *mindshare score* (p=0.248).

Regression 9:

Dependent Variable: *mindshare score*

Findings show that *total raised* is statistically significant at the 5% level (p=0.02). One million dollar increase in the *total raised* is associated with an increase in *mindshare score* by 2.83. *Last funding amount* is also statistically significant at the 5% level (p=0.041). One million dollar increase in *last funding amount* is associated with 1.68 increase in the *mindshare score*. *MARKET_4_LOCATION_2* has a statistically significant impact on *mindshare*

score at the 5% level (p=0.028). E-Commerce market in New York City is associated with about 151.8 increase in the *mindshare score,* compared to other markets in other locations. Findings also show that *type* (Angel raised through crowd vs. Angel companies) has no statistically significant impact on *mindshare score* (p=0.203).

In their study Robert & Romero (2015) assessed whether crowd size and diversity had an impact on performance, concluding that crowd size and diversity are two interconnected elements that must be studied conjunctively. Through their mathematical algorithm, they could observe that there is an optimal level of crowd size and diversity leading to better performance.

By building a database about AngelList´s syndicates and crowd of backers, we aimed to study how crowd diversity and performance impact companies´ performance. Our research suggests that the argument stating that small crowds with less diversity often outperformed more diverse crowds of the same size is valid. The regressions we performed, even if available data was limited, suggested that location plays a relevant role in influencing performance.

This research can be considered as a first attempt to study the effects of size and diversity on syndicated online investments. Expanding the AngelList database by integrating data from platforms such as Crunchbase or Linkedin may lead to more complex studies digging deeper about the effects of diversity within crowds.

References

Agrawal, A., Catalini, C., & Goldfarb, A. (2014). Some simple economics of crowdfunding. Innovation Policy and the Economy, 14(1), 63-97.

Agrawal, A., Catalini, C., & Goldfarb, A. (2015). Crowdfunding: Geography, social networks, and the timing of investment decisions. Journal of Economics & Management Strategy, 24(2), 253-274.

Alnuaimi, O.A., Robert, L.P., and Maruping, L.M. (2010) Team size, dispersion, and social loafing in technology-supported teams: A perspective on the theory of moral disengagement. J. of Management Information Systems, 27(1):203–230.

Boudreau, K. J., & Lakhani, K. R. (2013). Using the crowd as an innovation partner. Harvard business review, 91(4), 60-69.

Bray, D. A., Laubacher, R., & Malone, T. W. (2008). Collective intelligence: promoting diversity, crowd performance algorithms, and better decision outcomes.

Chen, J. M. (2016). Specific Applications of Prospect Theory to Behavioral Finance. In Finance and the Behavioral Prospect (pp. 213-246). Springer International Publishing.

Cummings, J.N., Kiesler, S., Zadeh, R.B., & Balakrishnan, A.D. (2013) Group Heterogeneity Increases the Risks of Large Group Size: A Longitudinal Study of Productivity in Research Groups. Psychological Science, 24(6):880–890.

Harburg, E., Hui, J., Greenberg, M., & Gerber, E. M. (2015, February). Understanding the Effects of Crowdfunding on Entrepreneurial Self-Efficacy. In Proceedings of the 18th ACM Conference on Computer Supported Cooperative Work & Social Computing (pp. 3-16). ACM.

Ioannides, Y. M. (2010). A Review of Scott E. Page's The Difference: How the Power of Diversity Creates Better Groups, Firms, Schools, and Societies. Journal of Economic Literature, 48(1), 108-122.

Kandasamy, D. M., Curtis, K., Fox, A., & Patterson, D. (2012, February). Diversity within the crowd. In Proceedings of the ACM 2012 conference on Computer Supported Cooperative Work Companion (pp. 115-118). ACM.

Kittur, A., & Kraut, R. E. (2008, November). Harnessing the wisdom of crowds in wikipedia: quality through coordination. In Proceedings of the 2008 ACM conference on Computer supported cooperative work (pp. 37-46). ACM.

Knudsen, T., & Srikanth, K. (2014). Coordinated exploration organizing joint search by multiple specialists to overcome mutual confusion and joint myopia. Administrative Science Quarterly, 0001839214538021.

Kollock, P. (1999). The economies ol online cooperation. Communities in cyberspace, 220.

Larson, J. R., Christensen, C., Abbott, A. S., & Franz, T. M. (1996). Diagnosing groups: charting the flow of information in medical decision-making teams. Journal of personality and social psychology, 71(2), 315.

Marwell, G., Oliver, P. E., & Prahl, R. (1988). Social networks and collective action: A theory of the critical mass. III. American Journal of Sociology, 94(3), 502-534.

Mendes-Da-Silva, W., Rossoni, L., Conte, B. S., Gattaz, C. C., & Francisco, E. R. (2016). The impacts of fundraising periods and geographic distance on financing music production via crowdfunding in Brazil. Journal of Cultural Economics, 40(1), 75-99.

Moisseyev, A. (2013). Effect of social media on crowdfunding project results. Dissertations and Theses from the College of Business Administration. Available at < digitalcommons.unl.edu/businessdiss/39/ > Accesed on 7th February, 2017.

Oliver, P. E., & Marwell, G. (1988). The Paradox of Group Size in Collective Action: A Theory of the Critical Mass. II. American Sociological Review, 1-8.

Oliver, P., Marwell, G., & Teixeira, R. (1985). A theory of the critical mass. I. Interdependence, group heterogeneity, and the production of collective action. American journal of Sociology, 91(3), 522-556.

Ordanini, A., Miceli, L., Pizzetti, M., & Parasuraman, A. (2011). Crowd-funding: transforming customers into investors through innovative service platforms. Journal of service management, 22(4), 443-470.

O'Reilly III, C. A., Caldwell, D. F., & Barnett, W. P. (1989). Work group demography, social integration, and turnover. Administrative science quarterly, 21-37.

Page, S. E. (2008). The difference: How the power of diversity creates better groups, firms, schools, and societies. Princeton University Press.

Poetz, M. K., & Schreier, M. (2012). The value of crowdsourcing: can users really compete with professionals in generating new product ideas?. Journal of Product Innovation Management, 29(2), 245-256.

Ponzanelli, L., Bacchelli, A., & Lanza, M. (2013, March). Leveraging crowd knowledge for software comprehension and development. In Software Maintenance and Reengineering (CSMR), 2013 17th European Conference on (pp. 57-66). IEEE.

Puranam, P., & Swamy, M. (2010). Expeditions without Maps: Why Faulty Initial Representations May Be Useful in Join Discovery Problems. Available at SSRN: https://ssrn.com/abstract=1153142 or http://dx.doi.org/10.2139/ssrn.1153142. Accessed on 7th February, 2016.

Robert, L. P. (2013, February). A multi-level analysis of the impact of shared leadership in diverse virtual teams. In Proceedings of the 2013 conference on Computer supported cooperative work (pp. 363-374). ACM.

Robert, L., & Romero, D. M. (2015, April). Crowd size, diversity and performance. In Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems (pp. 1379-1382). ACM.

Stol, K. J., & Fitzgerald, B. (2014, May). Two's company, three's a crowd: a case study of crowdsourcing software development. In Proceedings of the 36th International Conference on Software Engineering (pp. 187-198). ACM.

Surowiecki, J. (2005). The wisdom of crowds. Anchor.

Von Hippel, E. (2005). Democratizing innovation: The evolving phenomenon of user innovation. Journal für Betriebswirtschaft, 55(1), 63-78.

Whitla, P. (2009). Crowdsourcing and its application in marketing activities. Contemporary Management Research, 5(1).

Williams, K.Y. & O'Reilly, C.A. (1998) Demography and diversity in organizations: A review of 40 years of research. Research in Organizational Behavior, 20:77–140.

Variables AngelList and Mattermark Database

Variable	Description
Type - 0	It means that it is a company that raised money from syndicate investors
Type - 1	It means that it is a company that raised money only from traditional investors
Type - 2	It means that it is a syndicate investor
Type - 3	It means that it is a normal person

Variable	Description
ID1	Number of row
id	Identification number
name	Name of syndicate investor
backers	Amount of investors supporting the syndicate
backed_by	Amount of investments backing syndicate in US$
expected_deals_per_year	Number of investments expected per year
total_carry_per_deal	Percentage of carry syndicates takes per year
syndicate_investment_year	Year in which syndicate investment took place
syndicate_investment companies	Companies in which syndicate invested

Variable	Description
ID1	Number of row
id	Identification number
name	Name of syndicate investor
raised_via_angel:	Investments raised through the Angellist platform
Employees	Number of employees working at the company
Total_raised	Total amount raised through Angellist and/or other sources
Location	Location of the company
Markets	Markets in which the company operates
Founder	CEO of the company
Founder_name_1	Additional Co-founder company
Investment (1 to 6 – 1 most recent)	6 most recent investments raised on AngelList and/or other sources
Total_raised_sq	Total amount of investments raised through AngelList and/or other sources
N_location	Location of the company

Variable	Description
ID1	Number of row
id	Identification number

name	Name of user
location	Location of user
markets	Markets in which user operates
founder	Company/ies founded by the user
invests	Average amount that the users declares to invest on average
education	University at which the user studied/graduated
roles	Roles user is playing
investor	Companies in which the user invested
board_member	Companies at which the user is board member
employee	Companies at which the user was employed
Confirmed_investments	Number of confirmed investments on AngelList
n_location	Encoded location in which the user operates
n_markets	Encoded location of markets in which user operates
n_founder	Encoded company founded by user
n_education	Encoded university at which user studied/graduated
n_investor	Encoded company in which user invested
n_board_member	Encoded company in which user is board member
n_employee	Encoded company by which user was employed
c_invests	Encoded average amount user invests per company
Invests (from)	Minimum amount invested on average
Invests (to)	Maximum amount invested on average

Variable	**Description**
Growth Score	What is the Growth Score: Mattermark's Growth Score is the default ranking for all companies in Mattermark. It measures how quickly a company is gaining traction at a given point in time. How the Growth Score is Calculated: While Mattermark does not disclose the exact formula for calculating this score as it is part of Mattermark's "secret sauce," we can reveal the inputs for the score. These include a company's business metrics (such as employee count over time and publically announced funding) and the Mindshare Score (estimated web traffic, estimated mobile app downloads, inbound links from other websites, and followers/likes on various social media sites). These data points are weighted and the score provided is a rolling average over a 4-week period. The underlying assumption is that companies who see

	growth across these signals are shipping product and talking to customers, and are more likely to continue to grow as a result. It's important to note that there is no minimum or maximum to our scores. Additionally, each score is specific to that individual company, and is not reflective of how that company is performing compared to other companies or within an industry.
Mindshare Score	The Mindshare Score combines web, mobile, and social traction to determine a company's growth of online attention and how it changes over time. The signals tracked to create the Mindshare Score include estimated web traffic, estimated mobile app downloads, inbound links from other websites, and followers/likes on various social media sites. These are the same metrics used to determine the Weekly Momentum Score as well, but differs in that the Mindshare Score is a 4-week rolling average of the Weekly Momentum Score. Think of it as a subset of the Growth Score that accounts for social signals and the company's ability to gain and retain attention online. A positive score indicates aggregate growth across these signals, a score closer to zero indicates a plateau, and a negative score indicates a declining online footprint.
Employee Count	The number of present employees
Employee Growth Last Mo	The percentage growth of new employees hired during the last 30 days
Employee Growth Last 6 Months	The percentage growth of new employees hired during the last 6 months
Month Over Month Growth	Monthly overall growth
Stage	Whether the company was acquired or raised significant investments
Total Funding	The total amount of investments the company raised
Last Funding	The date of the last investment the company raised
Last Funding Amount	The size of the last investment the company raised