

Utilising Virtual Communities for Innovative Consumer Identification

University of Nottingham

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1. Table of contents

1. Table of contents	2
1.1. List of tables and figures	5
2. Acknowledgements	7
3. Publications	8
4. Abstract	10
5. Introduction	13
6. Literature review	19
6.1. Innovative consumers	22
6.1.1. Consumer labels	24
6.1.2. Identifiable characteristics	30
6.2. Motivations	32
6.2.1. Recognition and reputation	32
6.2.2. Access to information	33
6.2.3. Professional and economic	35
6.2.4. Ideologies	35
6.2.5. Social engagement	37
6.2.6. Friendship	38
6.3. Virtual communities	39
6.3.1. Foundations of virtual communities	41
6.3.2. Source of innovation	44
6.3.3. Social networks	47
6.4. Identification methods	48
6.4.1. Alternative identification methods	53
6.5. Summary	54
7. Research strategy	60
7.1. Methodologies	63
8. Different consumers for different stages	68
8.1. Outsourcing innovation	69
8.2. New product development	71
8.3. Methodology	73
8.4. Consumers in the innovation process	74
8.4.1. The idea	75
8.4.2. Initial screening	76
8.4.3. Preliminary market and technical assessment	77
8.4.4. Detailed market study and business/financial analysis	77
8.4.5. Product development	78

8.4.6. In-house product testing and consumer testing of product	78
8.4.7. Test market and trial sell.....	79
8.4.8. Pre-commercialisation business analysis	79
8.4.9. Production start-up and market launch	79
8.5. The spectrum of consumers	81
8.5.1. Ordinary consumers	81
8.5.2. Idea-generators	82
8.5.3. Innovators.....	82
8.5.4. User-entrepreneurs	83
8.5.5. Variable consumers.....	83
8.6. Mapping consumers to NPD stages	85
8.7. General discussion and conclusions.....	88
8.8. Implications for the findings	92
9. Preferences towards virtual communities	94
9.1. Influence of a social system	94
9.2. Identifying the right consumers.....	96
9.3. Methodology	98
9.3.1. Research setting.....	99
9.4. Design	102
9.5. Materials	102
9.6. Participants	105
9.7. Procedure.....	105
9.8. Scale development	107
9.9. Innovative user characteristics.....	107
9.10. Motivations to engage in virtual communities.....	109
9.11. Results.....	111
9.12. Discussion	120
9.13. Conclusion	122
10. The role of weblog data.....	124
10.1. Response rates	125
10.2. Design	126
10.3. Procedure	127
10.4. Analysis and results	127
10.5. Discussion and conclusion.....	131
11. The application and impact of innovative consumer identification research ...	134
11.1. Design	136
11.1.1. Research setting.....	136
11.1.2. Participants	137
11.1.3. Procedure.....	137

11.1.4. Materials	138
11.2. Results and discussion	139
11.3. Consumers and their content	139
11.4. Knowledge	140
11.5. Knowledge sharing	141
11.6. Collaboration	141
11.7. Recognition	142
11.8. Identification methods for consumers and content	142
11.9. Validating characteristics	143
11.10. Engaging the community broadly	147
11.11. Innovative community members	147
11.12. Education and intervention	148
11.13. General discussion	154
11.14. Conclusions	158
12. Discussion	159
12.1. Approaching consumer identification	159
12.2. The influence of social systems	160
12.3. Data driven decisions	162
12.4. Sticky knowledge	163
12.5. Source of efficiency	165
12.6. Implementation and considerations	166
12.7. Theoretical perspective	167
13. Conclusion	170
14. Limitations and future research	174
15. References	176
16. Appendices	194
16.1. Virtual community sample	194
16.2. Questionnaire items	197
16.3. Interview structure and questions	200
16.4. Industry domains	202
16.5. ANOVA	204
16.6. ANOVA descriptives	205
16.7. Negative binomial regression results for 'Joined date' of users	207
16.8. Identification methods	208
16.9. Multivariate multiple regression	209
16.10. Simple slopes graphs	212

1.1. List of tables and figures

Table 1: Cooper & Kleinschmidt (1986) activities for new product development.....	74
Table 2: Factor loading, variance and Alpha scores for Innovative consumer characteristics.	108
Table 3: Factor loadings, variance and Alpha scores for Motivations to engage in Virtual communities.	110
Table 4: Mean differences between simple forum communities (1) and advanced functionality communities (2).....	112
Table 5: One-way ANOVA results of the effect of virtual community complexity on Innovative consumer characteristics and motivations to engage.	114
Table 6: Multivariate multiple regression of product knowledge regressed onto motivations to engage.	115
Table 7: Multivariate multiple regression of Innovativeness regressed onto motivations to engage.	116
Table 8: Multivariate multiple regression of Dissatisfaction regressed onto motivations to engage.	117
Table 9: Multivariate multiple regression of willingness regressed onto motivations to engage.	118
Table 10: Output from a negative binomial regression of total number of comments by a consumer on innovative consumer characteristics and motivations to engage. .	128
Table 11: Results of a negative binomial regression of total number of posts by a consumer on innovative consumer characteristics and motivations to engage. ...	129
Table 12: Results of a negative binomial regression of total number of 'likes' received by consumers on innovative consumer characteristics and motivations to engage.....	130
Table 13: Results of a negative binomial regression of total number of 'Thanks' received by consumer on innovative consumer characteristics and motivations to engage.....	131
Table 14: A full list of virtual communities where respondents resided.....	195
Table 15: Full set of questions for virtual community investigation.	197
Table 16: A sample of Industry domains where consumer innovation has been observed.....	202
Table 17: ANOVA Output for motivations and consumer characteristics.....	204
Table 18: ANOVA descriptives, means and standard deviation.	205
Table 19: Negative binomial regression results for 'Joined date' of users.	207
Table 20: A summary of different identification methods.	208
Table 21: Multivariate multiple regression of all innovative consumer characteristics regressed onto all motivations to engage.	209
Figure 1: Stages of the innovation process. The top four stages where consumers can choose to participate, and below the line, stages that are conducted in-house by an organisation.	80

Figure 2: Consumer and characteristic relationships: A visualisation of the differentiating consumer characteristics, and how they are shared between consumer types, changing as a consumer ‘develops’ from ordinary to entrepreneurial.....84

Figure 3: Consumer Identification framework: Consumer characteristic relationship mapped on to stages of the NPD process, highlighting the connection between consumer, characteristic, and new product development stages.87

Figure 4: An example of a community member’s profile from Mobile Nations Android Central community, showing their recent activity and engagement statistics.100

Figure 5: Simple slopes graphs showing the differences in relationships between community types for product knowledge, personal gain and responsibility.....116

Figure 6: Simple slopes graphs showing the differences in relationships between community types for consumer characteristics and personal gain.119

Figure 7: Simple slopes graphs showing the differences in relationships between community types for consumer characteristics and reputation.....212

Figure 8: Simple slopes graphs showing the differences in relationships between community types for consumer characteristics and responsibility.213

Figure 9: Simple slopes graphs showing the differences in relationships between community types for consumer characteristics and personal gain.214

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3. Publications

Why Do Applications Request My Contacts Data? A Large-Scale Study on Openness & Control of User Contacts Permission in Android Mobile Applications Marketplace - Jianhua Shao; George Kuk; Matthew Terrell; Chen Su (China Mobile Research Institute). PACIS 2013, Jeju Island, Korea. June 2013

An Investigation into the Conditions that Influence Engagement in Virtual Communities - Matthew Terrell; George Kuk; Alexa Spence. Open User Innovation (OUI) 2014. Harvard Business School, Cambridge, MA. July 2014

A Unified Model of Consumer Characteristics in Service Innovation – Matthew Terrell; George Kuk; Alexa Spence. Open User Innovation (OUI) 2013, University of Sussex, Brighton, UK. July 2013

The Social Life of Design Artefacts in Thingiverse - George Kuk; Nadia Kirilova; Jianhua Shao; Matthew Terrell. OUI2012, Harvard Business School, Cambridge, MA. July 2012

“If manufacturers ignore the innovation potential of their customers, they may miss all promising user innovations that are primarily developed for personal use. They even risk losing their competitive advantage, if the ideas are detected and successfully exploited by competing firms. Therefore, manufacturers will have to take the initiative to search for innovating users.”

Christian Lüthie

4. Abstract

Consumers can play a pivotal role in the development of new products and services. People are observed to independently create and modify existing products in order to meet their needs, unmet by current market offerings (Luthje 2004; Von Hippel & Urban 1988; Hiennerth & Lettl 2011). Research into these innovative consumers has shown they can be differentiated from other consumers by a set of characteristics. This has enabled firms to identify and engage with these consumers, document their behaviour and integrate them into the process of developing new products and services. By doing so firms have experienced a range of benefits including an increase in product novelty, attractiveness and variety (Franke & Shah 2003; Schreier & Pruegl 2008; Franke et al. 2006). Today firms are utilising virtual communities to access consumer knowledge, discover their emerging needs and observe their own innovations. This has had a positive effect on a firm's innovation output and performance (Ryzhkova 2015; Wadell et al. 2013; Carbonell et al. 2009). Many investigations have started to focus on virtual communities, and their utility for firms to identify consumers, but given the sheer size of virtual communities, and their heterogeneity, our understanding of how to exploit these resources are under-explored.

This thesis conducted a series of investigations, seeking to contribute a new perspective on consumer innovation research in a number of different areas. The core aim is to provide a new understanding of how organisations can use virtual communities to help them efficiently identify innovative consumers in the pursuit of new insights and innovation. The investigation focuses on how to approach the identification of innovative consumers in virtual communities. Firstly the consumer's choice of the virtual community, which reveals innovative consumers, specifically those who are more willing to collaborate with organisations, are more likely to exist in forum style virtual communities. These are free from functionality that facilitates acts of selling and professional endeavours, such as shopping carts and

file exchange mechanisms. This has never before been considered as an influencing factor in the process of identifying innovating consumers, and shows that organisations could positively influence the overall outcome of the collaboration process with consumers if a consumer's choice of community was also included in the identification process. Ultimately this could have a positive knock-on effect to the type, and success of, the resulting innovation produced when collaborating with consumers for new product development (NPD). This study suggests that organisations need to take into consideration the following factors: community functionality, to reduce the number of consumers with professional interests; and the community social systems, to understand the values and ideologies of virtual communities when it comes to external collaboration. Additionally, this investigation expands on the existing knowledge about using weblog data for identification, by analysing the relationships between their self-reported data and web-log data. This is the first time the observation of weblog data and its potential to influence the wider use of weblog data has been taken into consideration. Almost all previous investigations appear to observe data that is isolated to a specific community (Füller et al. 2008), and do not consider how metrics could be transferable across communities to influence the overall approach to online consumer identifications, across communities.

Finally this study provides new knowledge on the application of the community manager in the process of identifying innovative consumers. The research concludes by highlighting novel insights gained from interviewing community managers. The significance, and arguably, the advantageous position held by the community managers, places them in a position to influence social systems that inform the perceptions of external collaboration; they understand the community dynamics and often individual characteristics of community members, and they act as a gatekeeper to the community. These findings show that, for organisations looking to collaborate with consumers of the community, they should approach the

community managers first. They can provide organisations with insights about the community social system, their values and ideologies, which will indicate the effectiveness of the community for identification. Essentially, by collating the findings from the thesis, organisations can add timesaving steps in the process of identification.

5. Introduction

Organisations have been using consumers to assist in the development of new products and services for many years. More common types of consumers such as ordinary consumers, can play an important role as they provide insight into unmet needs, despite often suffering from functional fixedness (Adamson 1952), and having a lack of technical knowledge about products (Magnusson 2009).

Other less-common types of consumers, such as lead-users, with high levels of innovativeness (Von Hippel & Urban 1988; Von Hippel 2005), have shown that when organisations work with consumers for co-design or collaborative projects they can benefit new products and services with greater novelty and commercial attractiveness (Von Hippel & Urban 1988; Lilien et al. 2002; Baldwin et al. 2006).

When these innovative consumers are tasked with creating new services and products, they can influence the costs in early stage ideation and conceptualisation within the new product development (NPD) process (Von Hippel & Herstatt 1992; Jeppesen 2005); increase product variety (Al-Zu'bi & Tsinopoulos 2012), and product satisfaction (Franke & Von Hippel 2003; Schreier & Pruegl 2008; Franke et al. 2006). These benefits have led consumer involvement into the NPD process to be considered one of the most important strategies extensively researched by open innovation scholars (Gassmann 2006).

When consumer innovation research became more recognised, following von Hippel's work on lead users (von Hippel & Urban 1988; von Hippel 1976; von Hippel 1978b), further research was conducted using various data collection methods such as telephone screening or postal surveys. However, today with the development of web technologies and the expansion of the Internet, and its accessibility, many organisations and consumers gather online to communicate.

Using the Internet enables individuals to communicate quickly, and over large geographical areas, often using virtual communities - an online environment where users from around the world come together to discuss topics, brands, products and other subject areas. These enable organisations to communicate with their consumers, and similarly, consumers to communicate with other consumers remotely. These virtual communities are now being observed as a source of innovation, where consumers will freely disclose their ideas, needs and solutions (Füller et al. 2007; Marchi et al. 2011; Von Hippel 2017). Additionally, virtual communities offer new alternative ways to identify innovative consumers, often using the weblog data generated by the consumer's behaviour in the virtual community.

Many organisations are beginning to recognise the value in connecting with consumers via online environments. Mahr & Lievens (2012) highlighted that more than 80% of organisations listed in the S&P 500 index¹ have established virtual communities for their consumers, which can also help organisations gain a competitive advantage (Prahalad & Ramaswam 2004). Furthermore, virtual communities are dramatically increasing in size, sometimes to millions of members, which is often beyond the capabilities of traditional identification methods. It is therefore important to understand how to approach virtual communities for consumer identification to ensure that the process is reliable and efficient.

While some scholars have started to explore the potential of virtual communities for the identification of innovative consumers (Belz & Baumbach 2010; Füller et al. 2007; Marchi et al. 2011; Füller et al. 2008; Füller 2006; Jacobsen et al. 2017), current consumer innovation research in virtual communities is still in its infancy,

1 "The S&P 500® is widely regarded as the best single gauge of large-cap U.S. equities. There is over USD 7.8 trillion benchmarked to the index, with index assets comprising approximately USD 2.2 trillion of this total. The index includes 500 leading companies and captures approximately 80% coverage of available market capitalisation." Source: <http://us.spindices.com/indices/equity/sp-500>

and the question remains as to whether virtual communities could be used to inform a more reliable method of innovative consumer identification.

To answer this question, a review of the extant literature on innovative consumers, their identifiable characteristics (Section 6.2), virtual communities (Section 6.4), methods of identification (Section 6.5) was carried out, which led to an investigation of the types of innovative consumers deemed as suitable for the different stages of the innovation process (Chapter 8). Understanding innovative consumer types and where and how they may be most likely to engage in virtual communities is important given the complexities of large communities, and the different stages of new product development (NPD) processes. This preliminary work that follows on from the literature review in Chapter 8, provides clarity on who is being identified, as there is currently ambiguity within the literature on how different types of innovative consumers are labelled, and the differences and similarities appear vague and undefined.

Following this, focus was placed on understanding the motivations innovative consumers engage in within different types of virtual communities, in order to compare the differences. While motivations for engaging in virtual communities have been previously explored (Butler et al., 2007), this is the first time they have been compared between communities for the purpose of observing if differences exist in the desire to collaborate with external entities (Chapter 9). This study also highlights that virtual communities can differ in functionality, leading to the attraction of, or discouragement of, certain types of innovative consumers participating in these communities.

Expanding on this study, weblog data of a virtual community was analysed, specifically looking at common sources of data within virtual communities, as opposed to the specific data sources that are used in related investigations. This

study focused on finding relationships between consumer characteristic weblog data commonly found in virtual communities, with the aim of contributing more transferable characteristics back to the consumer innovation literature, in the form of a digital footprint. Furthermore focus was placed on data that is accessible to organisations and scholars alike (Chapter 10).

Lastly, to fully understand the role virtual communities can play in consumer identification, and more specifically the efficiency of the process, virtual community managers (Chapter 11) were interviewed. The findings from this series of interviews informs how valuable community managers could be to the process of consumer identification, which has not been explored in this level of detail, nor in the same context. Their tacit knowledge of the community, and even individual consumers, can inform external organisations of the usefulness of the community, and help guide them towards more innovative consumers. While this could appear disruptive within consumer innovation research, as it could bypass the use of methodologies that have been refined to identify innovative consumers, there is still a need to guide the identification using innovative consumer characteristics to ensure those identified are a suitable fit for the stage of NPD being addressed by the organisation, which has also been addressed in this research.

The thesis starts with a literature review to understand the current research in the areas of consumer innovation research and virtual communities. Consideration was also made of other areas such as social networks and entrepreneurship to narrow down the boundary of research. From the literature review, gaps were identified within the current knowledge, such as an understanding of the relationships between consumers, their characteristics and their abilities to contribute to the new product development process, and the connection between innovative consumers and different types of virtual communities. The literature also lacked focus on how weblog data can be used as an identifiable measure alongside other commonly

used innovative consumer characteristics, and any investigations focused on virtual community managers who could potentially provide valuable insights into how virtual communities can be used for consumer identification. The gaps identified in the current literature sit within the context of external organisations looking to identify consumers to assist in their new product development process. Many examples of consumers collaborating with organisations exist in the literature, which is explored in Section 6.4.2. that demonstrates the scale and impact that can result from these collaborations. It is therefore valuable to understand how these collaborations can be harnessed in a world that is ever-increasingly online.

Following the literature review the initial gap in the literature was examined, and one considered to be a fundamental step in examining before continuing further: that being the gap in our understanding between the consumer, their characteristics and their ability to contribute to the NPD process. Chapter 8 is dedicated to reviewing the current literature that explicitly details the relationships from past investigations to build a picture of these relationships. This collation of information provides a fundamental understanding of both who to look for when identifying consumers, and how to differentiate them from other types of consumers. The leads onto Chapter 9 where an empirical investigation into the relationships between consumers and different types of virtual communities was conducted, as this hadn't previously been explored in consumer innovation literature. The investigation focused on two types of virtual community, and compared the results of a survey to understand if different types of innovative consumers gravitate to different types of communities. The results could have a significant effect on the time-saving aspect, and resulting costs, of consumer identification for both firms and scholars alike.

In parallel with the first empirical investigation, weblog data related to the survey participants was collected, with an aim to understand the relationships between their self-reported measures and their digital footprint. While the use of weblog data within virtual communities has been explored within the literature (see Section 6.4), it is not until now that this data is examined for its ability to indicate the presence of innovative consumers who are willing to collaborate.

The final research chapter takes a different approach from the quantitative path that has been focused on so far, and looks to add invaluable insights into the use of virtual communities from the perspective of the community manager. The result provides a novel insight into how they could assist with the identification process, and some of the findings link back to those in the previous research chapters. The investigation provides a vital part of the puzzle in understanding how organisations can effectively utilise virtual communities, by showing that community managers hold valuable knowledge on the community, are in a strong position to influence or change community perspectives and assist in the overall identification process.

This thesis concludes with a discussion and conclusion in Chapters 12 and 13. It was found that to utilise virtual communities in an effective way, external organisations require knowledge from within the community, specifically from someone who is embedded within the community and is able to oversee the majority of activities. Furthermore a framework of the types of consumers organisations should look towards identifying when they are required for a specific section of the NPD process was presented. Lastly the research was able to show that innovative consumers, specifically those willing to collaborate, can be located in specific types of virtual communities. The research process concludes with a discussion of possible future research and limitations.

6. Literature review

Consumers can create new products, innovate novel solutions to existing problems, and even build businesses to manufacture their innovations when existing manufacturers and product offerings do not support their needs. One of the earliest examples of a consumer innovating is given by Smith (1776):

“In the first fire-engines, a boy was constantly employed to open and shut alternately the communication between the boiler and the cylinder, according to as the piston either ascended or descended. One of those boys, who loved to play with his companions, observed that, by tying a string from the handle of the valve, which opened this communication to another part of the machine, the valve would open and shut without his assistance, and leave him at liberty to divert himself with his play fellows. One of the greatest improvements that has been made upon this machine, since it was first invented, was in this manner the discovery of a boy who wanted to save his labour.” (pg. 114-115).

Since this time, scholars have been documenting consumers' involvement in the creation of new product and solutions in various commercial and industrial domains. They have shown consumers are able to contribute novel and innovative ideas and make an impact on almost any product or service – demonstrating the importance of consumer contributors in innovations (Bonner & Walker 2004; Öberg 2010; Prahalad & Ramaswamy 2000; Von Hippel 1978a; Raasch et al. 2008). Some of the domains where consumers have contributed include mountain biking (Franke & Shah 2003; Luthje 2004; Luthje et al. 2006); surfing (Tietz et al. 2004; Franke et al. 2006), kayaking (Baldwin et al. 2006; Hienerth & Lettl 2011) sailing (Raasch et al. 2008); children's products (Shah & Tripsas 2007; Füller et al. 2006; Poetz & Schreier 2012), photovoltaic-powered products (Apostolou & Reinders 2016), fashion (Ramaswamy 2008; Füller et al. 2007; Berger & Piller 2003), transport (Marchi et al.

2011; Füller 2006), banking (Von Hippel & Oliveira 2009), software (Jeppesen & Molin 2000; Schreier & Prugle 2006), and medical products (Hienerth & Lettl 2011). In many of these examples mentioned above, consumers have worked independently to create a new product or service, and have subsequently freely shared and provided their solutions to their community of peers (Von Hippel 2017). This type of innovative behaviour can often evolve into more entrepreneurial activities (Shah & Tripsas 2012; Shah et al. 2012). For example, Hienerth & Lettl (2011) highlighted the case of Robert Sommer, a former professional downriver and slalom paddler who, after an injury, moved to traditional kayaking – which used longer paddles. He realised these longer, heavier paddles required for the sport could cause injury to the joints and started working on a solution for his own benefit. He soon developed a lightweight paddle, which caught the attention of other members at the kayaking club he attended. He started to produce lightweight paddles for the other members of his community, which eventually turned into a full-time business. His organisation evolved into the second-largest kayaking equipment organisation in the German market.

The above example highlights the potential of consumers who innovate independently when organisations have not yet produced a solution to their needs. The positive impact consumers can have on new products and services can also be seen when collaborating with organisations. For example, the company 3M, previously adopted a process to identify innovative consumers who can contribute to their new product development process (Lilien et al. 2002). When comparing the ideas developed by the innovative-consumers and current internal product development teams, the ideas generated by the consumers had future sales forecasts eight times higher than the sales of the currently funded projects – a forecast of \$146 million annual sales on average versus \$18 million within five years.

The involvement of consumers in the NPD process, and their independent innovative activities, have highlighted their potential to create novel products (Hienerth et al. 2007; Luthje 2004), which can additionally influence the purchasing decisions of other consumers. It has been found that other consumers' willingness to pay for a new product increases with the novelty of the product (Magnusson 2009), and consumer developed products are often rated more commercially attractive by both consumers and experts (Morrison et al. 2000; Franke et al. 2006). More specifically, individuals are willing to pay 20% more for ideas from consumers that differ from products currently available (Von Hippel & Herstatt 1992). Other benefits of involving consumers in the NPD process include reduced costs in early stage ideation and conceptualisation of the innovation process (Von Hippel & Herstatt 1992; Jeppesen 2005), an increase in product variety (Al-Zu'bi & Tsinopoulos 2012), and an increase in product satisfaction (Franke & Von Hippel 2003; Schreier & Pruegl 2008; Franke et al. 2006).

Today, through the growth and development of web technologies, organisations now have greater levels of access to consumers and their ideas and innovation than ever before, primarily using online communications channels such as virtual communities - communities are online environments that enable members to share, exchange and display information to other members.

Compared to other forms of online engagement such as social networks, virtual communities differ as they are often developed around specific topics, brands or shared purpose with the intention of exchanging information and knowledge between consumers (Rothaermel & Sugiyama 2001). This enables organisations to engage with consumers interested in specific topics, brands or products. While some social networks can also achieve this, they are not developed around a specific topic or brand, but are developed around social connections. Therefore the reasons someone will join a social network will differ from the motives behind why

a consumer will join and contribute to a virtual community. For this reason social networks will not be included within the boundary of this investigation, however the relevance of social networks is discussed further in Section 6.

Virtual communities now exist in great numbers² and individuals often showcase and share their innovations and ideas with other consumers, resulting in large 'information pools' of knowledge (Füller et al. 2007; Jeppesen & Laursen 2009), that often include ideas and innovations – a valuable resource to any firm looking to innovate, identify existing or emerging consumer needs, and better understand their customers and consumers. This value of using virtual communities to access consumers and enhance the innovation process has already started to be investigated with positive results relating to the identification process (Marchi et al. 2011; Füller et al. 2008; Von Hippel 2005; Martineau & Arsel 2017), yet on the surface there appears to be aspects of using virtual communities that could benefit the process further.

6.1. Innovative consumers

While consumer innovation has, for a long time, been documented, it wasn't until the twentieth century that scholars started to document combined evidence of consumers being the source of innovation for both new and existing products; together with identifiable characteristics and methods of identifying innovative consumers from groups of other (non-innovative) consumers (Von Hippel et al. 1999; Von Hippel 2005). These early innovative consumers were labelled 'lead users' by Eric Von Hippel, one of the most prolific scholars on the subject of consumer innovation, who developed both the original differentiating criteria for innovative consumers and a methodology for identifying them.

² Virtual communities such as Quirky (www.quirky.com) claim to have 1.2 million members who have contributed to over 2.1 million contributions to new products and ideas (as of May 2017).

Lead users were defined as consumers who are ahead of a trend (for the given product or service area), and are expected to obtain a relatively high net benefit from solutions to their needs, which are unmet by current market offerings (Von Hippel & Urban 1988). An example of the identification process and the resulting impact of innovative consumers, when involved in the NPD process, can be seen in Von Hippel's earlier work, where he investigated the consumers of Computer Aided Design (CAD) software.

Firstly, Von Hippel identified an underlying trend and need amongst consumers of CAD systems: the "density" of the computer chips and circuits on boards used in their computers. Secondly, screening a sample of CAD consumers, using telephone and postal surveys, to measure their dissatisfaction with current products, product modification (had these consumers built or modified their own products to solve the needs in question), and the rate at which each individual adopted new technology in this specific area. The results of the screening identified consumers of CAD systems, who (1) designed very high-density boards, and (2) were positioned to gain especially high benefit from increases in board density. A small group of these consumers who exhibited the two characteristics above were given the task to collectively develop a high-density board. Their solution was then evaluated against other current products on the market, proving to be 'superior' to currently available alternatives (Von Hippel & Urban 1988).

As mentioned above, a Lead user's two defining characteristics are, (1) they are at the cutting edge of a trend, and (2) they are expected to obtain a relatively high net benefit from a solution to their needs (Von Hippel & Urban 1988; Von Hippel 1986). The growing interest in lead users, and more broadly consumer innovation, led scholars to investigate consumers who exhibit other innovative attributes, which revealed characteristics, motivations and behaviours that have since also been used in the identification process of innovative consumers alongside the original

two differentiating characteristics. These additional characteristics include high levels of technical knowledge, product dissatisfaction, and user-experience (Franke et al. 2006; Jeppesen & Laursen 2009; Luthje 2004), alongside others discussed below.

6.1.1.Consumer labels

The growth of consumer innovation research led to an understanding that different types of consumers can contribute to the innovation process, beyond lead users. Alternative labels used to describe these other innovative consumers have emerged so as to not dichotomise consumers into innovative and non-innovative - as this is not an accurate representation of their ability to contribute to the innovation of new products (Morrison et al. 2004).

In addition to lead users, there are *extreme users*, so named as they gain considerable product knowledge through spending extensive time with the product or service in question, often a result of early adoption, a construct referred to as 'use experience' (Schuurman et al. 2013). Extreme users with high levels of use experience means they may have greater needs than other consumers due to increased use of the product, and could potentially identify problems with the current offering before traditional target market consumers. The extreme use of a product can be a precondition for innovation – when the consumer reaches the limits of the current product or service, and are forced to seek or produce a solution that meets their needs. Similarly, *expert users* have additional product knowledge. However, their knowledge comes from their experience in a related industry or technical domain rather than extended product use (Luthje et al. 2006; Scheid 1997; Schuurman et al. 2013). The labels *extreme user* and *expert user* describe consumers who hold high levels of knowledge about the product, and are likely to provide organisations with resourceful insights into the needs of other consumers.

Tinkerers are consumers who make modifications to a commercially available product (Franz 1999; Rindfleisch 2010). The act of tinkering or modifying a product shows the current product offering does not meet the consumer needs. Those who tinker, modify or innovate, expect to benefit from this change (Dyer et al. 2009; Franke et al. 2006; Von Hippel et al. 2012). *Consumer innovators* also fall into the same category of the consumer who modifies products (Von Hippel et al. 2012), but this term is less frequently used within the literature. It is however used frequently within this investigation as a broad term to encompass consumers who innovate.

The label *user-innovators* is often used alongside lead user, differentiated on the basis of whether the individual has innovated in the past, arguably motivated by 'defector behaviour' (Schuurman et al. 2013). This is where consumers defect from using a product or service as it does not meet their needs. Von Hippel, (1988 & 2005), simply described user-innovators as "*the ones that directly benefit from using their innovations*". As benefiting from the solution is one of the two defining characteristics of lead users, this suggests little to no difference between lead users and user-innovators.

Similarly, a *prosumer* is used to describe consumers who design and produce products and services to meet their need, a term first coined by Kotler (1986) and is likened to lead users and *DIY practitioners* who are motivated by economic benefits, dissatisfaction and the need for customisation (Hahn et al. 2016).

As discussed above, lead users are consumers who innovate their own solutions, and modify existing products to satisfy their needs. These innovations are often noted to be disruptive and profitable products and services (Eisenberg 2011; Lilien et al. 2002; Von Hippel et al. 1999). Lead users are defined using a set of characteristics, which over time have been extended to include: high levels of

technical knowledge (Von Hippel & Herstatt 1992; Jeppesen & Laursen 2009; Von Hippel & Urban 1988; Franke et al. 2006; Morrison et al. 2000), product dissatisfaction (Hienerth et al. 2007; Luthje & Herstatt 2004), product modifications (Marchi et al. 2011; Von Hippel & Herstatt 1992; Jeppesen & Laursen 2009), willingness to collaborate, and social engagement and knowledge sharing (Morrison et al. 2000; Marchi et al. 2011), which can depend on the life cycle and stage of the community at the time of observation (Shah 2000; Franke & Shah 2003; Baldwin et al. 2006).

Other types of consumers that can provide valuable information to organisations often fall within the periphery of innovative consumer research, such as *ordinary users or ordinary consumers*, who are typically at the centre of the target market and happy with the current product offering (Magnusson 2009; Schuurman et al. 2013), therefore do not actively innovate. It was often thought that ordinary consumers could not innovate due to suffering from 'functional fixedness', where consumers are unable to perceive items being used in a novel way (Adamson 1952; Franke et al. 2006). However, recent research suggests they can be resourceful, particularly in the initial ideation phase of an innovation process for new concepts as their lack of in-depth knowledge prevents them from bounding their ideas with technical restraints (Magnusson 2009).

Other peripheral consumers such as *laggards*, adopt products and services towards the end of the product life cycle, after the late majority (Mahajan et al. 1990). Often mentioned in the literature in comparison to *early adopters* (Füller et al. 2004), and defined by Slater & Mohr (2006) as consumers who “...*tend not to believe that innovation can enhance productivity and resist new technology purchases. Buy only if they believe all their other alternatives are worse and cost justification is absolutely solid.*” These consumers can be a source of information for firms and scholars, particularly with regards to *why* they may not adopt a

product, and *how* it could be improved to appeal to other consumers. Additionally, *defectors* do not use the products/services in question by choice, due to dissatisfaction with the current offering. They have needs that are unfulfilled by the current product offering (Duverger & Hassan 2008; Schuurman et al. 2013), and therefore can provide valuable insight for firms into their unmet needs.

While consumers can contribute towards the NPD process of an organisation or innovate for their own personal benefit, some consumers experience a high demand for their innovation, enabling them to start engaging in more entrepreneurial activities (Shah & Tripsas 2007). For example, *user-entrepreneurs*, who are similar to lead users, do not typically set out to start a business, yet begin to manufacture their innovations following high demand from the local community (Lettl & Gemünden 2005; Shah et al. 2012; Shah & Tripsas 2012). Similarly, *user-manufacturers* are defined as a group of one or more lead users who benefit from participating in a small lifestyle firm to produce and sell their innovations to others (Luthje 2004). Lastly, *innovative entrepreneurs* are used to identify more entrepreneurial consumers who are actively trying out new ideas, creating prototypes and launching various projects, enabled by a diverse set of skills (Dyer et al. 2009). However within the field not all consumers, even when engaging in entrepreneurial activity, are called entrepreneurial. For example lead-users who engage in entrepreneurial activities are sometimes still simply referred to as lead users (Hienerth & Lettl 2011).

Other types of consumers include *submitters*, who are consumers with a dyadic relationship with the organisation, undertaking passive collaboration (Rindfleisch 2010). This is most commonly observed in the form of a competition, where the consumer can be incentivised to share their ideas and solutions for new products with an organisation in return for a prize, or a chance to see their ideas brought to life. A similar label used for this type of consumer is a *contestant*, who self-select to

contribute into competitions or to collaborate with an organisation or other consumers (Piller & Walcher 2006). In addition to sharing ideas and knowledge, these consumers have also been known to build prototypes to help convey their ideas to the host firm (Archak 2010), similarly to some of the other types of consumers discussed above.

Other consumers who share information with others, and work collaboratively towards the development of new products and services are labelled *co-designers*. Who are seldom expected to have specific skill sets (Berger et al. 2005; Berger & Piller 2003; Rindfleisch 2010), and often no emphasis is placed on the quality, scale or impact of their contribution (Piller et al. 2010). Some co-designers, also referred to as *co-creators* (Matthing et al. 2008), have also been observed to exhibit lead user characteristics, such as high levels of product knowledge (Von Hippel & Oliveira 2009).

Brand evangelists and *brand community members* typically exist in dedicated communities populated by individuals motivated to engage with other consumers and the host (Marchi et al. 2011). The community is often made up of end-users of one or more of the host brands products or services. Members self-select to be part of the community and some community members exhibit high levels of passion and brand alignment, willingness to contribute to open innovation, along with other characteristics associated with innovative consumers such as: product knowledge, knowledge sharing and innovativeness (Fournier et al. 2001; Füller et al. 2007).

It would appear that existing consumer innovation research has provided a thorough overview of the spectrum of consumers who can innovate and/or contribute to the NPD process. However the boundaries of each 'type' of

consumer appears blurred, with many sharing similar characteristics and motives, and engage in similar practices.

Despite the many different labels used to describe consumers, their capacity to innovate and contribute to the NPD process appears linked to specific characteristics: as Magnusson (2009) highlighted, some consumers are best suited to the early stages of the process, when conceptualising new ideas, as their designs are not bound by technical limitations. Another perspective that needs acknowledgement is the individual's professional stance when contributing ideas for new products and services within a community. Jeppesen & Frederiksen (2006) observe that hobbyists, as opposed to professionals, are more likely to be innovative and engage in an innovative activity as they are focused on improving the products/services in the discussion.

Innovative consumers who act or engage in a professional capacity, are often labelled, and can be categorised by their position inside an organisation. For example, *embedded lead users* are defined as “employees who are lead users of their employing firm’s products or services” (Schweisfurth & Raasch 2015), however more recent studies show that while embedded lead users’ ideas are of higher quality than those of ordinary employees and consumers, they are often of lower quality than the ideas of external lead users (Schweisfurth 2017).

Other labels to acknowledge, but are seldom used in relation to innovative consumers, but apply to consumers within communities are *lurkers* and *posters* (Füller et al. 2007), *active individuals* and *outsiders* (Guo et al. 2017), *master* and *efficient contributor* (Füller et al. 2014), *core team* and *committer* (Hedberg & livari 2009).

Given the large number of consumers who exist within virtual communities, and the range of labels used to describe consumers, there is a need to further understand their differences, specifically when approaching virtual communities as a source of innovation. These labels, consumer differences, and their defining attributes, need to be considered when planning to collaborate and identify consumers. Given the capacity for each virtual community to house millions of consumers, it will be challenging and inefficient for an organisation to 'cut through the noise' without this knowledge, however a framework for how to differentiate and identify innovative consumers, specific to different stages of the innovation process, does not yet exist within the literature. Within the current literature this information exists. In each investigation about consumer innovation there are likely to be a set of identifiable characteristics, and an outcome – whether that be an idea, solution, or fully functional product. In many studies related to collaboration with external organisations, there is also likely to be an indication of the stage in the NPD process where the customer was brought in to collaborate. Collectively this information can provide new knowledge on how consumers relate to measurable characteristics, and stages of the NPD process.

6.1.2. Identifiable characteristics

As mentioned above each type of consumer displays different characteristics and abilities, some exclusive to specific types of consumers, while others are shared between the different types of consumers. Individual measures used to identify innovative consumers, such as lead user or user-innovators include *being ahead of a trend*, *expected benefits* (often measured with the proxy *speed of adoption*, or *dissatisfaction*), high levels of *product knowledge*, and *use experience*, as discussed above.

Other characteristics which are also used include *innovativeness* - measured using items such as “*I have original ideas*” and “*I am an inventive kind of person*” (Füller

et al. 2008), a *willingness* to engage in open innovation and collaborate (Marchi et al. 2011; Füller 2006), and *knowledge sharing* within a community (Jeppesen & Laursen 2009). Alongside individual measures, community measures are also used including *community identity* (Jeppesen & Frederiksen 2006; Jeppesen & Laursen 2009; Füller et al. 2007), *community communication* and *community based resources* (Franke et al. 2006; Luthje 2004; Franke & Shah 2003; Von Hippel et al. 2012), as the need to innovate and modify products often requires community resources, feedback and involvement (Franke et al. 2006). Items used to measure *community-based resources* include “*When I encounter technical problems, I know exactly who to ask for advice*” and “*If I were to make changes to my kite surfing equipment, I could count on getting positive feedback about the changes from my fellow kite surfers*”. However, as has been shown, not all innovative consumers require community resources, and can innovate independently (Von Hippel et al. 2012; Von Hippel 2017).

Other characteristics observed in innovative consumers include a *consumers commitment*, both to the product field (Franke & Shah 2003; Luthje 2004), and the task of innovating, which is measured using scales such as *task motivation* (Jeppesen & Frederiksen 2006), *task involvement* (Luthje 2004), and *time investment* (Luthje et al. 2006).

As touched upon above, motivations can also be used in the identification process. Interestingly both intrinsic motives (Jeppesen & Frederiksen 2006; Füller et al. 2007; Luthje 2004; Füller 2006; Füller et al. 2006), where consumers participate in an activity for its inherent satisfaction, and extrinsic motives (Jeppesen & Frederiksen 2006; Füller et al. 2006), where activities are done in order to attain some separable outcome, perceiving the task itself as a means to an end (Ryan & Deci 2000), can be used for identification of innovative consumers. Recently Von

Hippel (2017) highlighted the paradigm of free innovation, where consumers give away their innovations for free and are rewarded in alternative ways, such as an increase in the social welfare in their community. This paradigm is based on a transaction-free diffusion, where there is no motivation to directly gain or be compensated for the work, demonstrating that many consumers can act intrinsically. However the growth and development of virtual communities has put consumers in a position where it is easy for them to be compensated for their work – many virtual community platforms enable users to exchange or sell items with ease to much larger audiences. It is therefore important to consider these factors in the consumer identification process, and to investigate how the development of online technology could influence the motivations of consumers, and importantly the effect it could have on their willingness to collaborate with organisations.

6.2. Motivations

The motivations of consumers in relation to innovative activity are multifaceted. Motivations to innovate, or to disclose their innovations, will differ from motivations to engage in collaborative activities in consumer communities or with an organisation. Social psychology has shown, in relation to traditional (non-virtual) communities, that humans have a need to belong and be associated with other individuals. This is due to what a community can provide for a consumer, such as knowledge and help in achieving goals (Watson & Johnson 1972; Ridings & Gefen 2004). Motivations for joining traditional, non-virtual communities can be extended to observe membership in virtual communities, as discussed below.

6.2.1. Recognition and reputation

Butler et al. (2007) suggested that the primary reason for consumers to engage and share knowledge, a characteristic of innovative consumers (Jeppesen & Laursen 2009), is their expectation of being seen as skilled, knowledgeable or respected,

specifically within firm hosted communities. Jeppesen & Frederiksen (2006) argue that firm recognition also includes peer recognition, as achieving firm recognition leads to peer recognition.

Recognition has similarly been observed to motivate consumers to engage in communities as it increases their visibility to other consumers within the community and helps them receive credit for their contributions beyond their local boundaries (Malhotra & Galletta 2003). Recognition from the community for sharing knowledge can be achieved in virtual communities created by organisations (Jeppesen & Frederiksen 2006). Additionally, peer recognition has been observed to motivate innovative consumers to engage with other consumers in a community (Jeppesen & Laursen 2009).

6.2.2. Access to information

In addition to building a reputation, access to information can act as a motivation to engage (Furlong 1989; Jones 1995; B Wellman et al. 1996). Access to information retained and generated by the community is often free, and otherwise inaccessible or obscure (Butler et al. 2007; Furlong 1989; Wellman et al. 1996). Therefore, many consumers will be motivated to (Baym 2000; Wellman & Gulia 1999a) engage with this free source of information, and in turn contribute to communities in order to acquire this knowledge and learn (Amabile 1985; Csikszentmihalyi 1996; Jacobsen et al. 2017). This will include less knowledgeable consumers who wish to learn more about the current products and services they use, but also more innovative consumers driven by dissatisfaction with the current product offerings, and who thus seeks to exchange ideas and search for solutions (Füller et al. 2007; Luthje 2004).

Furthermore, virtual communities provide content that is member-generated, as opposed to other websites and online environments, which is typically provided by a firm. This is an important factor influencing the success of a virtual community (Filipczak 1998). As more consumers generate more content, the new content attracts more consumers (Hagel & Armstrong 1997). Knowledge within a virtual community is essentially a valuable currency or social resource (Binik et al. 1997; Rheingold 1993a; Sproull & Faraj 1997; Hiltz & Wellman 1997), and a virtual community can be an ideal place to ask relative strangers for knowledge and information (Ridings & Gefen 2004). This is often due to virtual communities being focused on very specific topics with relationships among consumer members being mostly intended for information exchange about specific topics (Baym 2000; Wellman & Gulia 1999a). Horrigan & Rainie (2001) noted that from a study of 1,697 virtual community members, those involved with entertainment, professional and sports groups focussed their discussions on exchanging information. This study also provides further supporting evidence of the scale of online engagement, contributing to the notion that greater efficiency is required when approaching virtual communities for consumer identification. Horrigan & Rainie also wrote:

“Sociologist Barry Wellman argues that many new social arrangements are being formed through “glocalization³” – the capacity of the Internet to expand users’ social worlds to faraway people and simultaneously to bind them more deeply to the place where they live. This report illustrates how widely “glocalization” is occurring. The Internet helps many people find others who share their interests no matter how distant they are, and it also helps them increase their contact with groups and people they already know and it helps them feel more connected to them.”

³ Glocalization, or Glocalisation, is a portmanteau of globalisation and localisation, and used to describe the adaptation of international products around the particularities of a local culture in which they are sold.

6.2.3. Professional and economic

A consumer's motivation may also be affected if they engage in a community on a professional level (a professional) or in their spare time, which does not form part of their employment (a hobbyist), where it has been observed that hobbyists are more likely to be innovative consumers and engage in innovative activities (Jeppesen & Frederiksen 2006).

Moreover, the time and effort an individual invests into the community can be affected by external factors, such as economic returns (Von Hippel 2007), as individuals who engage in a community as part of their employment (e.g. digital marketing representatives, designers, or other workers whose role requires them to engage with external communities) are likely to be extrinsically motivated to do so and therefore focused on their work objectives and less likely to engage beyond these. In contrast, contribution and engagement in many communities are uncompensated and therefore individuals who are actively engaging are unlikely to be motivated by means-to-an-end motives. This assumption is supported by the observations that those who are likely to innovate, such as lead users, are intrinsically motivated, often by a sense of enjoyment (Belz & Baumbach 2010; Bryant et al. 2005; Füller et al. 2007).

6.2.4. Ideologies

Another motive that contributes towards a community is ideology, which is specifically observed within open source software communities (Lakhani & Wolf 2005; Stewart & Gosain 2006) and communities such as *Wikipedia* (Nov 2007). Shared goals within a community that can contribute towards the process of product development, are often derived from spending time within a community and can be influenced by the 'social system', as discussed in the Diffusion of Innovations theory (Rogers 2003). The Diffusion of Innovations theory highlights the effect of the social system on innovation. A social system is defined as, "a set of

interrelated agents, or units, that are engaged in joint problem solving, to accomplish a common goal” (Rogers 2003). The units or agents can be individuals, consumers or groups. The social structure, specific agents (if seen as opinion leaders) and system norms can be affected if an innovation is accepted or rejected by an individual, or by a collective.

An innovative consumer within a social system, who understands the values and interests of others in the social system, may decide not to pursue with their innovation through fear of disturbing the status-quo. The structure of a social system in a community can “*facilitate or impede the diffusion of innovations in the system*” (Rogers 2003), and in turn this can be affected by an individual’s normative beliefs, which are concerned with the likelihood that important individuals or groups approve or disapprove of a given behaviour (Ajzen 1991), which could be directly influenced by the type of community. If the values of the consumer do not match the objectives and activities of the community, they may be unlikely to join specific communities.

When exploring consumers' motivations to engage in innovation through co-creation activities in the gaming and video games industry, Roberts et al. (2014) found that: “*motivations appear to differ across types of co-creation efforts. Innovating independently of the firm appears to be driven by egocentric motives; innovating as part of a community appears to be driven by altruistic motives; and innovating directly in collaboration with the firm appears to be driven by opportunity - or goal - related motives*”, highlighting the motives that drive different consumers. It would appear logical to take into consideration the differing motives that drive consumer behaviour when planning any type of consumer identification, as firms may wish to avoid or attract certain types of consumers (e.g. those who are willing to collaborate with firms). Furthermore this may affect where firms can locate consumers, as different virtual communities may appeal more or less to specific

types of consumers. However it has not been possible to find any research that has investigated the locality of the consumer or whether this has influenced the motivations.

6.2.5. Social engagement

Virtual communities often inform social engagement and relationships between members; as some studies have suggested, individuals would share knowledge within virtual communities with the expectation of enriching their knowledge, seeking support and making friends (Andrews 2002; Zhang & Hiltz 2003). Specifically, communities have been characterised by the existence of "weak ties", which are suggested to significantly contribute to the generation of content; relationships can exist between strangers in order to obtain information through online networks (Constant et al. 1996; Ridings & Gefen 2004). In this scenario, reciprocity is the most cited motive - giving back to the community in return for receiving help (McLure Wasko & Faraj 2000), and providing some feeling of responsibility to contribute or maintain relationships with other members. Some studies have shown that innovative consumers identify with other consumers exhibiting similar levels of knowledge (Jeppesen & Frederiksen 2006), however they appear less motivated by reciprocity and usually do not primarily engage with one another to socialise or develop personal relationships (McLure Wasko & Faraj 2000).

Additionally, engagement and interactions between consumers often informs group cohesion and unity, provides a member's feeling of ownership of the virtual community, as well as their loyalty to the community, and organisational citizenship behaviours (Koh & Kim 2004; Organ 1989). As consumers exchange information within communities, they have been observed to exhibit the same level of emotional attachment to the community as people have with physical places (Brown & Duguid 2000). Furthermore, it has been suggested that consumers share

knowledge with the expectation of helping the community to accumulate its knowledge, continue its operations, and grow (Bock & Kim 2001; Kolekofski & Heminger 2003).

Social support is another reason why consumers will join a virtual community, and can be described as “the degree to which a person's basic social needs are gratified through interaction with others” (Thoits 1982). This can also be linked with motivations to join communities for the sense of belonging and affiliation it brings (Watson & Johnson 1972) and the way it addresses the need for self-identity (Hogg 1996). This supports the notion that online environments are social settings in which people can exchange socially, and also support each other (Mickelson 1997).

6.2.6. Friendship

As discussed above, consumers and the public have been found to join physical (face-to-face) communities to belong and be with other individuals (Watson & Johnson 1972), and to achieve friendship (Ridings & Gefen 2004). A study on a community titled Usenet Newsgroup, highlighted that while individuals were drawn there to discuss television shows, friendliness was prominent within the community (Baym 2000). Similarly, Utz (2000) observed in gaming virtual communities that individuals form friendships and those who did not have friendships would spend less time in the community.

The nature of the internet makes it easier for individuals, and organisations, to find others with similar interests or in similar situations than it is in real life (Igbaria 1999; Wellman & Gulia 1999a), particularly if the common interest is unusual. Furthermore, it has been suggested that individuals with jobs that are isolated will seek others in virtual communities to exchange opinions, discuss needs and problems, and to engage in conversations (Filipczak 1998; Lowes 1997; Wellman

1997) or simply for the purpose of friendship and “hanging out” together (Parks & Floyd 1995; Rosson 1999).

Given the variety of motivations associated with engaging in a virtual community, it is important to consider these when considering identification of innovative consumers. But are these the only reasons? There appears to be a notable gap in the literature on the features and functionality of virtual communities, and what these enable individuals to do, and how these could influence the engagement. As mentioned before, different communities will attract different types of people, with different interests and motivations. However, there is an unanswered question in the current literature about how the functionality and features of a virtual community could affect innovative consumers. Which would inform where we look to identify them.

6.3. Virtual communities

Virtual communities have been described as communities of individuals who meet to discuss subjects of interest with other community members (Figallo 1998), and individuals with shared interests or goals for whom the primary interaction is via electronic communication (Dennis et al. 1998). The word “community” is often used in reference to a geographic area (Wellman & Gulia 1999b), however the combined term “virtual community” indicates it is without a physical place as a home (Handy 1995). Virtual communities are therefore online environments, containing functionality to enable the exchange of information between members creating “social aggregations that emerge from the Net when enough people carry on those public discussions long enough, with sufficient human feeling, to form webs of personal relationships in cyberspace” (Rheingold 1993b).

Compared to other forms of online engagement, virtual communities differ as they are often developed around specific topics, brands or shared purposes with the

intention of exchanging information and knowledge between users (Rothaermel & Sugiyama 2001). Virtual communities often contain large numbers of members from decentralised locations, who participate in the community discussions and exchange freely and voluntarily (Guo et al. 2017).

These communities can exist in great numbers often enabling members to showcase and exchange information about new product ideas (often related to the community topic, interest or brand), discuss problems they encounter, and share new innovations to these problems with other consumers. Due to the nature of virtual communities, all of these discussions are often openly accessible to other members, creating what's known as an 'information pool' (Füller et al. 2007). Communities with information pools are attractive for both consumers and organisations, and can often help organisations to connect with consumers and include their ideas and contributions into a NPD process (Von Hippel & Katz 2002; Sawhney et al. 2005; Romero & Molina 2011). However the success of this involvement in the NPD process is dependant on the consumer's participation, ability to conceptualise solutions, and communicate these within the community (Sawhney & Prandelli 2000; Füller et al. 2010). When communities become large it could arguably be hard for consumers' contributions to be noticed, and for organisations to see potentially valuable contributions. For example, the virtual community Quirky - a social invention virtual community⁴ - claims to have over 1.2 million members. Similarly, Mobile Nations, a forum for smartphone consumers claims to have over 500,000 users engaged each month⁵. The forum for Apple products MacRumors, claims to have over 900,000 members, who have collectively exchanged over 23 million messages within 1.9 million different discussions⁶. These numbers highlight the scale of virtual communities, and the

⁴ <https://www.quirky.com>

⁵ <http://www.mobilenations.com>

⁶ <https://forums.macrumors.com>

volume of information contributed by consumers to their information pools. Furthermore, it opens up the question as to how organisations can efficiently find suitable consumers willing to contribute to the NPD process in virtual communities of this magnitude.

Other examples of virtual communities include chat rooms or bulletin boards, where members contribute frequently on common interest topics such as mobile technology, health issues, etc. However there appears to be no explicit definition for what constitutes a virtual community member (Ridings & Gefen 2004). The term 'member' includes those who do and do not contribute to the virtual community. For the purposes of this research, member will be used as a synonym for consumers who contribute to a community, by explicitly commenting, sharing knowledge or digital artefacts, or anyone who reads or engages with contributions of other members, regardless of frequency.

6.3.1. Foundations of virtual communities

Virtual communities have evolved over many years, from *Inter Organisational Systems* shared by different companies and primitive online gaming platforms, to advanced social invention platforms. Standardised networking procedures coupled with the deregulation of the internet in 1995 has led to individuals being able to communicate over a global network (Plant 2004).

Virtual communities also have multiple definitions, such as *computer-mediated spaces*, where there is a potential for an integration of content and communication with an emphasis on member-generated content (Hagel & Armstrong 1997). Other definitions include: *Symbolically delineated computer-mediated spaces* whose existence is relatively transparent and open, that allows groups or individuals to attend and contribute to a similar set of computer-mediated interpersonal interactions, defined by Jones & Rafaeli (1999) who referred to virtual communities

as *Virtual Publics*. Or more abstract definitions as described by Hesse, such as a community that spins time and geography, a community that supplements buildings and streets with personal computers and information superhighways. For a full review of virtual community definitions see Lee et al. (2003).

Not all virtual communities are created equally, or with the same ethos or purpose, and can often be classified into distinctive categories according to their underlying principals or applications, such as ownership or authority (Plant 2004). For example: *Self-governed* virtual communities, formed by community members, are where activities and discussions are either fully or partially initiated by the community members (Füller & Von Hippel 2008; Marchi et al. 2011); these communities can operate without any governance from an organisation (Piller et al. 2010). Alternatively the virtual community can be created and managed by an organisation, as many organisations do to facilitate a discussion between them and their consumers (Füller et al. 2008; Marchi et al. 2011; Franke & Piller 2004), often referred to as *firm-hosted*.

Other classifications of virtual communities can be formed around the desire to satisfy certain needs, such as relationship, transactional, fantasy, and general interest needs (Hagel & Armstrong 1997; Carver 1999). The examples these authors give include a finance website as a community of interest; a forum for cancer related issues as a community of relationship; a gaming focused community that is classed as being a community of fantasy, and a business to consumer platform as a community of transaction. Similarly, virtual communities can be classified in relation to their function, for example *marketplace communities* enable the consumer to engage to gain financial compensation or other rewards, which creates a competitive environment and attracts consumers who have professional interests. In relation to communities that facilitate innovation, it is possible that this type of community negatively affects the free flow of information about consumer

innovations, and decreases the individual's intrinsic motivation to engage in the community (Franke & Shah 2003) and negatively influences a consumer's creativity (Amabile 1985).

Virtual communities can also be considered *closed* or *open*, to manage the members' access to information and contributions. Closed communities are not accessible to the general public; some facilitate anonymous contributions, thereby discussing topics that they may otherwise not do in a physical location (Herring 1996), which may arguably influence individuals to engage online in more or less intensive ways than they normally would (Suler 2004). On the other hand, open communities make their information pools available to the general public.

In relation to innovative consumers, Mahr & Lievens (2012) have coined the term 'virtual lead user communities', and defined them *as being a "firm-hosted virtual community in which members with lead user characteristics interact to create knowledge about new products and services."* The authors go on to state that the innovating firm and members communicate in short iteration cycles to enhance the collective knowledge about consumers' needs and possible solutions.

In relation to virtual community functionality, many are designed and structured differently to accommodate different activities (Battistella & Nonino 2011). Some virtual communities, often forums, enable only simple interactions, such as text-mediated exchanges. While others enable the exchange of files and other forms of data and even currency, in the form of an online shop, enabling the consumer to make money and use the community for both personal and professional interests. Some communities will use mechanisms such as leader-boards, measurements of contribution, peer review (rating) systems, monetary rewards and point systems (Wiertz & de Ruyter 2007; Chai et al. 2009), to incentivise contributions. Although these incentive mechanisms can influence contributions (Rashid et al. 2006; Burke

et al. 2009), they can often lead to “*commitment by compliance*” where the primary focus of the user attention is driven by potential extrinsic rewards available. This extrinsic focus may have a negative effect on the value of the information pool, as the contributions made are not with the intention of adding value but to obtain a reward (Cheng & Vassileva 2006).

As discussed above, the categorisation of virtual communities into self-governed or firm-hosted represent a specific understanding of communities, from one perspective. Communities can also be sub-divided into geographic, demographic or topical types. While structure is important, a virtual community can also be defined relating to its frequency of use, as consumers become committed to their communities and will visit them frequently (Hiltz & Wellman 1997). In some instances, individuals can become highly dependent on a community, whereby they can be described as addicted (Hiltz 1984).

Figallo (1998) broadly defines virtual communities are those where individuals feel part of a larger social group, have on-going exchanges with other members about areas of shared value, and have lasting friendships with other members. An alternative definition of a virtual community is a group of individuals with a common interest and values, that communicate regularly and for some duration in a structured and organised way over the internet in a common location (Ridings et al. 2002); this is the definition used in this investigation.

6.3.2. Source of innovation

The growing size of some virtual communities presents a challenge in identifying what could be a small handful of innovative consumers, and has resulted in new approaches to identify innovative consumers. As highlighted above, virtual communities can be hosted or utilised by organisations to harness the innovative behaviours of consumers, and integrate their ideas and solutions into the NPD

process, despite traditional views that consumers are situated outside the boundaries of organisations (Porter 1985; Priem et al. 2012). New technology and means of communication bring them both closer together, and often blur the boundaries between them (Bowen 1986; Baldwin & Von Hippel 2011).

Organisations are progressively leveraging external knowledge from consumers in virtual communities (Bogers & West 2012), by giving consumers a more active role in the value creation process (Nambisan 2002), which has shown to have a positive impact upon a company's innovation output and performance (Ryzhkova 2015; Wadell et al. 2013; Carbonell et al. 2009). Consumer involvement in the NPD process is also considered one of the most important strategies extensively researched by open innovation scholars (Gassmann 2006). Furthermore, it also represents a movement from internal (closed) R&D processes toward a more open, collaborative approach providing a greater understanding of consumers needs and problem-solving abilities (Chesbrough 2003; Von Hippel 2005).

Mahr & Lievens (2012) highlighted that more than 80% of firms listed in the S&P 500 index have created virtual communities for their consumers. Consumers have even been referred to as "partial" employees (Mills et al. 1983). The involvement of consumers in the new product development (NPD) process, and their independent innovative activities, have highlighted their potential to create novel products (Hienerth et al. 2007; Luthje 2004). Notably, it has been found that consumers' willingness to pay for a new product increases with the novelty of the product (Magnusson 2009), and novel products are rated more commercially attractive by both consumers and experts (Morrison et al. 2000; Franke et al. 2006). More specifically, individuals are willing to pay 20% more for ideas from consumers that differ from products currently available (Von Hippel & Herstatt, 1992). Other benefits of involving consumers in the NPD process include reduced costs in early stage ideation and conceptualisation of the innovation process (Von Hippel & Herstatt

1992; Jeppesen 2005), an increase in product variety (Al-Zu'bi & Tsinopoulos 2012), a positive direct effect on technical quality and innovation speed (Carbonell et al. 2009), and an increase in product satisfaction (Franke & Von Hippel 2003; Schreier & Pruegl 2008; Franke et al. 2006).

Many empirical investigations have also focused on the advantages of utilising online or web-based tools to enhance collaboration with consumers (Matzler et al. 2013; Franke & Von Hippel 2003; Parmentier & Gandia 2013), showing that organisations with these tools can benefit from an improved brand image, request ideas for new products (Parjanen et al. 2012; Witell et al. 2011), improve their overall consumer relationships and provide more efficient help and support (Nambisan & Baron 2007). It is arguably critical for organisations to understand how to utilise virtual communities, understand how they function, and to obtain insight into how they can act as a valuable asset for accessing and identifying innovative consumers. Virtual communities will also provide access to a much larger pool of consumers, as discussed above, in real-time, faster than is possible in physical communities. Virtual communities also enable contributions to be searched, analysed and extracted to evaluate a user's level of contribution and their innovativeness (Füller et al. 2007), without being intrusive.

Given the range of different virtual communities, it is also important to understand which types of virtual communities attract innovative consumers, and to a greater extent those who are willing to collaborate, which is seldom mentioned in the current literature. Besides the recent research into virtual lead user communities, which focused on firm-hosted communities, there is little information or knowledge surrounding this area. Furthermore, the theory of innovation diffusion highlights the importance of social systems of consumers, which may itself have an effect on a consumer's individual innovativeness (Rogers 2003). Understanding which virtual communities both attract and facilitate innovative consumers could therefore have

a significant impact on the effectiveness and efficiency of the identification of innovative consumers.

6.3.3. Social networks

The focus of this research is on virtual communities that are created around specific interests, brands or products. However there are other types of online environments that exist, which can also support organisations looking to identify consumers for NPD development. Furthermore, while the internet is a fundamental part of virtual communities, the notion of community is applicable to all online environments (Erickson 1997; Fernback 1999).

Social networks including Facebook and Twitter, which are used by many firms to communicate with consumers, and promote new products and services, can also act as a source of innovation (Nambisan & Nambisan 2008); these platforms can support community discussions around specific topics, and act as a consumer support communication channel (Quercia et al. 2011; Cha & Gummadi 2010; Roberts et al. 2016).

However, many of the social network platforms being investigated for this research were not designed to facilitate consumer-organisation engagement, but have instead adapted to support this. The information provided by social media platforms can therefore appear disjointed and the profile of the user is often limited; the current value and benefits of using social networks for this purpose are arguably still not being realised by firms (Roberts & Candi 2014).

Social networks, similar to chat rooms, are simply online environments for individuals to meet without any sense of permanence or consistency among the members (Ridings & Gefen 2004). Moreover, these environments exist to cater to individuals, and each will experience a different mix of people contributing each

day, with no guarantee of regularity. Therefore, due to the lack of intended purpose for developing discussion and contribution around shared interests, topics or brands, and a lack of regular contributions by consumers, these types of online environments could be considered to not qualify as a virtual community (Jones 1997). Although they have a similar definition to virtual communities ("*Social network sites are virtual platforms on which people can synchronously or asynchronously create, share, modify, or react to various forms of electronic content*") (Roberts & Candi 2014), they will not be included within this investigation. Furthermore, other analogous areas of research such as entrepreneurship can arguably be included within the area of investigation, as factors such as human and social capital (Davidsson & Honig 2003; Anderson & Miller 2003), can be likened to the characteristics of the innovative consumer, and virtual communities can facilitate entrepreneurial activities. This investigation is bounded to the identification of innovative consumers within virtual communities given that many are not interested in entrepreneurship activities; Von Hippel (2017) indicates that less than 10% of household innovators are interested in becoming entrepreneurs. The magnitude of innovations apparently are not taken to mainstream markets by the original innovator indicating the wealth of innovations potentially unseen by firms, and other consumers who would also benefit from the innovation.

6.4. Identification methods

An essential part of the process of collaborating with innovative consumers is identification – spotting the characteristic of the consumer that can indicate their ability to conceptualise or produce innovative ideas - if they are not already openly disclosing their ideas within a virtual community. Whether identifying innovative consumers in virtual communities, physical communities or both, different methodologies are used to capture this information. Due to the nature of virtual communities scholars are now able to access alternative data sources, and observe consumers in new ways.

Traditionally, popular methods of identifying innovative consumers, often used for large consumer communities, included questionnaires and surveys as they could be used to reach global audiences with relative ease (Franke et al. 2006; Füller 2006; Luthje et al. 2006; Jeppesen & Laursen 2009; Morrison et al. 2004). Often in the form of self-reported questionnaires, relatively less resources are required to collect the data, and it provides the respondent with an opportunity to disclose data and information that is not easy to observe, such as thoughts, new ideas, and experiences, outside the community.

Additional methods used to identify and measure innovative consumers in many early studies included screening – often a semi structured interview, or using a questionnaire, via the telephone to enable the data to be collected directly by the researcher. The difference between self-reported questionnaires and screening is that, within screening the researcher collects the responses of the participant, and also had the opportunity to ask additional questions following the initial screening (Von Hippel & Herstatt 1992; Ogawa 1998).

Similarly, a method referred to as *pyramiding* has proven successful (Von Hippel et al. 2009). When using a pyramiding method, the researcher asks respondents if they can refer someone who is more knowledgeable or innovative than them, each time moving closer to someone who is more likely to be an innovative consumer.

With the growth and development of virtual communities, it is now possible to observe certain behaviours and abilities without the need to engage directly with a consumer. Specifically, when an individual engages in a virtual community, they are creating a digital footprint, made up of objective web-log data. This data often consists of almost everything a person does in a virtual community, from first accessing the web pages of the community, to the number of times they have made comments, posts, engaged with other members, and uploaded/downloaded

files. In many communities these engagement statistics are displayed on members profile pages to help signal that the community is active, or arguably to incentivise others to contribute.

Methods specific to online observations such as *netnography* have been adapted from existing methodologies, to support the identification and observation of individuals in these virtual communities (Belz & Baumbach 2010; Jeppesen & Frederiksen 2006; Jeppesen & Laursen 2009; Füller et al. 2007; Marchi et al. 2011). Specifically, a netnography consists of applying ethnographic research techniques to online environments, and commonly uses information publicly available on the Internet, or data provided by the community management. The data collected can include text data, including simple sentences and messages between consumers discussing new product ideas, material such as images and 3D models uploaded to visualise ideas for new products and services discussed, and even numerical data such as the number of contributions a consumer makes to the community. For example, Marchi et al (2011) investigated a virtual consumer community, where 824 members had posted 2403 messages over 14 months about the development of a new motorbike, on a company created virtual community. To evaluate a consumer's level of innovativeness, the authors aligned the individual consumer suggestions with the 22 identified changes actually undertaken during the development of the motorbike with consumers receiving points for each identified change they were involved in discussing.

Within the same investigation, the vocabulary and terminology of the consumer was also used as a proxy to understand the consumer's level of product knowledge. In the virtual community there was an extensive glossary of technical terms created by the platform owners and the community. A text-retrieval technique of QDA text miner software was used to measure the number of words mentioned by each member from the glossary. A similar method was used to

understand each user's strategic alignment with the brand. A set number of items were extracted from the platform owner's mission statement and this was then used to score users on how many of the statements, or references to the items appeared in the members posts. This example highlights the subjectivity of utilising data from virtual communities as this interpretation of data would unlikely be applicable to another virtual community. As discussed here web-log data has many benefits, however it is often used to analyse retrospective contributions and can be time consuming and often community-specific.

Additionally, contributions to a virtual community have been used to measure characteristics such as consumer motivations (Füller et al. 2007), or to measure the lead user characteristic 'expected benefits' by using proxies such as a member's *time, investment, speed of adoption, and dissatisfaction* (Bilgram et al. 2008a). For example, to understand the motivations of innovative consumers in online basketball communities, Füller et al. (2007) identified text that showed the members' reasoning for their contributions. The text contributions were used as an indication of the consumer's motives, and in specific instances could be seen in patterns, where specific information was contributed to the community at different times. This often happened in response to competitions, where there were noticeable patterns related to the responses in week 1, week 2, and so on.

To provide context to the type of contributions being discussed, in the example above, several members of the virtual community discuss serious ankle injuries when playing basketball. The injury is commonly attributed to insufficient ankle protection and cushioning in existing basketball shoes. Starting from this problem, individuals started to present solutions to solve this problem. For example, the possibility of taking out the insoles of one basketball shoe and inserting the insoles into another model, the cushioning could be drastically improved while, at the same time, guaranteeing ankle stability: *"What I do right now is go half a size big on*

shoes with zoom air and use that extra space to insert another insole...which provides me with that great court feel...but better impact protection”, comments such as the one above are individually analysed to determine the various characteristics of the consumers within the community. As the data extracted from the community needs to be consistently coded and interpreted, methods such as the *Consensual Agreement Technique (CAT)* are often used to achieve this (Mahr & Lievens 2012).

Jeppesen and Laursen (2009) coded the weblog data they collected, via a web-based questionnaire in a software community, according to patterns of posted contributions. Consumer text contributions were coded into whether these (1) posted a question (to the community), (2) answered a question of another consumer, or (3) wrote something that was neither 1 nor 2. The data was analysed to understand how the consumer's knowledge was being shared, and how responsive the consumer was to other community member's questions, and showed that users with a high degree of innovative consumer characteristics tend to enjoy revealing and sharing their knowledge.

Other characteristics such as *commitment* and *willingness to collaborate*, have also been inferred using weblog data by Marchi et al. (2011), through the analysis of the number of contributions over time. Similar measures using frequency have been used to measure commitment and willingness (Nambisan & Baron 2009; Bilgram et al. 2008a; Füller et al. 2007).

It is important to consider *willingness to collaborate* for organisations when identifying consumers, and should arguably act as an important differentiating attribute. Consumers who are innovative yet unwilling to collaborate with organisations are questionably less valuable, and could use up valuable resources

in the identification process if willingness to contribute is not considered within the items measured.

Product knowledge has been measured by interpreting vocabulary use by consumers in their text contributions in a virtual community, specifically using the frequency with which consumers used domain relevant vocabulary as a proxy (Marchi et al. 2011). Scholars have also used numerical data to identify innovative consumers. For example: innovative consumers, such as lead users, can be observed to have higher levels of engagement than other members (Füller et al. 2007; Marchi et al. 2011). One example from Füller et al. (2007) identified (through analysing text contributions) that the top 3% of contributors or “frequent posters” possessed extensive product knowledge, and are well known within the community, often taking the role of an opinion leader, who contributes both new knowledge and is highly engaged with other members.

While there are many examples, and observations from scholars on this subject, which are listed in the appendices for references (see Section 16.8) the literature appears to lack input and experience from industry experts, and insight into industry practice for identifying innovative consumers. Community managers, platform creators, and founders – those with inside knowledge on how best to use, interpret and identify consumers at the forefront of the community – could provide valuable insights.

6.4.1. Alternative identification methods

Organisations such as Internet security software providers could be considered to have a leading edge status when it comes to identifying innovative consumers to help solve the problems their organisations face. For many years now these firms have participated in events to award prizes to consumers who are highly skilled in

hacking software⁷. These individuals are offered a prize to come up with innovative ways to hack computer software, with the prize often being a large sum of money or a job at the firm hosting the event. This approach to solving problems, could also attract innovative consumers, and be used as an alternative method of *attracting* them, as opposed to *searching* for them, which is often the case with the other methodologies. The traditional screening format used above for identifying innovative consumers is essentially a competition, yet the aim is to identify a resourceful and knowledgeable individual and not a new product. Similarly, it is common for organisations to utilise highly innovative users by holding similar events called hackathons⁸ to motivate consumers to create and compete against other individuals and teams in building software products, for a prize in exchange for solving the problems or providing the basis for a new product.

Other, more indirect, methods of organisations 'listening' to their consumers, to understand their needs, is mass customisation (MC), which allows consumers to customise and modify products from pre-defined components to meet their needs (Tu et al. 2004), and can be considered a form of co-creation (Wind & Rangaswamy 2001). Organisations such as Adidas have used MC systems to enable the customer to choose the style, colour, size and other features of their sports trainers, which are then manufactured to their specification.

6.5. Summary

The current literature informs us that new knowledge is one of the most important components of innovation (Nelson & Winter 1982), and that it is central to the development of new products and services (Madhavan & Grover 1998). Innovation is defined as an idea, practice or object that is perceived as new by an individual, an onlooker, or other unit of adoption (Rogers 2003). For this investigation the

⁷ <https://www.defcon.org/index.html>

⁸ <http://www.hackathon.io/events>

onlooker is the firm who is looking for new ideas, solutions and innovations to support its existing consumer needs, or to diversify into new markets. Novel and commercially attractive innovations, solutions and ideas often stem from innovative consumers, but can be difficult to access due to their location outside a firm's boundaries (Schweisfurth 2017). To overcome this firms will often adopt processes to understand and acquire a consumer's needs and preferences (Jaworski & Kohli 1993). Due to new technologies making internet access and discussions more common, organisations are now leveraging knowledge of consumers using virtual communities (Bogers & West 2012).

Consumer involvement in the NPD process is considered one of the most important strategies extensively researched by open innovation scholars (Gassmann 2006), and has a variety of impactful outcomes. These include the creation of novel products (Hienerth et al. 2007; Luthje 2004), rated more commercially attractive by both consumers and experts (Morrison et al. 2000; Franke et al. 2006), and being marketed at higher prices (Von Hippel & Herstatt 1992). In addition to this influence, reduced costs in early stage ideation and conceptualisation of the innovation process can also be experienced (Von Hippel & Herstatt 1992; Jeppesen 2005). Furthermore, innovative consumer involvement can lead to firms gaining a competitive advantage (Prahalad & Ramaswam 2004), an increase in product variety (Al-Zu'bi & Tsinopoulos 2012), and an increase in product satisfaction (Franke & Von Hippel 2003; Schreier & Pruegl 2008; Franke et al. 2006). As noted by Mahr & Lievens (2012), knowledge creation can also be amplified if the firm includes more and carefully selected consumers.

Furthermore, collaboration with consumers can improve the effectiveness of the new product development process and outcome, including the speed and quality of innovation (Carbonell et al. 2009; Gruner & Homburg 2000). For example consumers with lead user characteristics can contribute to commercially

successful products and services (Morrison et al. 2004; Von Hippel 2005), however they may also hinder the creation of certain types of knowledge due to their differences from other consumers such as ordinary users (Moore 2002; Magnusson 2009). This indicates that certain types of consumer are better suited to different stages of the NPD process than others. Consumer involvement also represents a movement from an internal (closed) R&D process toward a more open collaborative approach, providing a greater understanding of consumers needs and problem-solving abilities (Chesbrough 2003; Von Hippel 2005).

Today, due to advances in technology, virtual communities can offer organisations a more diverse set of consumers at a lower cost (Hoffman & Novak 1996). However, while these online communities provide greater access to a range of consumers, the sheer size adds a layer of complexity in relation to identifying the relevant type of consumer, or customer within the community. Today we experience many digital products and services for free, that are not direct purchases using traditional payment methods. We can also 'gift' or exchange, and even create and sell digital products. Due to this, within this paper, the word 'consumer' is used as a synonym for customer where appropriate, unless explicitly excluding individuals who purchase the goods or services. Additionally the current literature does not provide a framework for which consumers are relevant to specific stages in the NPD process, and how they are differentiated from the other consumers within the community.

In addition to the various types of consumer, there are various types of virtual community. Furthermore there are many underlying reasons why consumers are attracted to these communities to satisfy needs, such as relationship, transactional, fantasy, and general interest needs (Carver 1999; Hagel & Armstrong 1997), or to share their ideologies and interests (Füller & Von Hippel 2008; Marchi et al. 2011), which adds a secondary layer to the complexity when navigating the sea of

consumers in order to identify those willing to collaborate. An understanding of what type of virtual communities innovative consumers prefer to contribute to is yet to be understood. In relation to communities that facilitate innovation, it is possible that some types of community negatively affects the free flow of information about consumer innovations, and decreases the individual's intrinsic motivation to engage in the community (Franke & Shah, 2003) and negatively influences a consumer's creativity (Amabile 1985).

When looking to identify consumers from a virtual community, organisations and scholars alike have a range of methodologies to choose from to analyse the consumer data built up over time by their contributions to the community. These include content analysis to analyse participation volume and frequency (Füller et al. 2007), behaviours and advancement (Jensen & Scacchi 2007), and decision-making power and technical capabilities (Hedberg & livari 2009; Bach & Twidale 2010) for a full review see Guo et al. (2017). Other methodologies that can be used include more traditional screening, surveying and netnography (Belz & Baumbach 2010). However as highlighted above, weblog data is often used to analyse retrospective contributions and can be time consuming and often community-specific. Further investigations into the application of data generated within virtual communities would increase our understanding of the role this data can play in the identification process, specifically for its ability to indicate the presence of innovative consumers who are willing to collaborate with external organisations.

Additionally, missing from consumer innovation, OUI, management, product innovation and even information system literature is an understanding of the virtual community manager's activities, interests and knowledge surrounding consumer identification. Their input could provide valuable insights into which methodologies are most appropriate and practical, specifically from a longitudinal perspective, as

many consumer innovation studies focus on short-term identification activities, and are less focused on the embedding of methodologies into firm practice.

Diffusion of innovation theory defines diffusion as the process by which an innovation is communicated through certain channels over time among the members of a social system (Rogers 2003). This theory, specifically goes on to discuss the role of the social systems that can influence consumers. The social systems within virtual communities may be influences on consumers and their level of engagement within a specific virtual community. Furthermore, this choice could affect their ability to innovate - as stated by Rogers (2003), individual innovativeness is affected by the nature of the social system in which the consumers are members; this knowledge will inform this research and findings.

A social system, specifically within a virtual community, may affect the ability for some to disclose innovations and share knowledge, or in contrast may encourage this behaviour. Therefore, the structure of a social system in a community can *“facilitate or impede the diffusion of innovations in the system”*, and in turn this can be affected by an individual’s normative beliefs, which are concerned with the likelihood that important individuals or groups approve or disapprove of a given behaviour (Ajzen 1991), which could be directly influenced by the type of community.

A consumer's ability to contribute to and join specific virtual communities, can also be influenced by their level of perceived behaviour control (Ajzen 1991), and could also influence choice of virtual community. For example, a virtual community may exhibit a community ambience of expertise or professionalism informed by their social system, that may cause some consumers (innovative or not) to experience low perceived behaviour control as they do not feel they can contribute successfully to that community, therefore they may search for a different

community to join. This could also extend to a consumer's willingness to collaborate.

This investigation will focus on the identification of innovative consumers for organisational collaboration of NPD, within virtual communities. Collectively, Open User Innovation (OUI), organisational and management literature highlight the value of innovative consumers; entrepreneurial, marketing and informational system literature also support the integration of innovative consumers to add value to a new product service or process being developed. However there are a number of gaps within the literature regarding the identification of consumers within virtual communities that, if understood, would help organisations to more reliably and efficiently identify innovative consumers. This research will therefore aim to bridge the gap between the different types of consumers, and their suitability for each stage of the NPD process; investigate how different types of communities appeal to different types of consumers, specifically highlighting which types of virtual communities engage innovative consumers who are willing to collaborate, and understand if 'willing' consumers can be identified with data sources created by the consumers' digital footprint. Finally, gain knowledge from community managers on consumer identification from within the virtual community, which has not yet been investigated.

7. Research strategy

The aim of the investigation will seek to explore the knowledge gaps highlighted above to develop a deeper understanding of virtual communities as an asset for organisations identifying innovative consumers in the pursuit of collaboration and new knowledge to inform the creation of new products and services, ultimately answering the question:

How can external organisations use virtual communities to help them efficiently identify innovative consumers?

The investigation will firstly address the development of a consumer identification framework to understand the relationships between consumers, characteristics and the stages of the NPD process. The aim of this stage is to provide a foundation of knowledge for external organisations planning to identify consumers in virtual communities. Secondly, different types of virtual communities will be examined to understand if some are more effective and reliable for finding innovative consumers who are willing to collaborate. Next, an examination of the use of weblog data within a virtual community will be carried out, to understand how this can be further used to measure if innovative, and willing, consumers exist. Furthermore an examination of more commonly used sources of data found across many different types of virtual communities will be explored. Lastly focus will be placed on interviewing community managers to understand if it is possible to learn more from working with community managers, and to gain insight into how internal consumer identification is conducted. Collectively a greater understanding of these areas will enable organisations to assess how to select suitable virtual communities, target consumers, and utilise specific data sources linking innovative consumers with the NPD process.

This strategy will take the form of four stages: firstly, an inductive approach is used - following observations from the current literature - to develop an understanding of what types of consumers should be identified by firms from virtual communities for the necessary stage in the NPD process. This will address the current lack of clarity surrounding consumer types, and inform a robust approach when looking to involve consumers within the NPD process, as detailed above. As no precise boundaries exist for these consumers, this first stage will build on an interpretive paradigm, as current types of consumers are simply labelled based on observations and interpretations. Furthermore, the stages of the NPD process that consumers contribute to can change depending on the observer.

Given that virtual communities can exist with millions of members and the current literature fails to address how best to screen for innovative consumers in an efficient and, importantly, reliable way, this first step will outline the differences between consumers, so that organisations may focus their resources and efforts on the right consumers; while also knowing how to differentiate them from other consumers. Due to the amount of current literature documenting consumer types and their involvement in the NPD process, the first approach will be to return to the current literature and investigate the relationships between consumer types and their involvement in NPD.

As there are a myriad of virtual communities online, and a spectrum of community types, the structure of the virtual community could affect the innovativeness of the members. The second step will therefore be to investigate if innovative consumers are attracted to specific types of virtual communities. This will ensure that firms not only understand who they are looking to identify within a virtual community, but which communities to focus on. Specifically, this research is interested in which communities will and will not contain innovative consumers willing to collaborate with external organisations, as different communities could attract consumers who

are unwilling to collaborate depending on their ideologies, values and needs to contribute to a virtual community. While this has yet to be explored within the consumer innovation literature, this second study takes a positivism perspective that can measure the consumers known characteristics and motives to engage.

Following this stage, there will be a focus on the value of weblog data created by the members' digital footprint, to assist in identification and signpost the potential for locating innovative consumers, specifically those that are willing to collaborate. Currently no data sources in virtual communities have been linked to consumer willingness. However this addressed the areas of efficiency - if a link can be determined between consumers who are willing to collaborate, and specific data in a community, this would inform the efficient identification of innovative consumers.

The final stage of this investigation will focus on community management insights. The stage will be conducted last to evaluate insights from community managers, with the hope to obtain the current practices of consumer identification from their perspective. This study will be primarily interpretive and therefore inductive, as no current understanding or knowledge in this area exists.

The aims of this investigation are therefore to, A) clarify the differences between different types of consumers, and their suitability for each stage of the NPD process; B) understand how different types of communities appeal to different types of consumers, specifically highlighting which types of virtual communities engage innovative consumers, who are willing to collaborate; C) understand objective data sources created by the consumers' digital footprint that can be linked to consumer willingness to help determine the appropriateness of the consumer audiences for the organisations' needs, and D) acquire insights from community managers on the activities, interests and motivation for consumer identification from within the virtual community.

Collectively, new knowledge gained from each step in this investigation will contribute to understanding how organisations can use virtual communities to help them efficiently identify innovative consumers. This will contribute new knowledge to consumer innovation literature by increasing our knowledge about the community and identification in this domain.

7.1. Methodologies

The first stage is built on an interpretive paradigm, and will take an inductive approach following the findings in the Literature Review. This inquiry will utilise the large corpus of information documenting the identification and involvement of innovative consumers in the NPD process. Therefore, it will be necessary to continue to identify patterns and trends of when various types of consumers have previously contributed to the NPD process at various stages. As NPD stages can be interpreted and defined in different ways depending on the on-looker, Cooper & Kleinschmidt's (1986) NPD stages will be used as a framework. This includes stages both internal and external to the organisation, and was chosen due to the linearity of the model. Other models such as the waterfall or V-model (Balaji & Murugaiyan 2012), while the individual stages are similar they are not as relevant for this investigation. This stage of the research will be inductive, as the preliminary observations have already been made in the initial Literature Review, and the subsequent identification of pattern then follows.

To understand what types of virtual communities innovative consumers are attracted to, an investigation between two types of virtual communities will be conducted. From consulting existing literature, this study is designed from a positivism perspective, where the reality is measurable. This deductive approach, built on existing knowledge, will therefore utilise traditional methodologies from existing consumer innovation literature (Jeppesen & Laursen 2009; Füller et al.

2008; Luthje & Herstatt 2004). A survey of community members was carried out to A) identify that innovative consumers exist within the communities, and B) measure their motives and/or ideologies associated with the chosen communities. An analysis of the responses for significant differences between the two samples informed if and how the different groups of consumers from different types of virtual communities differed in relation to established innovative consumer characteristics and associated motivations and ideologies of the community types.

In conjunction with this investigation data collection of the objective weblog data from one community was paired with the survey data to understand the links between innovative consumer's willingness to collaborate, and their digital footprint. To achieve this data scraping was used, depending on the data available from the community. Data scraping is the process for retrieving data that exists on a website, and converting it into a format that is usable for analysis. The aim being to understand the relationships between consumer characteristics and their data; understanding the effect of the community or other consumer characteristics on the application of objective data, to identify innovative consumers willing to collaborate would require a mediation analysis to analyse the external influences on these motives. This second part of the investigation, also takes a positivism viewpoint that what is being investigated can be measured, and therefore a suitable methodology is applied.

To obtain insights into a virtual community from the perspective of a community manager, semi-structured interviews were conducted, to enable a flexible approach to data collection, to provide freedom to discuss different areas in more or less depth while keeping the interview focused on key topics, including: methods of identification, the application of weblog data in the process of analysing consumers, and the reason for identifying specific consumers. Semi-structured interviews were chosen as a suitable method as this was an exploratory

investigation to create a foundation of knowledge, as nothing similar exists within the current literature.

The staged approach within this investigation addressed the main research question in the following way: the first stage (study 1) provided an overview of how to approach identifying innovative consumers in virtual communities. With communities so large, it is not possible to screen them or use traditional methodologies to achieve a large reach. Furthermore, as highlighted in the Literature Review, there is ambiguity and overlap with types of consumers and their differentiating characteristics. To efficiently identify a sample of innovative consumers within a virtual community, clarity is needed on who is being identified and how to differentiate them. Additionally the theory that each type of consumer will be more or less suited to a specific stage in the NPD process, and that firms will only open select stages within this process will be postulated. Therefore to efficiently identify an innovative consumer from a large online community, it is important to know A) which consumer is suited for each stage, B) how to differentiate them, and C) what items can be used in the data collection process which are exclusive to that type of consumer. Answering this will provide guidance on how to approach large virtual communities for identification.

The next stage (study 2), would analyse the relationships between motives to engage innovative consumers and different types of virtual communities to provide information on how to choose a virtual community to collect data from; and where willing consumers will more likely exist. This would offer further guidance on the approach of identification for virtual communities and enable a more streamlined and efficient process, as opposed to using communities that could discourage the contribution of innovative consumers. Additionally, (study 3) examined the role of weblog data in the identification process, to understand if this data could help

inform more efficient processes, once the organisation knew which community to focus on.

Lastly, by speaking to community managers the aim was to gain insight into how they look for innovative consumers. This would provide valuable information of what a person does when they have access to the whole community. Someone so embedded within the community, whose job it is to observe the community will bring valuable knowledge on how virtual communities can be efficiently used to identify innovative consumers.

To summarise, study 1 therefore informs organisations as to which consumers are appropriate for them (depending on their needs); study 2 informs them where to find these consumers; study 3, informs them if data that is really available to the organisation can assist in the identification process; and finally study 4 informs organisations that the community manager can also be pivotal in efficiently identifying innovative consumers from a virtual community.

The collection of studies in this thesis take different theoretical perspectives, either interpretiveism or positivism. They also contain a mixture of inductive and deductive approaches. While traditionally a single perspective or approach is used, this multidisciplinary thesis benefits from combining data that can be measured with interpreted findings to answer the main research question, and contributes information that may have been missed by adopting only one perspective (Roth, W. D., & Mehta, J. A. L., 2002). One aspect of the research question addressed identification, which is a subjective concept that requires appropriate interpretation. Similarly, the use of consumers in NPD stages can be interpreted differently. However the motivation and characteristics of consumers are measurable, and built on a positivist perspective. While these different methods may not be epistemologically reconcilable, and both have limitations, they allow for a greater focus on the functional outcomes of the research (Hovorka, D. S., & Lee, A. S., 2010) and combined for complementary purposes, which has been argued as an

appropriate approach, even when the approaches are ontologically and epistemologically incommensurate (Sale et al., 2002).

8. Different consumers for different stages

Virtual communities provide us with access to vast quantities of consumers. Yet how do we know which consumers will be able to provide the right knowledge for different stages of the new product development (NPD) process? Different types of consumers have previously been observed to contribute at different stages of the NPD process (Romero & Molina 2011; Magnusson 2009; KIM et al. 2008), yet it is understood that not all types of consumer are suitable for each stage (Magnusson 2009). In some instances consumers are less useful to certain stages of the NPD process because they possess different levels of knowledge that other consumers do not (Mahr & Lievens 2012), or limited imagination about products or services that do not yet exist (Davis 1993), which may result in limited input, and less prosperous solutions (Henard & Szymanski 2001).

However, lead user theory holds that the involvement of consumers, who met Von Hippel's two lead user characteristics - being ahead of market trends and expect significant benefits from innovations - produce innovations that have more commercial value and success (Morrison et al. 2004; Von Hippel 2005). Specifically innovative consumers, such as lead users, who possess high levels of expertise and user-experience, and exhibit personality traits such as a high locus of control and innovativeness (Schreier & Pruegl 2008; Ozer 2009) which enables them to provide precise information about their needs and possible solutions (Von Hippel 2005).

The application of consumer-driven innovation processes in firms (Olson & Bakke 2001), and their impact on successful innovation has been well documented (Lilien et al. 2002), for a review, see Luthje & Herstatt (2004). Earlier investigations have focused on entire community involvement such as open source software communities, open-content communities and innovation-contest communities (David & Shapiro 2008; Arazy & Nov 2010; Füller et al. 2014; Barcellini et al. 2015).

However, until recently they have not focused on the NPD process in the community, resulting in a lack of knowledge concerning consumers' roles and contributions in the NPD process (Guo et al. 2017). It is therefore necessary to understand how different consumers are suited to the stages of the NPD process, and how they are differentiated, as their input can be pivotal to the success of a new product or service.

Furthermore, understanding how different types of consumers fit into each stage of the NPD process will enable organisations to be more efficient in the identification process, and benefit from further input at more stages, depending on the sample of consumer available. Moreover, this understanding will enable firms to know what types of consumers sit within their reach.

8.1. Outsourcing innovation

The NPD process typically consists of a set of stages that are often followed to develop new products and services. Many organisations open up a part of the process, one or two stages, to external parties including to consumers (Gassmann 2006), as consumers denote an exceptional source of knowledge, often critical for the success of new products and services, that cannot be obtained from other sources (Prahalad & Ramaswam 2004). Familiar examples include asking consumers to co-design products or to provide feedback on new products and prototypes. Other examples are outsourcing the research and design stages, which can mitigate potential barriers to innovation (Katz & Allen 1982), or involve suppliers in the early stages of the process, which has been shown to increase innovation performance in many businesses (Hagedoorn 2002), and lead to the development of new products and solutions that are novel and valued by other non-innovative consumers (Kristensson et al. 2004).

The growth in the popularity of outsourcing some of the innovation processes has increased over time: by the mid-90's as much of 65% of input into product innovation came from external sources (Conway 1995). Today the development of technology enables organisations to easily access other sources of information and innovation such as consumers. The way in which organisations open the stages of the innovation process can be described using three archetypes, 1) the inside-out process, where ideas are sold or licensed outside the organisation; 2) the outside-in process, where organisations integrate external suppliers and consumers into the process; and lastly, 3) a coupled process which is collaborative in nature, and combines both inside-out and outside-in processes (Enkel et al. 2005).

The focus of this investigation is on the integration of consumers for new product development processes to influence and inform innovation – the outside-in process. Specifically, in this chapter, the aim is to clarify from existing research how the different types of consumers who can contribute to the NPD process (such as ordinary users, lead users, user entrepreneurs, etc.) are suited to the various stages, in relation to their ability to contribute valuable knowledge.

This research study comes at a time when efficiency and accuracy in consumer identification could have a large impact on the outcome of the process, specifically as consumer communities are continuing to grow, and therefore it will arguably take firms longer and longer to search these virtual communities for relevant consumers. While scholars have attempted to make this task more manageable, by exploring some automated methods, a more suitable starting point to help address the main research question of this thesis is to clarify the ambiguity that currently exists around defining innovative consumers. Understanding this will enable organisations and innovation managers alike to focus their attention on the consumers that are best suited to the collaboration they are looking to achieve.

While some organisations may be able to choose if they want to open up part or all of the process to consumers, there are risks associated with doing so, such as loss of knowledge within the organisation over time, as the organisation may no longer accommodate internal experts, and dependency on consumers' views on innovation (Enkel et al. 2005). Therefore, it may be more appropriate for some organisations to only open up specific stages and to target only specific consumers. However, to do this efficiently, product innovation managers need to know the differences and similarities between innovative consumers.

Knowledge is one of the most important components of innovation (Nelson & Winter 1982), and also central to the development of new products and services (Madhavan & Grover 1998). However, not all types of consumer are suitable for each stage of new product development, as observed in previous research (Magnusson 2009). To understand the right type of consumer for each stage will help improve the efficiency and value of consumer identification for firms searching vast collectives of consumers in virtual communities, and contribute towards understanding how virtual communities can be utilised for more efficient means of consumer identification. Further understanding of how to navigate and survey large heterogeneous communities to select innovative consumers will ultimately improve the overall efficiency of the identification process.

8.2. New product development

Products and services can be developed using many different types of processes: linear processes, where various stages such as ideation, product development and consumer testing are conducted in sequence, finally ending in the launch of a new product. Circular or spiral processes also exist where the product is developed in iterations, revisiting different stages – such as consumer testing – to continually improve the product until deemed ready for market launch. However, the process is shaped and is often broken down into stages to make it more disciplined, tangible

and accessible to those involved (Tietz et al. 2004). The number of stages in a process will depend on various factors such as the type of product being developed, but can range from six and thirteen (Rochford & Rudelius 1997; Cooper & Kleinschmidt 1986).

Rochford & Rudelius (1997) highlighted that when developing 'new-to-the-world' products, compared to product modifications, significantly greater effort and performance is placed on preliminary market analysis, preliminary technical analysis, market study, product development, consumer product testing and market testing. Table 1 provides an overview of the stages that are used in a new product development process.

In the examples presented in the Literature Review, where consumers take an active role in the development of new products and services with an organisation, they are observed to be involved in different stages. These range from the initial idea generation to the development of the solution, along with consumer testing nearing the end of the development. Similarly, consumers acting independently – innovating for personal use, will go through a similar process showing the potential to contribute successfully to multiple stages of the process.

However, as there are different types of consumers who have been observed to successfully contribute to the NPD process, from ordinary consumers (typical target market consumers) through to user-entrepreneurs (consumers who innovate and then start diffusing and selling their innovations to other consumers), it is important to understand which types of consumers are best suited to each of the stages.

8.3. Methodology

To address the questions of which consumers are suitable for different stages of the NPD process, and to understand if a more efficient identification can be conducted in the ever-growing virtual communities, an inductive approach to this investigation will be undertaken to identify patterns and trends of when various types of consumers have previously contributed to the NPD process at various stages using the Cooper & Kleinschmidt (1986) distinction of stages in the NPD process as a framework.

While other frameworks exist, this is more extensive and includes stages that are sometimes omitted by many companies – as highlighted in their findings – showing that many organisations seldom use the full 13 stages in the framework. However, using a more extensive framework ensures that the findings can apply to a greater number of organisations who may use all stages in their NPD processes.

To do this, it will be necessary to return to the literature and analyse existing empirical studies, case studies, and other articles that explicitly state the consumer's role in the innovation process, to highlight relationships between consumers, their associated characteristics, and where they have been used in the NPD process. To map the stages in the innovation process to types of consumers and their associated characteristics, the literature was reviewed using a theoretical thematic analysis (Braun & Clarke, 2006) to organise the findings into 13 stages of the innovation process⁹.

A retrospective analysis, as opposed to an empirical study, was conducted to help identify additional knowledge gaps in understanding of how to identify consumer types and the links between their involvement in NPD and their characteristics.

⁹ The referencing software QSR Nvivo was chosen as the most suitable to used for organising the literature. Other software such as MAXQDA used by Belz, & Baumbach (2010), was also considered, but QSR Nvivo was better suited for the thematic analysis.

First there was an examination of the stages of the innovation process, secondly the types of consumers were reflected upon; this culminates in a discussion on the relationship between these stages and the consumer types.

8.4. Consumers in the innovation process

Within the Literature Review, multiple types of consumers were identified across a ‘spectrum’ of innovative consumers. This side-by-side comparative view provides clarity for a number of different consumers. Consumers with low levels of knowledge, such as ordinary consumers appear to be suited to idea generation; highly knowledgeable consumers such as expert consumers, lead users and entrepreneurial consumers, appear to be better equipped for assisting in product development and market trials; consumers with experience of developing their own solution may be particularly useful for prototyping stages; lastly, entrepreneurial consumers arguably appear best suited to pre-commercialisation business analysis due to their exposure to areas of business and aspects of the process of commercialising a product that other consumers would not necessarily have. To understand their suitability for the different stages of the NPD process, a review of the relevant stages as outlined by Cooper & Kleinschmidt (1986) was carried out. The additional stage ‘The idea’ was added to the stages from Cooper & Kleinschmidt, as this was a relevant part of the process related to the conceptualisation of ideas (Magnusson 2009).

Table 1: Cooper & Kleinschmidt (1986) activities for new product development.

Activities	Description
1. Initial screening	The initial go/no go decision where it was first decided to allocate funds to the proposed new product idea.
2. Preliminary market assessment	An initial, preliminary, but non-scientific, market assessment; a first and quick look at the market.

3. Preliminary technical assessment	An initial, preliminary appraisal of the technical merits and difficulties of the project.
4. Detailed market study/ market research	Marketing research, involving a reasonable sample of respondents, a formal design, and a consistent data collection procedure.
5. Business/financial analysis	A financial or business analysis leading to a go/no-go decision prior to product development.
6. Product development	The actual design and development of the product, resulting in, e.g., a prototype or sample product.
7. In-house product testing	Testing the product in-house: in the lab or under controlled conditions (as opposed to in the field or with consumers).
8. Consumer tests of product	Testing the product under real-life conditions, e.g., with consumers and/or in the field.
9. Test market/trial sell	A test market or trial sell of the product - trying to sell the product but to a limited or test set of consumers.
10. Trial production	A trial production runs to test the production facilities.
11. Pre-commercialization business analysis	A financial or business analysis, following product development, but prior to full-scale launch.
12. Production start-up	The start-up of full-scale or commercial production.
13. Market launch	The launch of the product, on a full-scale and/or commercial basis: an identifiable set of marketing activities specific to this product.

8.4.1. The idea

The literature sample and context of this investigation means that the generation of ideas for new products will likely come from the consumers or end users. Cooper & Kleinschmidt (1986), when investigating the different stages of the innovation process, also discovered from many of the companies they surveyed that ideas for new products and services were 'market derived' – coming from a consumer, sales person or competitor. Their analysis showed that often consumers requested new services or products, which is consistent with the current consumer innovation

literature, where in some cases organisations create workshops bringing together innovative consumers to generate ideas (Von Hippel & Urban 1988; Von Hippel & Herstatt 1992; Lilien et al. 2002; Magnusson 2009). Alternatively, ideas are generated by asking the community to describe problems they have encountered and the solutions they have generated to resolve these, or through initiating discussions around new products (Franke et al. 2006; Füller et al. 2007). Organisations can also access consumers ideas through looking at the consumer's contribution in virtual communities (Hahn et al. 2016; Marchi et al. 2011). In this latter example of the consumer's role in idea generation, consumers frequently generate these ideas independently, triggered by their need for a more suitable, or improved product, than is currently available (Von Hippel et al. 2012; Shah & Tripsas 2007; Jeppesen & Frederiksen 2006). Various consumers would therefore be suitable for this ideation stage of the NPD process.

8.4.2. Initial screening

Initial screening is when those ideas that have been conceptualised or 'market derived', are reviewed by the organisation, and successful or promising ideas will go through to the next stage. As this stage can require financial decision making it is unlikely consumers will be involved.

However, there are some virtual communities such as Quirky (www.quirky.com), social product development platforms (Piller et al. 2010), which utilise their community for new ideas but also ask their members to vote for ideas they like. If an idea for a new product receives enough votes, it will be subject to an internal review – an initial screening. Therefore while consumers are not directly involved in the decision-making, they act as a filtering mechanism to bring the popular and desirable ideas to the fore.

8.4.3. Preliminary market and technical assessment

These further two stages, similar to the initial screening, require internal knowledge of the organisation's manufacturing capabilities and resources to understand the challenges and feasibility of creating the idea.

When consumers independently innovate, this is the stage which can divide those consumers who are 'idea generators' and those who are 'inventors', as the practical barrier of building a product also requires the consumer to have access to resources that can include tools and materials (Tietz et al. 2004; Franke & Shah 2003). Access to the resources required to take an idea from paper to prototype is therefore considered to be a precondition that needs to be overcome to progress to further stages.

8.4.4. Detailed market study and business/financial analysis

At this stage, further market research is carried out with consumers, often target market consumers. However, the consumer's input into this stage can vary depending on the type of research being conducted. While there is no specific documentation of this in the current literature, innovative consumers can play a more influential role in this stage, by providing information of the problems experienced by those ahead of a trend, i.e. lead users or other innovative consumer types. Above we saw evidence that organisations do access their consumer communities to extract current problems they experience, and solutions for innovations from virtual communities (Hahn et al. 2016; Marchi et al. 2011), we could therefore assume that if any information is extracted to be used in this stage, then consumers are playing a passive role. An exception to this could be the

consumer actively contacting the organisation regarding their needs, e.g. a consumer complaint regarding the product or service.

8.4.5. Product development

The product development stage, where a solution is developed and prototypes are built, is a stage where consumers can be resourceful. Firstly, as can be seen from the current literature many innovative consumers can develop novel and commercially attractive solutions (Luthje et al. 2006; Von Hippel & Urban 1988; Von Hippel & Herstatt 1992; Franke et al. 2006), and in comparison to traditional internal product development teams, products created by innovative consumers, such as lead users, have a positive impact and influence on sales and company performance (Lilien et al., 2002). Furthermore, many consumers have experienced creating their own products and prototypes (Von Hippel et al. 2012; Franke & Shah 2003; Luthje & Herstatt 2004).

8.4.6. In-house product testing and consumer testing of product

This stage suggests that 'in-house' testing is conducted away from consumers (Cooper & Kleinschmidt 1986; Rochford & Rudelius 1997). While internal staff can also be considered lead users (Von Hippel & Herstatt 1992), and companies can still gain feedback from end-users and innovative consumers without taking the product 'into the field', this is a stage which does not directly involve typical consumers.

When organisations do take products to consumers for testing, it is common to use people from target markets, or ordinary consumers who make up the larger percentage of the market compared to innovative consumers (Magnusson 2009). However, lead users specifically are more suited to this part of the NPD process, as they are often 'heavy' users of the product or service (Luthje 2004; Von Hippel &

Herstatt 1992; Hienerth & Lettl 2011), and can provide technical feedback on the prototype. Working with lead users, who have knowledge about the product and possible experience in developing a solution, provides the organisation with access to 'sticky' knowledge - knowledge held by the consumer which is often difficult to transfer (Ogawa 1998; Von Hippel 1998). Similarly, when consumers are the source of innovation, they often utilise their community for feedback and assistance in their own innovation processes (Shah & Tripsas 2007).

8.4.7. Test market and trial sell

This stage requires consumers to purchase the products, therefore innovative consumers, who are arguably looking for a better solution, and have been observed to be early adopters of new products (Crowther 2006; Frattini et al. 2014; Engel et al. 1969; Droge et al. 2010), could be utilised at this stage. However within the literature no evidence exists to suggest companies do use innovative consumers at this stage.

8.4.8. Pre-commercialisation business analysis

Traditionally, this is an internal exercise for the organisations who are funding the innovation, therefore no consumers are involved. However, when acting independently, consumers who have developed their innovation and experienced high levels of demand from their community will invest in developing a strategy to take their products to market, including investing in patents (Shah & Tripsas 2007). It is questionable that consumers' actions could be observed to gain knowledge for this stage.

8.4.9. Production start-up and market launch

The final stages of the process require little to no input from consumers, besides providing feedback to use in marketing material. However, there is evidence to

suggest that consumers within social networks can be resourceful to organisations around the time of a product launch (Roberts et al. 2016).

To summarise consumers are utilised in the initial idea generation, product development, and consumer testing. Consumers can also be utilised to assist in the initial screening stage as a mechanism for filtering large amounts of ideas, and the market research stages. There is little to no evidence of consumers being utilised in the other stages of the process, although there is scope for certain types of consumers to contribute to these too, as discussed below.

The diagram (Figure 1) illustrates those stages of the innovation process that consumers are known to participate in, positioned at the top, and below the stages that are conducted in-house.

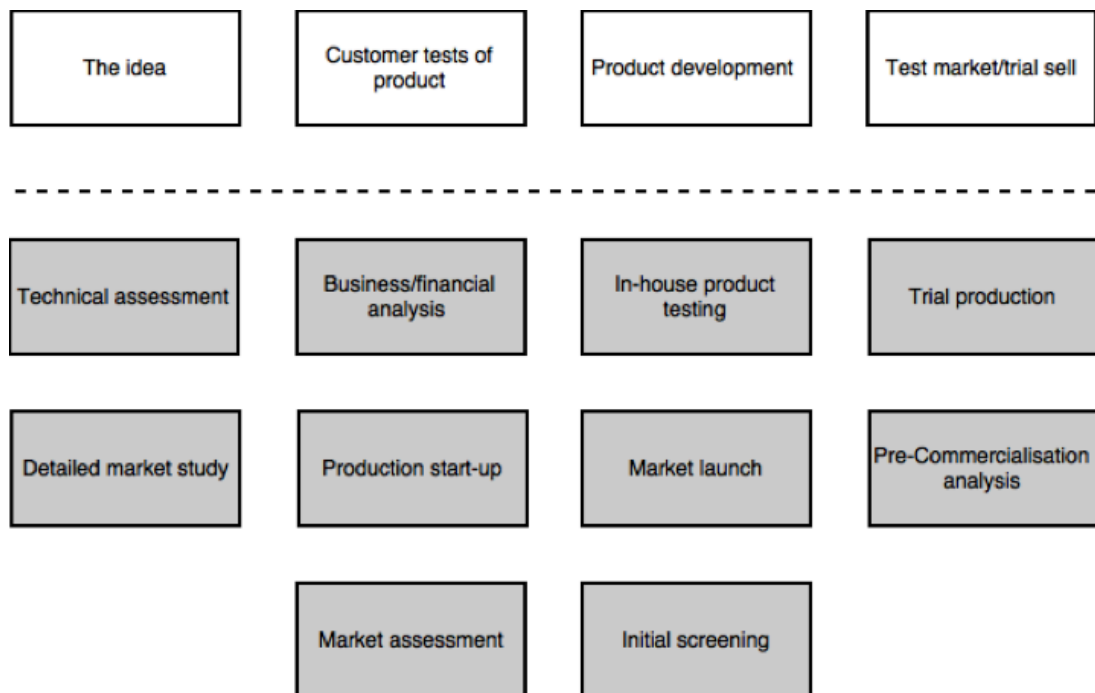


Figure 1: Stages of the innovation process. The top four stages where consumers can choose to participate, and below the line, stages that are conducted in-house by an organisation.

8.5. The spectrum of consumers

Reviewing the different stages of the NPD process has provided further clarity of where consumers can contribute, and highlighted the specific stages at which they can, and have contributed. The next step is to reflect on the various types of consumers that are present in the current literature.

The consumers discussed in the Literature Review, and their associated characteristics, provide us with a means of comparing how these types of consumers may differ. From analysing the literature, four distinct types of consumer can be identified, as the other consumer types discussed in the Literature Review can be likened to one of these types. These four consumer types: ordinary consumers, idea-generators, innovators, and user-entrepreneurs, are discussed below.

8.5.1. Ordinary consumers

Ordinary consumers are identified within the target market as being best positioned at this early stage due to their lack of technical knowledge which enables them to generate creative concepts not restricted to technical or manufacturing limitations (Magnusson 2009). They are best suited to the initial ideation stages if high level concepts are desired and during consumer testing stages to gain feedback from the larger target audience.

However more innovative consumers, discussed below, can be suitable for the same stages. The choice of consumer depends on the goal of the process. If high-level concepts that are not bound to current manufacturing capabilities or technical experience are sought, then ordinary consumers may be most appropriate. If the organisation is interested in developing a solution to a known problem or looking for more disruptive innovations, then this early idea generation would be better suited to those with higher levels of technical knowledge such as lead users.

8.5.2. Idea-generators

If a consumer is to have valuable input into anything other than high-level concepts or feedback about the current product offering, some technical knowledge is required (Hienerth et al. 2007). Technical knowledge enables a consumer to develop their initial concepts into more viable solutions (Tietz et al. 2004), and separates consumers who can contribute high-level concepts from those whose contributions are more likely to be viable solutions. The term idea-generators, coined and described by Tietz et al. (2004), reflects the expert consumers; these are consumers who have above average technical knowledge and user-experience. However, they are limited in their ability to actually take their idea to the next stage. While it can be beneficial to have limited technical knowledge for the development of new ideas, it could be considered a precondition for the consumer to contribute to further product development stages.

8.5.3. Innovators

The inventors are the lead users, and innovative consumers, who create new products and services. They are motivated to innovate by their dissatisfaction for the current market offering, while having the technical knowledge and access to resources to create a solution (Tietz et al. 2004). In the current literature, those consumers who fall within the innovator category are defined by certain characteristics, including their level of knowledge, expected benefits from obtaining a solution, and their position in relation to a specific trend. However, the focal point and defining factor in many studies are product modification or creation – where the user has created their own solution or modified an existing product to meet their needs (Von Hippel & Urban 1988; Von Hippel & Herstatt 1992; Franke & Shah 2003; Luthje 2004). This experience makes innovators suitable for the product development stage.

8.5.4. User-entrepreneurs

While consumers seldom become involved in the later stages of the innovation process, beyond purchasing the new product, the experience of some consumers whose involvement does extend beyond this could be valuable to organisations. These consumers are user-entrepreneurs, and in some instances innovators who were end-users of a product, who have proceeded to develop their own solutions. These consumers depend on other members of their network and community to diffuse their innovation to other consumers (Shah & Tripsas 2007; Von Hippel et al. 2012).

Beyond manufacturing or selling their innovations, there are few distinctions between innovators and user-entrepreneurs. However, entrepreneurial activity requires an investment in time and additional resources and often assumes more extrinsic motivations. Perhaps surprisingly, extrinsic motivations, such as pecuniary motives, provide little insight into whether an individual is innovative and likely to diffuse innovations. Many innovators who become user-entrepreneurs are more likely to be motivated intrinsically (Shah & Tripsas 2007).

Consumers in this position will have a network of other consumers they can access. They may also be considered as 'opinion leaders' within their respected communities (Schrammel et al. 2009; Jeppesen & Laursen 2009), and therefore can become a gatekeeper to other consumers for organisations.

8.5.5. Variable consumers

Consumer characteristics, knowledge and abilities are not constant; they will change and develop over time as their use of the products increases. Arguably consumers, who are ordinary consumers, could one day become innovators and even user-entrepreneurs.

All consumers start in the same place, as an ordinary consumer, with limited user-experience. Those who have, or acquire, technical knowledge are considered idea-generators – as this technical knowledge enables them to generate solutions to problems they may identify with the products or services. If a problem is identified, and a solution conceptualised, those who create their innovation (and who also have access to the resources to do so) are considered innovators. If and when their innovation becomes popular amongst other community members, peers and friends, they may choose to start diffusing their innovation and/or selling the product/service to other consumers, thereby becoming a user-entrepreneur.

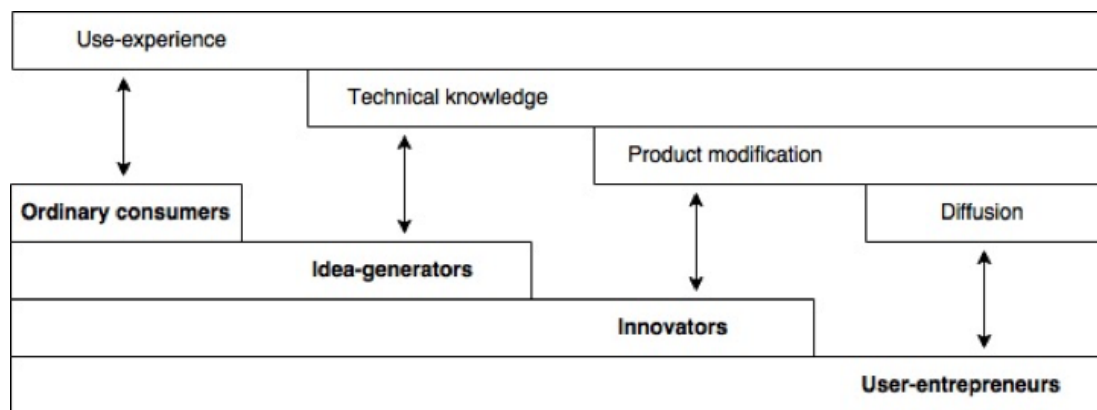


Figure 2: Consumer and characteristic relationships: A visualisation of the differentiating consumer characteristics, and how they are shared between consumer types, changing as a consumer ‘develops’ from ordinary to entrepreneurial.

As illustrated in the diagram, a user-entrepreneur should arguably have these four characteristics, while ordinary consumers only one. Ordinary consumers can therefore progress into user-entrepreneurs by acquiring these additional characteristics through education and expanding their network and access to resources. While there are other important factors to consider that are known to define innovative consumers, entrepreneurs and consumers; current consumer innovation literature shows these four characteristics to be the differentiation between the four types of consumers who can contribute to the innovation process.

Note that whilst the characteristics and consumer types are illustrated as a hierarchy, it is proposed that while this is the most likely line of development, it is not fixed, that is to say, consumers could possess characteristics further up in the hierarchy without possessing those further down. For example, a community member who has user-experience could help a friend with entrepreneurial activities without gaining technical knowledge or innovation user-experience.

In order to develop a framework intended to increase the efficacy for consumer identification, relevant information was collated and the proposed relationships were mapped onto the diagram of stages (Figure 1). This was achieved by combining Figure 1 with Figure 2, as described below.

8.6. Mapping consumers to NPD stages

Figure 3 below, shows the combination of both stages of the NPD process, and the relevant types of consumers; linking them together to create a consumer identification framework. Starting from the top right, the consumer characteristic user-experience; a prerequisite of being a consumer is using the product or service. By acquiring user-experience then informs any further requirements from the consumer; resulting in need information (Fredberg & Piller 2011; Piller et al. 2010). Possessing both user-experience and need-information enables the consumer to conceptualise new ideas for their needs or, at the very minimum, to express their needs.

For consumers to continue the development of their ideas, they will need to acquire theoretical technical knowledge - this is the first precondition, as discussed above. Without this technical knowledge a consumer cannot progress to develop their innovation into a viable solution and become an idea-generator (Tietz et al. 2004).

To become an innovator, the idea created by the consumer needs to be realised. This is done through modifying a current product or creating something new in place of the current product. Innovating shows the consumer has technical knowledge and can apply their knowledge (having both theoretical and applied knowledge of the product). Furthermore, it shows the consumer has higher than expected benefits for a new solution, as they have taken it upon themselves to create a solution. Finally, they have access to the network and resources to realise their idea.

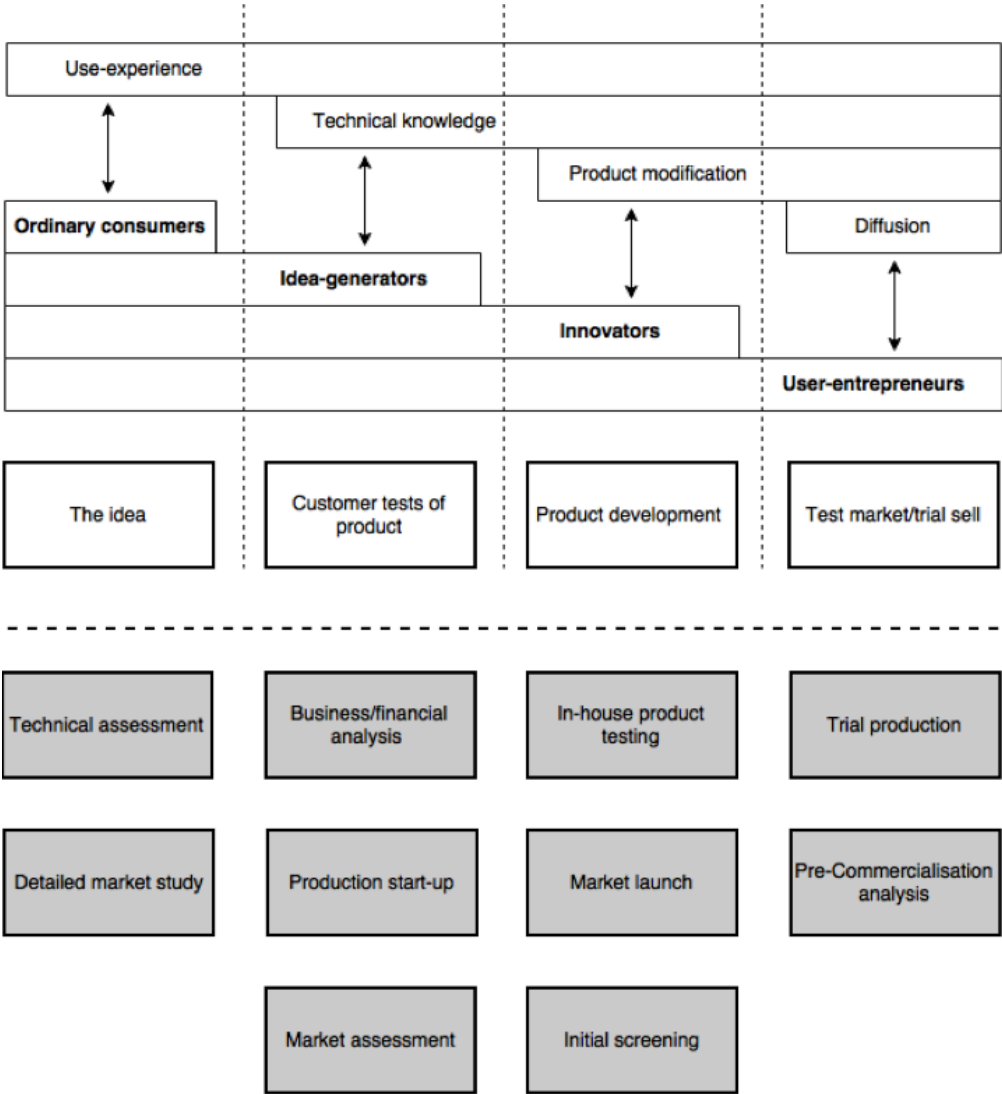


Figure 3: Consumer Identification framework: Consumer characteristic relationship mapped on to stages of the NPD process, highlighting the connection between consumer, characteristic, and new product development stages.

If a consumer generates an idea, and realises that idea, they may then receive interest from their community, which often happens to innovative consumers (Franke & Shah 2003). They then have a choice to start diffusion and/or selling their innovations, which many do (Von Hippel et al. 2012), thereby becoming more entrepreneurial, more so if they start to mass produce or monetise their innovations.

The diagram shows the stages of the innovation process, connected to the types of consumers and their differentiating characteristics. This aims to provide clarity to those looking to identify consumers from large virtual communities; showing the differentiating characteristics and where they have known to be utilised successfully in past studies. For example, suitable consumers to participate in the product development stage are innovators. They have product modification, technical knowledge and user-experience as their defining characteristics. These three characteristics will also apply to user-entrepreneurs. Some innovators, who will have diffused their innovation, but may not be monetising their innovation, are likely to lack the same insight into the entrepreneurial stages of product development. However, they will still be useful in the product development stages as both innovators and user-entrepreneurs will still have the same experience realising their innovations.

In Figure 3, the vertical dotted lines between consumer types act as a guideline, as from reviewing the literature the real lines between consumers are much more blurred, and cannot always be defined due to ever changing circumstance, factors and characteristics that influence consumer behaviour; equally the variables used to measure consumers are seldom consistent. However, this diagram is an attempt

to visualise and clarify what can be extracted from the literature as evidence of differentiators between consumers, and guidance on where different consumers are suited in the NPD process.

Furthermore, this is a starting point for further understanding on how to identify innovative consumers in large online communities in an effective and efficient way. This model essentially requires testing, although it is based on previous research, primary empirical investigations could provide more generalisable evidence for this model.

8.7. General discussion and conclusions

Further analysis of the literature has shown that amongst the various labels that are used to describe the consumers, there are four distinct types that have emerged as suitable for contributing to different stages of the NPD process. The characteristics used to identify consumers, including the four highlighted above, are known and used in the literature, however this is the first time they are being considered as differentiators for the process of consumer identification. It is also the first time that they are being used in a framework to map consumers to stages of the NPD process they are most suited to contribute to. Bringing attention to these relationships provides an important bridge for scholars and organisations looking to identify consumers, in understanding which consumers are best suited to participate in the process at various stages.

When taking into consideration all stages of the NPD process, and the complexities that exist, the findings from this research suggest that it could be beneficial for organisations to take a passive approach to consumer identification, specifically for early stage ideation. This could mean observing ideas, problems they have experienced and their solutions, which are voluntarily disclosed by consumers in the communities. Organisations can then conduct appropriate in-house stages,

such as a technical assessment to filter ideas that are within the organisation's capabilities. The organisation could then engage with customers better suited for later stages in the development process, who have greater user-experience and often obtain knowledge from analogous markets (Luthje 2004), which would assist in the development and creation of the innovation.

For later stages of the process, innovative consumers (innovators) may need to be separated and communicated with separately to filter out the 'noise' from other community members. As information from innovative consumers can be sticky and therefore costly to transfer (Luthje et al. 2006), a more active or hands-on integration approach could be more effective, e.g. investing time in identifying and working with innovative consumers to generate ideas for specific problems or trends.

For commercialisation and market launch of a new innovation, working directly with consumers who have realised their innovation and diffused into other consumers (user-entrepreneurs), could provide valuable insights into how and why those consumers adopted the new solution, and who those consumers are; the user-entrepreneur could also act as a gatekeeper to this community of early adopters.

In relation to the findings above it needs to be noted the process of identifying and integrating consumers into the innovation process, is subjective and dynamic depending on other external variables such as the type of product in question. For example, products such as cars can be considered relatively expensive and therefore not often replaced by average users. As any contributions to the product will take a long time to be developed the consumer is unlikely to see benefits in the short term, if at all. The innovation time scale could therefore have an effect on the consumer's willingness to collaborate in the NPD process. The differentiation between those who do innovative, and those who exhibit the ability to innovate

could be restricted by external factors. In relation to identifying consumers from virtual communities, it proposes the questions as to where different types of consumers differ on their ability to contribute to the innovation process, if their exposure to opportunities and resources are excluded.

As there is no standardisation for labelling consumers, an investigation into how consumers can be labelled appropriately would be recommended, thereby informing continuity within the research community, and the use of labels that reflect the consumer's abilities and position within the innovation stage.

Notably, if organisations are looking to educate or increase the innovativeness of their consumer community, the consumer characteristics discussed above could be used to provide assistance to consumers. For example, under conditions where consumers are limited to the early stages of the innovation process, firms might benefit from providing access to products and information that they can then use to conceptualise solutions or new ideas. While firms often test products with consumers, this often happens when the product(s) are further on in the development stage. It may actually be beneficial to introduce consumers to products at earlier stages and to support innovative developments. Some researchers have similarly suggested that consumers be taught the different skills needed to progress in the innovation development process (Magnusson 2009). A new form of consumer integration could be developed where firms involve their consumers in workshops to increase their user-experience and technical knowledge to elicit the required information, gained through using the products in a more 'extreme' way in an attempt to increase the commercial viability of the ideas produced by the consumers involved.

Figure 3 shows the types of consumers and stages of the process together, and provides a visual representation of the stages and movement of consumers

through the innovation process, while acting as a guide on the expected outcome from consumer integration at different stages. However, further testing and validation of the model is recommended before applying the model directly. The model is constructed from existing published literature, which provides some initial validity and reliability.

While consumer innovation research provides information and guidance on the practices of integrating consumers into the innovation process, until now the literature has provided no overarching perspective on the different types of consumers and their ability to contribute to the different stages of the innovation process, or how to differentiate between the 'types' of innovative consumers to potentially increase the accuracy and efficiency of the identification process.

This investigation has therefore been able to clarify how different consumers are applied to different stages in the NPD process, which is pivotal to the understanding of how we can assess if virtual communities are able to improve the efficiency and accuracy of the identification process, by simply clarifying many of the differences and similarities between consumers. Therefore, going forward, it is easy to understand which characteristics are required for identification, or evaluate who is present in a virtual community by cross referencing their characteristics.

If a prerequisite for innovation (specifically ideation) is knowledge and experience, and a prerequisite for inventing (realisation of the idea) is access to tools and resources (Tietz et al. 2004; Luthje 2004), it could be argued that knowledge, experience, and access to resources are the three fundamental measurements that could allow us to predict someone's potential innovativeness. Specifically asking them if they are willing to invest time into developing new products/solutions related to their interests, or if they would rather spend time actually participating in their interest, could be tested in the future. Additional measures, such as

reputation, which has been observed in innovative consumers, could also be investigated.

8.8. Implications for the findings

This study provides a foundation of knowledge and a basic framework that can be used by organisations and scholars alike to help improve the efficiency and reliability of the identification process, specifically when consumers are only required for specific stages. Although further research would require the framework to be tested and its generalisability considered in more detail, this offers a new opportunity to plan identification processes with more guidance and structure. Importantly, for firms who are new to the process of engaging with consumers, this framework and information can provide them with guidance. It also presents new opportunities for research, as there are stages of the NPD process that appear to be only suited to the organisation, however it could be beneficial to expose consumers to these stages and see how else they may be able to add value to the process. Furthermore, these findings provide valuable information for organisations when identifying innovative consumers, who often find that doing so is a balancing act between opening up the NPD process and removing some of the control over those processes (Parmentier & Mangematin 2014).

In some instances, it may be in the organisation's interests to identify very knowledgeable consumers, who can contribute to the later part of the NPD process. However they may only be able to recruit less knowledgeable consumers. This framework provides the relevant information on prerequisites so that the organisation could coach the consumer to be more knowledgeable, or expose them to more information, even provide them with resources to escalate them up to the required level needed for a specific stage. Consumer innovation research has informed us that highly knowledgeable consumers are a valuable asset. Therefore

this could be used by organisations to increase the value they gain from their consumer by making them more knowledgeable.

9. Preferences towards virtual communities

Previously, scholars have successfully identified innovative consumers in virtual communities using text data from community contributions and discussions (Füller et al. 2007; Marchi et al. 2011), demonstrating that innovation related activities exist within virtual communities, and that this activity is commonly done free of any expected reward (Von Hippel 2017). However, virtual communities differ in form, function and design – arguably to facilitate and satisfy different consumer motives. When looking at innovative consumer attributes, it prompts the question as to whether consumers select different virtual communities based on these functions or design features. For example, innovative consumers are arguably more intrinsically motivated – they freely share knowledge and contribute for enjoyment, as discussed in the Literature Review, Section 6. Furthermore, innovative consumers also identify with other innovative consumers (Belz & Baumbach 2010; Bryant et al. 2005; Füller et al. 2007). Therefore, it could be possible that they consciously select virtual communities, and the embedded social systems, containing individuals who not only share similar attributes, but also contain structure and functionality that match their intended behaviours.

9.1. Influence of a social system

The Diffusion of Innovation theory highlights the importance of interpersonal channels (Rogers 2003), and their impact of the effectiveness of persuading an individual to adopt an innovation – relying on subjective evaluations of an innovation that is conveyed to them from other individuals like themselves who have previously adopted the innovation. Similarly this form of communication and trust in other's opinions within the social system could extend towards collaborating with an organisation and the level of willingness from the community who may have previously experienced beneficial collaborative activities with organisations.

A social system is defined as a set of interrelated units that are engaged in joint problem solving to accomplish a common goal (Rogers 2003). The social system may affect the ability for some to disclose innovations, share knowledge, or even take part in activities such as collaborating and sharing information with external entities. These social systems are built within rigid communication channels. Therefore some consumers will be attracted to social systems that reflect their values.

“The structure of a social system can facilitate or impede the diffusion of innovations in the system” (Rogers 2003). In this context the structure of the social system can be influenced by the community type, its function, design and governance; the communication channels that exist within communities will facilitate different actions and motives.

Furthermore, a consumer’s ability to succeed in specific virtual communities could depend on their perceived behavioural control (Ajzen 1991), which could influence their choice of community. They may gravitate towards communities or social systems that exhibit lower barriers to entry, or communities where their work is not exposed in a professional or competitive way.

Therefore when searching for innovative consumers in virtual communities, can we be sure that all virtual consumer communities will contain innovative consumers? Often virtual communities can facilitate the selling and exchange of digital artefacts, the structure of which may not appeal to those intrinsically motivated innovative consumers, yet arguably could appeal to those with a more entrepreneurial streak. Virtual communities that enable consumers to sell artefacts are intending to support professional behaviour – consumers engaging in the community for work or for personal economic gains. For organisations seeking innovative consumers willing to collaborate, the structure of the community

examined, and specifically whether the community contains selling functionality may impact who is identified. However this has not previously been investigated.

Therefore an understanding of which virtual communities and social systems attract innovative consumers, who are willing to collaborate, will help to answer the overall question of *How can external organisations efficiently use virtual communities to identify innovative consumers?* Understanding how the virtual community itself attracts and deters innovative consumers will ultimately refine the identification process, and enable research settings to be chosen efficiently.

9.2. Identifying the right consumers

The immense size of some virtual communities presents a challenge in identifying what could be a small handful of innovative consumers. Some virtual communities claim to have over 1.2 million members¹⁰. Similarly, Mobile Nations, a forum for smartphone users claims to have over 500,000 users engaged each month¹¹. By understanding which types of virtual communities attract innovative consumers, a more accurate and efficient search can be conducted. There have been attempts at using automated methods to identify certain consumers within large communities (Cha & Gummadi 2010). However, the problem of whether the search is being conducted in the right community, one that is likely to contain innovative consumers, still exists.

Innovative consumers are not only potentially good at creating new products and solutions, but have also been observed to act as opinion leaders, and are known for sharing knowledge. Information exchange within virtual communities has often been regarded as a pivotal element that may determine the success of the community (Filipczak 1998; Sreenivasan 1997); knowledge sharing activities within

¹⁰ <http://www.quirky.com>

¹¹ <http://www.mobilenations.com>

a community can act as a proxy for the community health (Koh & Kim 2004). Prior research identifies knowledge as an attraction for many consumers, as communities often provide access to information that is free, inaccessible or obscure (Butler et al. 2007; Furlong 1989; B Wellman et al. 1996). Furthermore, the consumers who are attracted to the community often go on to contribute more knowledge (Hagel & Armstrong 1997), thereby increasing the size and attractiveness of the information pool. Therefore by understanding what types of communities innovative consumers are attracted to, it may be possible to not only inform a more efficient innovation process, but also to assist organisations in designing a virtual community. In summary, virtual communities have become an important source of information online, where users can express views, provide and request information, express feelings, and discuss problems and solutions (Herring, 1996). If virtual communities are designed to attract innovative consumers who share knowledge and actively engage in the community, the virtual community will have a greater chance of success, and be likely to contain more ideas and innovations.

In relation to the consumer's motives to engage in specific communities, it could be that innovative consumers are likely to be 'heavy' users of the products and services in question, and given that they are likely to be ahead of the trend, may engage with communities to acquire knowledge, seek to report problems, exchange ideas and search for solutions (Füller et al. 2007; Luthje 2004). Expectations of being respected, recognised and increasing one's reputation within the community have been seen to motivate individuals to engage (Malhotra & Galletta 2003; Butler et al. 2007). Whilst innovative consumers such as lead-users are predominantly motivated intrinsically, they have also been observed to contribute for extrinsic reasons (Jeppesen & Frederiksen 2006). There is evidence that some lead users do transition into entrepreneurial consumers – arguably, at this point, their motives to engage in the community may change. Consumers with

economic interests, who wish to capitalise on their innovations, can be considered professional consumers, who participate within the community as part of their profession, and economic returns for their investment will influence and motivate contributions (Lerner & Tirole 2000), and imply they will be less willing to share their ideas with external organisations. The hypothesis posed in this research is that virtual communities facilitating professional interests will attract consumers who are less willing to collaborate with external organisations. Within this investigation an exploration of the motivations to engage with different communities for innovative consumers will also be carried out.

9.3. Methodology

To understand if innovative consumer's motivations to engage, and willingness to collaborate with organisations differs between consumers in different types of virtual communities, an investigation was required to compare participants across virtual communities. Data was collected from participants within each virtual community, so that a comparison could be drawn between the different communities and consumers. A questionnaire was used to collect the data from the consumers within each community. As an established data collection method, this would also enable the use of existing validated items measuring innovative characteristics.

To test the assumptions above, the study needed to include a research setting that exhibited functionality related to professional interests, and one that did not. This was to test how willingness to collaborate differed between the two communities, specifically to answer the question: Are innovative consumers, who are willing to collaborate, more or less prominent in virtual communities with collaborative tools that can support extrinsically motivated behaviours?

In the process of collecting data, it was also a suitable opportunity to collect weblog data, specifically from the respondent's profiles with their permission and the permission of the platform managers. This would allow comparisons to be drawn between self-reported data and objective data, to further understand how to increase efficiency and accuracy when identifying innovative consumers in virtual communities, discussed in the next chapter. This analytical approach would contribute to answering the overall research question, by providing insight into how, and if, the types of community influences where willing innovative consumers choose to contribute. This would help to inform the choice of community for external organisations, so that suitable research settings could be vetted and filtered more efficiently.

9.3.1. Research setting

The first community chosen for this investigation was Mobile Nations. Consumers gather on Mobile Nation forums to discuss mobile technology hardware, software and mobile applications. An initial observation showed that many self-disclosed developers operated in the community to communicate information about the development of new products and modifications including both their own and manufactured innovations.

Members of the Mobile Nations community are able to access and engage in any of the five forums: Android Central¹² (for Android mobile devices), iMore (for Apple IOS/Mac devices),¹³ WPCental¹⁴ (for mobile phones running a Microsoft Windows operation system, renamed to Windows Central shortly after the study was

¹² <http://www.androidcentral.com>

¹³ <http://www.imore.com>

¹⁴ <http://www.windowscentral.com>

conducted), CrackBerry¹⁵ (for BlackBerry devices) and Connectedly¹⁶ (for wearable technology).

The collaborative tools for the member is basic text mediated communication. Each member has their profile that lists their contributions and displays engagement statistics for each different virtual community within the Mobile Nation's portfolio of forums. Figure 4, shows an example of a community profile, which lists recent activity and various statistics about how frequently they and other members engage with them.

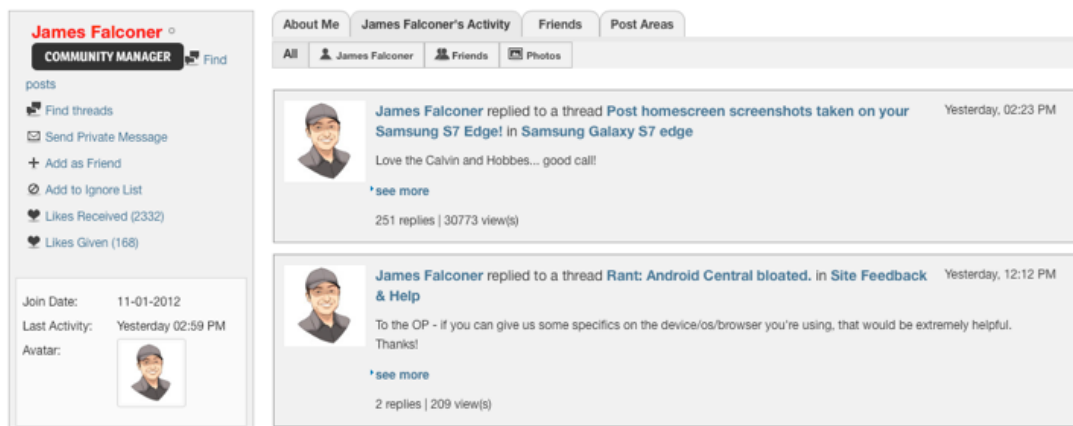


Figure 4: An example of a community member's profile from Mobile Nations Android Central community, showing their recent activity and engagement statistics.

Prior to choosing Mobile Nations as a suitable online community to conduct this research study other similar virtual communities were evaluated, such as MacRumors¹⁷ Forums, AppFutura¹⁸ and CNET Mobile application forum¹⁹. Mobile Nations was chosen for this research study, as they were able to provide access to the community, support for promoting the questionnaire, and were willing to take part in future follow-up research if required. The community design was also

¹⁵ <http://www.crackberry.com>

¹⁶ <http://www.connectedly.com>

¹⁷ <http://forums.macrumors.com>

¹⁸ <https://www.appfutura.com/forum>

¹⁹ <http://www.cnet.com/forums/mobile-apps>

familiar to many online forums, and contained observable web-log data, that the community managers also agreed to provide access to.

It should be noted that the community Connectedly was omitted from the investigation as it had been recently launched and was only occupied by a small percentage of the Mobile Nations users. Furthermore, the 'wearable technology' focused on in Connectedly, such as smart watches and fitness trackers, can be considered a different product category to a smartphone, and therefore would add consumers with differing interests in different products into the sample. Additionally, the wearable technology industry is still emerging and it is likely that many users will be unfamiliar with the technology; therefore the user community may vary greatly in levels of knowledge or dissatisfaction with the technology.

In summary, the first communities selected were mobile technology communities (N=4), all containing basic text mediated exchange systems. The second communities selected for the investigation were from the 3D printing and modelling sector.

Significantly more virtual communities for 3D printing were selected in the second sample (N=60), as the community managers could not offer the same level of support as the mobile technology communities, such as promoting the survey to the community. The comparison between the mobile technology community and the 3D printing communities will also highlight any potential industry differences. Therefore to try and achieve similar response rates more 3D communities were contacted. These industry sectors are similar in that both enable users to create their own derivatives and creations on the foundation of the technology underpinning the sector. For example, the development of mobile technology has seen a rise in developers building mobile applications and add-on hardware for smartphones; developments in 3D printing technology have enabled the public to

create and print 3D objects which can be used to create new products and modify existing products.

The 3D printing communities contained both communities with simple text mediated exchange systems, the same as the mobile technology communities, and more advanced communities enabling the exchange of files and facilitated professional users selling their 'innovations' and exchanging files.

9.4. Design

This study focused on investigating innovative consumers who were likened to lead-users. The phrase 'likened to lead-users' was used here, as the ability to validate consumers' ability to innovate new products and solutions to consumer needs would require additional stages to validate their innovations. Here, the focus was on identifying consumers who score high on the characteristics exhibited by lead users.

9.5. Materials

Innovative consumer characteristics measured included: *willingness to collaborate*, to measure the differences in the willingness to engage in open innovation activities between innovative consumers and those with professional interests; *product knowledge* and *user-experience*, to measure a consumer's level of domain specific knowledge; *innovativeness*, to measure the consumer's ability to have original ideas, and *dissatisfaction*, used as a proxy for expected benefits, and having needs greater than current product offerings can meet.

To measure *willingness* and *innovativeness*, six items from Füller et al. (2008) scales on innovativeness and participation in open innovation were used. For example, for Willingness one of the items was "*I would be interested in participating in the*

development of new mobile applications”, and for Innovativeness, “*I am an inventive kind of person*”. Seven items were used to measure *product knowledge* and *user-experience*, adapted from Füller et al. (2008) scales on domain specific skills and brand knowledge, such as “*I consider myself very knowledgeable about mobile phone applications*”. *Dissatisfaction* was measured using three items from Franke et al.’s (2006) scale for measuring high expected benefits, including questions such as “*In my opinion, there are still unresolved problems with mobile technology*”.

Motivations for engaging in the community measured included a mixture of intrinsic and extrinsic motivations chosen to identify differences between the motives for engaging in communities of different complexities. These included: *knowledge acquisition*, the extent to which users used the community to acquire knowledge and help solve problems; *knowledge giving*, the motivation and behaviour of a consumer to share knowledge with others or to collaborate within the community; *social motivation*, to engage in a community to build and maintain relationships; *reciprocal motivation*, to be motivated to engage as the user feels they have a duty of care and responsibility to the community; *recognition*, to engage to build a reputation within the community; *professional motivation*, to engage in a community for economic gain, and *enjoyment*, to engage in the community for leisure.

Knowledge acquisition was measured using three items adapted from Franke et al.’s (2006) scale for community based resources. This included questions such as “*I engage with the community to help increase my knowledge and understanding about product development*”. Six items measuring *knowledge giving* were adapted from the Jeppesen & Laursen (2009) scale on knowledge giving, which included questions such as “*I enjoy sharing my ideas with other community members*”. Koh

& Kim's (2004) scales on community participation and community promotion were consulted for the development of items to assess *social motivations* and *reciprocal motivation*, with questions such as “*When asked I will help other members of the community*” and “*I often log onto the community to maintain my relationship with other members*” which were measured with four and three items respectively. Jeppesen & Laursen's (2009) study examining knowledge sharing was consulted for the development of items measuring *recognition* and *enjoyment*, which were measured using four and three items respectively, including questions such as “*I engage in the community forum to help build my reputation amongst other members*”, and “*I engage in discussions for fun and enjoyment*”. Füller et al.'s (2006) scale examining compensation was consulted to develop the three items used to measure professional interests.

The questionnaire also contained questions on the *consumer's occupation* (full-time education, part-time education, full-time employment, part-time employment, retired, self-employed, unemployed, volunteer); *level of education* (GCSE/high school, high school senior/A-levels, college degree, Bachelor's degree, masters degree, doctoral degree, other); *community identity*, how the user considered their participation in the community (As a hobbyist, As a professional, As a student, I participate on behalf of other people, I do not consider myself part of the community, Part of my employment). Community members were also asked to state the length of time they have been part of the virtual community (I do not engage in this community, 0-3 months, 3-6 months, 6-12 months, 1-2 years, 2-3 years, 4+ years).

The questionnaire contained a total of 46 items, which can be located in the Appendices. Including scales assessing innovative consumer characteristics,

motivations for engaging in virtual communities, and demographics including occupation and education level.

9.6. Participants

The respondents in both samples mainly identified as a hobbyist with 68% in Mobile Nations communities, and 47% in 3D communities identifying as hobbyists. Secondary to hobbyists were professionals, with 8.4% in Mobile Nations, and 38.4% in 3D communities. The respondents for the survey were mainly in full-time employment (50.8%), with the second largest majority being self-employed (13.2%), and 59.2% possessed a college degree or higher.

9.7. Procedure

The data for this study was collected in two stages. Firstly, responses were collected from the Mobile Nations²⁰ virtual community – a large mobile technology community, consisting of five simple text mediated consumer forums containing over 3.9 million registered users, claiming on their website to have approximately 500,000 engaged users each month. The second set of responses was collected from a variety of 3D online communities, both simple and complex communities (N=60). The size of the communities ranged from 5 community members to over one million members (listed in Chapter 16). Obtaining community numbers was challenging as many communities do not disclose the number of members. To collect data from the virtual communities it was necessary to work closely with the community management who posted the survey to the communities.

In collaboration with one of the community managers at Mobile Nations, an online questionnaire was launched in March 2014, in the form of a community forum post on all four communities, and stayed online for the agreed data collection period of 10 days. Within this period, the questionnaire attracted 303 respondents, with 180

²⁰ <http://www.mobilenations.com>

of these responses gained within the first 6 days. The questionnaire announcement was exposed to members of the community approximately 43,600 times over the 10-day period (number of unique views was not available). While the response rate may seem low at 0.7%, the promotion of the survey can be likened to that of an online advert, where the average click through rates (CTR) for even targeted audiences are estimated to be as low as 2.6%, with some sources citing CTR's of 0.5% (Richardson et al. 2007). A series of t-tests were used to check for non-response (late response) bias, no significant differences were found between early and late responses.

For the 3D virtual communities, the questionnaire was sent out in February 2014, initially to 59 community managers of hobbyist communities such as Hackspaces and amateur 3D modelling and printing groups. After this, it was sent to course conveners for taught 3D courses in 61 relevant higher education institutions, and 65 design and animation consultants. Lastly, 10 relevant online blogs were contacted. From the 195 recipients, 59 responded to confirm they had forwarded the questionnaire onto their community/network (11 hobbyist community managers, 29 education course conveners, 11 professional consultancies, and 8 blogs). 17 respondents notified me they were unable to forward the survey for various reasons including communication and marketing policies.

In the first 14 days, the survey had 170 responses. A follow up email was then sent to all recipients who had not responded to the original email, asking if they could forward the survey on to their networks. Another 105 responses were then collected in the following 14 days. The survey was then taken offline after 28 days. After the data had been cleaned, by removing incomplete data only 185 responses were retained.

9.8. Scale development

To ensure the scales were measuring their intended characteristics, and to test the reliability for each scale, an exploratory factor analysis (EFA) was conducted on consumer characteristics, and then again on the motivational items. An EFA, as opposed to confirmatory factor analysis (CFA), was conducted as, although many of the items are from previous scales, these have been tailored to this context and new items added. Therefore it seemed appropriate to use an EFA to ensure the items were measuring the intended characteristics.

9.9. Innovative user characteristics

A principle components analysis (PCA) was conducted on the 19 items measuring consumer characteristics (product knowledge, user-experience, dissatisfaction, professional intentions, willingness to collaborate in open innovation and innovativeness) with orthogonal rotation (varimax). The test extracted four factors, using Kaiser's criterion of eigenvalues over 1, and in combination explained 74.27% of the variance. The Kaiser-Meyer-Olkin measure verified the sampling adequacy for the analysis, KMO = .821, and all KMO values for individual items were > .694, above the 0.5 minimum. Bartlett's test of sphericity (X^2 (91) = 2596.398, $p < 0.001$) indicated that correlation between items were sufficiently large for PCA. The four factors extracted represent (1) *product knowledge*, the consumer's self-reported level of knowledge; (2) *willingness to collaborate*, the consumer's willingness to collaborate on new product development; (3) *innovativeness*, an indication of creativity and ability to come up with original ideas; and (4) *dissatisfaction*, as a proxy for expected benefits of new innovations, based on their current level of satisfaction with available market products.

Table 2: Factor loading, variance and Alpha scores for Innovative consumer characteristics.

Items	FL	Var (%)	Alpha
Product Knowledge			
I consider myself very knowledgeable about mobile phone software	0.891	34.91	0.87
I consider myself very knowledgeable about mobile phone applications	0.855		
I consider myself very knowledgeable about mobile phone hardware	0.841		
I have a lot of experience with mobile products	0.754		
I possess profound knowledge relevant for the creation of new mobile products	0.616		
Willingness			
I would be interested in participating in the development of new mobile applications	0.903	17.92	0.91
I would be interested in participating in the development of other technology products (not mobile phones or applications)	0.89		
I would be interested in participating in the development of new mobile hardware products	0.873		
Innovativeness			
I consider myself to be creative and original in my thinking and behaviour	0.898	11.78	0.85
I have original ideas	0.871		
I am an inventive kind of person	0.818		

Dissatisfaction			
I am dissatisfied with some of the mobile technology currently available	0.855	9.66	0.72
In my opinion, there are still unresolved problems with mobile technology	0.785		
I often get irritated by the lack of advancements in mobile technology	0.705		

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

Rotation converged in 6 iterations.

9.10. Motivations to engage in virtual communities

A second principle components analysis (PCA) was conducted on the items measuring consumers' motivations to engage in a virtual community. The test extracted three factors, using Kaiser's criterion of an eigenvalue over 1, and in combination explained 65.13% of the variance. Table 3 shows the items used to measure each motive to engage, the factor loadings for each, the total variance explained for each characteristic and the internal reliability score, measured using Cronbach's alpha. The Kaiser-Meyer-Olkin measure verified the sampling adequacy for the analysis, KMO = .763, and all KMO values for individual items were > .634, above the 0.5 minimum. Bartlett's test of sphericity ($X^2(45) = 1137.552, p < 0.001$) indicated that the correlation between items were sufficiently large for PCA. The three factors extracted represent (1) personal gain, measuring professional interests such as approaching other members to offer professional services; (2) responsibility, a consumer's interest in helping and engaging with other consumers in the community; and (3) reputation, measuring engagement in a community primarily to increase reputation and recognition. In both EFA's some items were removed due to low communalities (below 0.5) and if the items cross loaded or had a loading less than 0.4. The full list of items used in the questionnaire alongside the means and standard deviation can be viewed in the Appendices (see Section 16.2).

Table 3: Factor loadings, variance and Alpha scores for Motivations to engage in Virtual communities.

Items	FL	Var (%)	Alpha
Personal gain			
If someone in the community requires professional services, I will often approach them	0.803	47.78	0.79
I find the community useful for showcasing my work and skills	0.747		
I often use the community to promote my own work	0.717		
I often benefit from contributing to collaborative work in the community	0.678		
Responsibility			
As a community member, I feel responsible for helping other members resolve problems and find solutions to their questions and discussion topics	0.813	11.72	0.7
When asked I will help other members of the community	0.775		
I have a responsibility to acknowledge and reply to other users comments and posts when I can	0.65		
Reputation			
I participate in the community to increase my 'likes', 'votes' or 'rank' from other members	0.87	10.64	0.75
I engage in the community forum to help build my reputation amongst other members	0.713		
I often log onto the community to maintain my relationship with other members	0.654		

*Extraction Method: Principal Component Analysis.
 Rotation Method: Varimax with Kaiser Normalization.
 Rotation converged in 5 iterations.*

9.11. Results

Virtual communities were coded into a binary level of complexity variable (1 = simple complexity, 2 = greater complexity), differentiated by the functionality of the platform that the consumer engaged with. Details of all communities included, the level of complexity the community was coded as, and the number of respondents from each can be located in the Appendices (see Section 16.1). Communities that enabled only text mediated communications, such as MobileNations.com, were classified as being of simple complexity. Communities that enabled members to exchange files and sell artefacts, such as Thingiverse.com, were classified as communities with greater complexity.

Table 4 presents mean differences between the two samples. This shows that the willingness to collaborate and dissatisfaction are potentially higher in simple communities, while reputation is potentially higher in complex communities. While this provides an initial overview, further analysis is needed to understand these differences.

A one-way ANOVA was conducted to identify differences in characteristics and motivations to engage of consumers between communities of different complexities. Consumer characteristics of product knowledge, willingness to engage in open innovation, innovativeness, and dissatisfaction, were examined and motivations to engage comprised professional interests, responsibility, and reputation.

Table 4: Mean differences between simple forum communities (1) and advanced functionality communities (2).

Characteristics	Group	N	Mean	SD
Product Knowledge	1	294	4.711	1.250
	2	74	4.684	1.392
	Total	368	4.705	1.278
Willingness to collaborate	1	287	5.182	1.291
	2	74	4.527	1.391
	Total	361	5.048	1.337
Innovativeness	1	280	5.167	1.186
	2	74	5.748	0.956
	Total	354	5.288	1.165
Dissatisfaction	1	285	4.447	1.235
	2	74	3.887	1.105
	Total	359	4.332	1.229
Personal gain	1	318	4.065	1.286
	2	85	4.735	1.139
	Total	403	4.206	1.284
Responsibility	1	342	5.139	1.229
	2	92	5.098	1.333
	Total	434	5.131	1.250
Reputation	1	297	3.663	1.361
	2	77	4.130	1.383
	Total	374	3.759	1.377

The output of the one-way ANOVA indicated that there were significant differences between simple and complex virtual communities. The results in Table 5 indicate that respondents were more willing to collaborate in open innovation in simple communities ($F(1,359) = 14.7, p < 0.001$), and that they also experienced higher levels of dissatisfaction than respondents from complex communities ($F(1,357) = 18.4, p < 0.001$). Significant differences were also observed in innovativeness ($F(1,352) = 19.8, p < 0.001$), with greater levels of innovativeness reported in complex communities.

No significant difference was identified for the levels of product knowledge between communities. Therefore for consumer characteristics, respondents in simple communities reported higher levels of willingness to engage in open innovation and dissatisfaction, than complex communities; higher levels of innovativeness was reported in communities with greater complexity. The full ANOVA output can be viewed in the Appendices (see Section 16.5 and 16.6).

For a consumer's motivation to engage in a virtual community, respondents in communities of greater complexity indicated significantly greater intentions to engage for personal gain ($F(1,401) = 30.2, p < 0.001$). With respect to engaging to influence one's reputation, respondents from simple communities were less concerned with their reputation than those from complex communities ($F(1,372) = 7.2, p = 0.008$). There was no significant difference between the respondents of the different communities with respect to responsibility – those respondents that felt compelled to help others, and would respond to other's requests for assistance. To summarise, respondents from complex communities reported higher levels of motivation for both personal gain and reputation.

Table 5: One-way ANOVA results of the effect of virtual community complexity on Innovative consumer characteristics and motivations to engage.

Characteristics	F	Sig.	N	Mean	SD
Product knowledge	0.026	0.872	368	4.705	1.278
Willingness to collaborate	14.68	0.000	361	5.048	1.337
Innovativeness	15.15	0.000	354	5.288	1.165
Dissatisfaction	12.566	0.000	359	4.332	1.229
Personal gain	19.12	0.000	403	4.206	1.284
Responsibility	0.08	0.778	434	5.131	1.250
Reputation	7.153	0.008	374	3.759	1.377

A multivariate multiple regression was used to examine how innovative consumer characteristics related to the consumer's motivations to engage, and how these differed in communities of different complexities, shown in the table below. To help illustrate the impact of introducing complexity, the results were separated into individual tables.

Similar to a linear regression, a multivariate multiple regression tests the relationships between multiple predictors and outcome variables (here consumer characteristics and motivations to engage). The items used in the questionnaire were primarily measured using Likert scales, where 7 was coded to indicate agreement with the questions/statement and 1 was coded to indicate disagreement with questions/statement. The level of complexity of the communities (coded as simple=1, complexity=2) was included as a moderator variable so as to examine how the relationships between consumer characteristics and motivations to engage varied across forums of differing levels of complexity.

Table 6: Multivariate multiple regression of product knowledge regressed onto motivations to engage.

Variables	Coef.	Std. Err.	t	Sig
Product knowledge (predictor variable)				
Reputation	0.187	0.058	3.230	0.001
Responsibility	0.169	0.070	2.430	0.016
Personal gain	0.037	0.063	0.590	0.552
_cons	2.991	0.329	9.100	0.000
Product Knowledge x Complexity				
Reputation	0.290	0.114	2.530	0.012
Responsibility	-0.098	0.138	-0.710	0.478
Personal gain	0.577	0.125	4.630	0.000
_cons	2.734	0.651	4.200	0.000

The results of the analysis showed a positive significant relationship between product knowledge and reputation ($b=0.187$, $p=0.001$) and responsibility ($b=0.169$, $p=0.016$), as shown in Table 6. This indicates that as the consumer's level of product knowledge increased so did their motivations to engage in a community to increase their reputation, but also to help others. When the complexity was introduced, it significantly moderated the relationship between product knowledge and personal gain ($b=0.577$, $p=0.000$) - changing personal gain from non-significant to significant - and moderated the relationship between product knowledge and reputation ($b=0.290$, $p=0.01$).

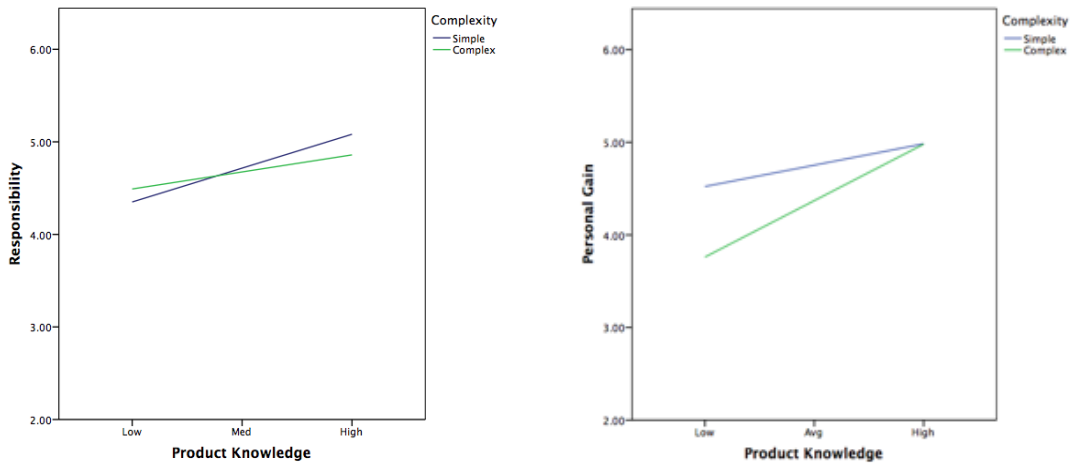


Figure 5: Simple slopes graphs showing the differences in relationships between community types for product knowledge, personal gain and responsibility.

To demonstrate the direction of the effects of the moderations, simple slopes analysis was conducted. The graphs in Figure 5 show that as a consumer’s level of product knowledge increases with their reported level of responsibility - to help other members of the community, and provide assistance, guidance and even share knowledge. This could be observed in both simple and complex communities, however within simple communities this increased at a different rate. Similarly, reported levels of personal gain with different levels of product knowledge, moved in the same direction, in complex communities the change was greater.

Table 7: Multivariate multiple regression of Innovativeness regressed onto motivations to engage.

Variables	Coef.	Std. Err.	t	Sig
Innovativeness				
Reputation	0.116	0.054	2.140	0.033
Responsibility	0.045	0.065	0.700	0.487

Personal gain	0.133	0.059	2.250	0.025
_cons	4.068	0.307	13.230	0.000
Innovativeness x Complexity				
Reputation	0.210	0.134	1.560	0.119
Responsibility	-0.254	0.162	-1.570	0.117
Personal gain	0.749	0.146	5.110	0.000
_cons	3.925	0.764	5.140	0.000

The consumer's level of innovativeness, shown in Table 7, has a positive and significant relationship with both reputation ($b=0.116$, $p=0.033$) and personal gain ($b=0.133$, $p=0.025$), indicating that a consumer's level of innovativeness increased with their interest in personal gains, and their concern with reputation. When complexity was introduced, it significantly moderated the relationships for personal gain ($b=0.749$, $p=0.000$), while reputation became non-significant.

Table 8: Multivariate multiple regression of Dissatisfaction regressed onto motivations to engage.

Variables	Coef.	Std. Err.	t	Sig
Dissatisfaction				
Reputation	0.120	0.060	2.020	0.045
Responsibility	0.020	0.072	0.280	0.777
Personal gain	-0.026	0.065	-0.400	0.690
_cons	3.881	0.339	11.460	0.000
Dissatisfaction x Complexity				
Reputation	0.204	0.094	2.160	0.031
Responsibility	-0.206	0.114	-1.810	0.071
Personal gain	0.391	0.103	3.800	0.000

_cons	3.831	0.537	7.130	0.000
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For dissatisfaction, a significant relationship exists between reputation ($b=0.120$, $p=0.045$) – those who were dissatisfied with current product offerings were also interested in influencing their reputation, as shown in Table 8. Complexity was shown to significantly moderate the relationships between dissatisfaction and personal gain ($b=0.391$, $p=0.000$), while reputation remained significant ($b=0.204$, $p=0.031$). The results of the simple slopes analysis all showed a similar pattern for both innovativeness and dissatisfaction, where reputation, personal gain and responsibility all increased with levels of innovativeness/dissatisfaction. Notably the relationships between innovativeness and motivations appeared higher in complex communities, while for all other characteristics they appeared higher in simple communities. All simple slopes graphs can be viewed in the Appendices (see Section 16.10).

Table 9: Multivariate multiple regression of willingness regressed onto motivations to engage.

Variables	Coef.	Std. Err.	t	Sig
Willingness to collaborate				
Reputation	0.085	0.062	1.370	0.172
Responsibility	0.360	0.075	4.820	0.000
Personal gain	-0.028	0.068	-0.410	0.679
_cons	2.936	0.353	8.320	0.000
Willingness to collaborate x Complexity				
Reputation	0.200	0.106	1.880	0.061
Responsibility	0.150	0.128	1.170	0.243
Personal gain	0.492	0.116	4.250	0.000
_cons	2.389	0.604	3.960	0.000

When it came to a consumer's willingness to collaborate in open innovation, there was only one positive significant relationship with the motive responsibility ($b=0.360, p<0.001$), therefore those who were motivated to engage in a community to help others were also willing to collaborate, as shown in Table 9. However complexity was shown to moderate this relationship, as responsibility became non-significant once complexity was introduced. While reputation almost became significant ($p=0.061$), complexity significantly moderated the relationships between willingness and personal gain ($b=0.492, p=0.000$).

The simple slopes analysis reveals the respondents who reported high levels of personal gain were less willing to help others in the community, and did not feel a sense of responsibility. Those in complex communities who appeared to be more willing reported higher motives for engagement for their reputation.

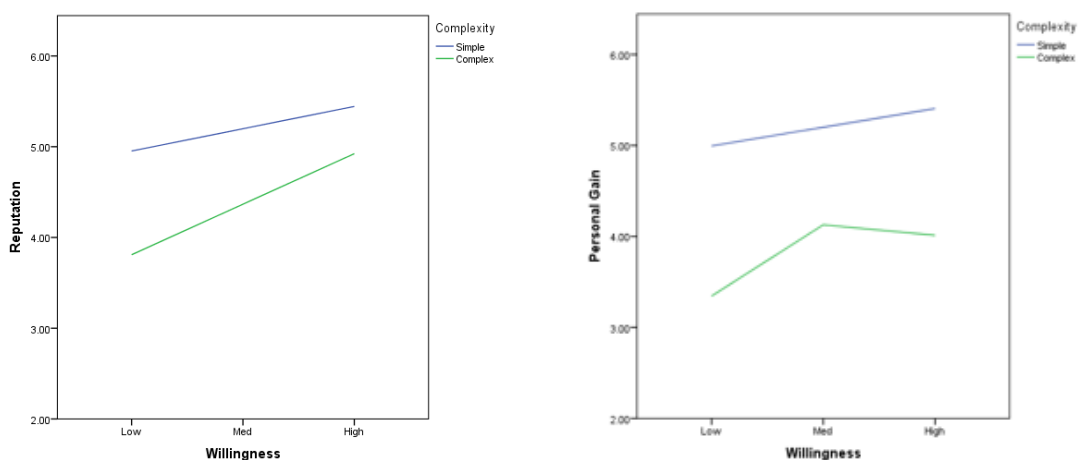


Figure 6: Simple slopes graphs showing the differences in relationships between community types for consumer characteristics and personal gain.

Observations from the simple slopes analysis (such as willingness to collaborate, which decreased as interest in personal gain increased and the relationships between innovativeness and personal gain was much higher in complex communities than simple) provides evidence that supports the hypothesis for this investigation, that virtual communities which facilitate professional interest will

attract less innovative consumers willing to collaborate in external innovation activities.

9.12. Discussion

Currently, there is no research that investigates the types of virtual communities that innovative consumers prefer, or more specifically if innovative consumers who are willing to collaborate with external organisations are attracted to specific types of virtual communities. This study provides the first evidence of how organisations can conduct more efficient and reliable consumer identification processes by taking into consideration the type of virtual community.

While respondents in simple communities reported higher levels of willingness to engage in open innovation and dissatisfaction than complex communities, the innovative consumer characteristics appeared to be shared between the communities. However respondents from complex communities reported higher levels of motivation for both personal gain and reputation. Comparing this with the simple slopes analysis it can be observed that those who reported higher levels of personal gain, also reported lower levels of willingness. Across all simple slopes graphs (see Section 16.10) willingness was higher in simple communities than complex. Furthermore, with the exception of innovativeness, the moderation analysis showed that the relationships between consumer characteristics and personal gain were all non-significant. Introducing complexity showed this significantly moderated relationships, as those between consumer characteristics and personal gain were positive and significant once complexity was introduced. Collectively this provides evidence to support the hypothesis that virtual communities which facilitate professional interests, where members will engage for personal gain, are also less willing to collaborate.

While this investigation has been unable to confirm that innovative consumers who are willing to collaborate exist in a specific type of community. This investigation has shown that consumers from different communities can be more or less willing to collaborate, and those who are less willing to collaborate tend to engage in complex communities, motivated by personal gain. Furthermore, for the first time it is now possible to compare the differences between consumer characteristics associated with innovative consumers alongside motivations to engage against different types of virtual communities.

Furthermore, the results showed that responsibility – where consumers helped others find solutions, responded to the comments and were generally supportive – increased with the consumer's levels of product knowledge, more so in simple communities than complex. This reflects findings from previous research that innovative consumers with high levels of knowledge were also willing to help their community by sharing knowledge (Jeppesen & Laursen 2009).

Notably, innovativeness proved less useful in this investigation for indicating innovative consumers. It was possible that some communities took a modest stance when reporting on their own abilities. Furthermore, social desirability bias could have played a role in the respondent's choices. However as this investigation did not analyse these areas, this would be beneficial to consider in any future research.

The results of this investigation provide a foundation for improving the efficiency and accuracy of the innovative consumer search, by introducing the type of virtual community as a factor for consideration in the identification process. For organisations interested in collaborating with innovative consumers, this provides clarity and direction. While the results were limited to two industries, the results

provide a foundation of evidence to build upon, while also suggesting that further investigations could provide more generalisable findings.

This first empirical study has contributed evidence on where to identify innovative consumers who are willing to collaborate with organisations. However the generalisability of the results are limited to two domains – 3D printing and mobile technology. Further analysis and a comparison of other domains would provide more insight into how different consumer communities may differ, and how other functionality in virtual communities could attract or deter innovative consumers. Furthermore, not all domains may have virtual communities of differing complexity. Therefore some domains will only have simple virtual communities, which would mean that all innovative consumers – willing and non-willing - will be located in the same type of community. To summarise, this study is limited by the sample of virtual communities and the number of respondents from each. Additionally it would have been useful to have directly asked respondents why they preferred specific types of virtual communities. This would provide additional insight into understanding if and why innovative consumers are attracted to specific virtual communities.

9.13. Conclusion

This investigation has provided the first evidence that innovative consumers who are willing to collaborate are likely making conscious decisions to contribute to specific types of virtual communities. Therefore organisations can conduct a more reliable and efficient identification process of innovative consumers by taking these factors into consideration. This study is the first to provide evidence that innovation managers could benefit from using the functionality of the virtual community as a factor when looking for innovative consumers who are willing to participate in the innovation process. The findings here also apply to organisations that are investing

time and resources into building a virtual community, who are interested in attracting specific types of consumers.

The study presents the first insights into how consumer identification could change in the future by not only focusing on consumer characteristics, but also the virtual communities these consumers exist within. The way the community is designed will arguably play a large role in who the community is marketed towards, what the community enables them to achieve, and will either include or exclude certain types of consumer by design. While this is only speculation, this study provides the first evidence that virtual communities can have an impact in the identification and locality of types of innovative consumers.

In relation to the findings from the previous chapter, those consumers who operate in more complex communities could be more valuable to organisations who are in the stages of trial production, market trial, or pre-commercialisation analysis. While simple communities could prove more effective for the earlier stages of NPD.

10. The role of weblog data

The previous investigation showed that virtual communities can be used to inform a more efficient identification process for innovative consumers by guiding organisations toward those consumers willing to collaborate. Building on the previous investigation a review of the weblog data created exclusively by online environments was required to understand how virtual communities can further inform more efficient identification processes for external organisations.

As highlighted in the Literature Review, when an individual engages in a virtual community they are creating a digital footprint, made up of web-log data. This data can consist of almost everything a person does in a virtual community, from first accessing the web pages of the community, to the number of times they have made comments, posts, engaged with other members, uploaded, and downloaded files – which are often openly displayed to the community.

Weblog data has been used in a number of studies previously to identify potentially innovative consumers in virtual communities. Text contributions have been used to determine a consumer's level of product knowledge (Marchi et al. 2011), understand their motivations (Füller et al. 2007), or to measure the lead user characteristic 'expected benefits' by using proxies such as user investment, speed of adoption and dissatisfaction (Bilgram et al. 2008a). Other methods used to identify consumers within a virtual community include analysing numerical or 'frequency data' including the number of posts related to specific subjects, see list in Appendices (see Section 16.8). This data can also be used to compare and benchmark individuals in a community and to help determine characteristics, such as willingness to contribute, product knowledge and opinion leadership (Füller et al. 2007; Bilgram et al. 2008b). However, data collected from virtual communities is often specific to that community. Additionally it is often retrospective and often not applied in the research design for seeking suitable innovative consumers. This

investigation will therefore build upon the previous study by analysing the use of weblog data as an additional element that can be used to inform a more efficient identification process, by being used to detect innovative consumers willing to collaborate.

10.1. Response rates

Identifying innovative consumers using traditional screening methodologies, e.g. questionnaires and interviews are time intensive. Methods such as self-administered questionnaires allow a standard set of questions to be sent to a large sample of community participants. However, it relies upon the recipient of the questionnaire responding and often response rates obtained are variable. Other methods such as Pyramiding²¹, are often quicker to administer and reduce the cost of the search compared to survey or interview screening methods (Von Hippel et al. 2009). However the response rate will be variable depending on the sample size, and resources available. Whilst Füller et al. (2008) gained a response rate of only 0.28% of the community, others have gained more - Tietz et al. (2004) achieved a 39.1% response rate from those consumers contacted (both relating to physical communities, using a self-administered questionnaire, one in person and the other by mail). While high response rates and access to a large number of consumers in physical communities is possible, it requires greater effort and resources to reach the majority of consumers in the community.

In virtual communities, it is possible to access more consumers with less effort. For example, Jeppesen & Laursen (2009) in an attempt to identify and understand how lead users share knowledge, gained a response rate of 62.7% by showing users a pop-up window in the web-browser, asking them to participate in the questionnaire – highlighting the difference in effort required per-participant to traditional methods.

²¹ Pyramiding is the method of requesting if respondents they can refer someone who is more knowledgeable or innovative than them, each time moving closer to someone who is more likely to be an innovative consumer (Von Hippel et al. 2009). See Section 6.4 for more details on identification methods.

Other methods allow the researchers to start with the maximum numbers of known users and then reduce the number down using various indicators to locate the small percentage of innovative users, using data on the consumer's engagement and behaviour. Using this approach Füller et al. (2007) analysed text from approximately 460 posts in forums from five online communities. A combination of text and frequency analysis was able to determine different types of users, highlighting frequent posters (approx. 3%) that had a likeness to lead users.

Using weblogs and data as a behavioural indicator can, therefore, be an efficient method of allowing an examination of more (and potentially all) of the user community members for key characteristics of interest. Weblog data can be collected unobtrusively and requires no input from the community. Unlike "offline measures" such as telephone screening, and self-administered questionnaires, standard and recognised data features within weblogs are not yet established for individual characteristics used to identify lead users. Scholars are currently developing and testing a range of measures, which can use weblog data as an indicator of relevant behavioural characteristics

10.2. Design

In the questionnaire used in the previous chapter, respondents had the option to disclose their community username, allowing the collection of objective data displayed on their profiles including the number of comments and posts made. This data was only collected from the Mobile Nations community, as it was not possible to visit and collect data from the all of the 3D communities, as it was not possible to obtain a response from the community managers regarding the use of data.

This data was collected to make a comparison of the self-reported data and objective data to understand the relationships between the two. This comparison

will allow the investigation of the likelihood of identifying relationships between innovative consumers, their motives to engage and their online footprint. The aim of analysing this data was to provide a foundation for using weblog data for innovative consumer identification in large communities where it is not possible to have all members respond to a questionnaire.

10.3. Procedure

From the respondents who disclosed their username, data from 155 user profiles was collected (51% of Mobile Nation respondents from the study described in Chapter 9). Data was collected on the number of posts each member had made in the community, the number of comments made in response to other member's posts, and the number of *thanks* and *likes* received by from other members. Members use *thanks* to indicate that a post or comment was helpful, and *likes* to show they liked a post or comment. The date the community member joined the community was also collected, along with the number of communities members contributed to, as not all members contributed to all Mobile Nation forums – some were only interested in the Android smartphone, while others were interested in different types of smartphones.

10.4. Analysis and results

A negative binomial regression was chosen to analyse the data between the self-reported variables and number of posts and comments made by each consumer, including the number of communities they were active within, and the joined date (no. of months since they joined the community) as the weblog data consisted of count data that was not normally distributed, therefore a normal linear regression would not be appropriate²².

²² <http://www.ats.ucla.edu/stat/stata/dae/nbreg.htm>

Table 10: Output from a negative binomial regression of total number of comments by a consumer on innovative consumer characteristics and motivations to engage.

Total comments	Coef.	Std. Err.	z	P>z
Personal gain	-0.083	0.164	-0.51	0.613
Responsibility	0.752	0.144	5.23	0.000
Reputation	-0.014	0.159	-0.09	0.928
Product Knowledge	0.104	0.175	0.6	0.55
Willingness	-0.226	0.153	-1.48	0.139
Innovativeness	0.168	0.160	1.05	0.295
Dissatisfaction	0.164	0.135	1.21	0.226
_cons	0.206	1.062	0.19	0.846
/lnalpha	0.632	0.114		
alpha	1.881	0.215		

*Likelihood-ratio test of alpha=0: chibar2(01)
= 3.6e+04.
Prob>=chibar2 = 0.000*

When the predictor variable was the total number of comments by the consumer, as shown Table 10, the only outcome variable to show a significant and positive relationship is Responsibility (B=0.752, P=0.000), proving that when the motivation of a user to engage in the community to provide assistance and help to others increases, so does their overall number of comments. All other relationships were non-significant. However, product knowledge showed marginal significance (B=0.104, P=0.055), indicating a trend that users with greater knowledge comment more.

Similarly, when the predictor variable was the total number of posts, the only positive significant relationship was with Responsibility (B=0.534, P=0.001), see

Table 11. Again, users who have a sense of responsibility towards the community also make more contributions.

Table 11: Results of a negative binomial regression of total number of posts by a consumer on innovative consumer characteristics and motivations to engage.

Total posts	Coef.	Std. Err.	z	P>z
Personal gain	-0.104	0.198	-0.53	0.599
Responsibility	0.534	0.160	3.33	0.001
Reputation	0.138	0.177	0.78	0.436
Product Knowledge	0.368	0.201	1.83	0.067
Willingness	-0.047	0.162	-0.29	0.77
Innovativeness	-0.177	0.146	-1.21	0.225
Dissatisfaction	0.151	0.1305	1.16	0.246
_cons	2.329	0.974	2.39	0.017
/lnalpha	0.633	0.110		
alpha	1.884	0.208		

Likelihood-ratio test of alpha=0: chibar2(01) = 2.9e+05 Prob>=chibar2 = 0.000

When it came to the number of 'likes' each user received for the posts and comments, there was a positive and significant relationship with Product Knowledge (b=0.525, p=0.027), alongside a marginal significant result for Responsibility (p=0.051) as shown in Table 12 below. With regards to the collective number of 'Thanks' received by each user, only a marginal (positive) significance for Product Knowledge (b=0.454, p=0.054) was shown.

Table 12: Results of a negative binomial regression of total number of ‘likes’ received by consumers on innovative consumer characteristics and motivations to engage.

Total ‘likes’ (sum)	Coef.	Std. Err.	z	P>z
Personal Gain	-0.121	0.263	-0.46	0.646
Responsibility	0.384	0.197	1.96	0.051
Reputation	0.294	0.232	1.27	0.203
Product Knowledge	0.525	0.238	2.21	0.027
Willingness	0.038	0.203	0.19	0.851
Innovativeness	-0.337	0.180	-1.87	0.061
Dissatisfaction	0.299	0.179	1.67	0.094
_cons	0.304	1.275	0.24	0.811
/lnalpha	0.918	0.113		
alpha	2.505	0.285		

Likelihood-ratio test of alpha=0: chibar2(01) = 1.2e+05 Prob>=chibar2 = 0.000

Interestingly there was a marginal significant negative relationship between ‘Thanks’ received and Innovativeness ($b=-0.329$, $p=0.055$), as shown in Table 13, indicating that as Innovativeness decreases, the number of ‘Thanks’ increases. Similarly Product Knowledge showed a marginal positive relationship ($b=0.454$, $p=0.054$). The analysis that was counted using the joined date (no. of months since first joining the Mobile Nations community collective), showed no significant results, the result for this can be located in the Appendices (see Section 16.7).

Table 13: Results of a negative binomial regression of total number of ‘Thanks’ received by consumer on innovative consumer characteristics and motivations to engage.

No. of ‘Thanks’ (Sum)	Coef.	Std. Err.	z	P>z
Personal Gain	-0.114	0.251	-0.45	0.65
Responsibility	0.234	0.180	1.3	0.193
Reputation	0.408	0.223	1.83	0.068
Product Knowledge	0.454	0.236	1.92	0.054
Willingness	-0.102	0.194	-0.53	0.598
Innovativeness	-0.329	0.171	-1.92	0.055
Dissatisfaction	0.221	0.170	1.3	0.193
_cons	1.433	1.310	1.09	0.274
/lnalpha	0.851	0.114		
alpha	2.343	0.267		

Likelihood-ratio test of alpha=0: chibar2(01) = 5.1e+04 Prob>=chibar2 = 0.000

10.5. Discussion and conclusion

The aim of this investigation was to understand the role of weblog data in identifying consumers. Specifically this investigation focused attention on data sources that could help organisations and scholars alike to utilise a source of data that appears across many different types of virtual communities. This was the first study of it’s kind to focus on the role of web-log data in this context. Furthermore this was the first study to investigate the links between a consumer’s digital footprint in relation to the number of posts and comments, and their innovative consumer characteristics and motivations to engage, with the aim to understand if the data can help to identify consumers willing to engage.

The results highlighted that the characteristics Responsibility and Product Knowledge have significant and positive relationships with data such as the number of posts, indicating that this data source could potentially be used to inform a more efficient and reliable identification process for consumers who are knowledgeable, and are willing to share knowledge – which is considered valuable in the innovative consumer identification process for lead users (Jeppesen & Laursen 2009).

Specifically it was found that responsible users, who were motivated to help others and had a sense of responsibility towards the community would contribute more and be present in more of the Mobile Nations communities, and more knowledgeable users received more 'likes' from other members. A marginal significance was also present between Product Knowledge and the number of comments made and number of communities engaged with. Therefore it could be argued that this data could also be an indicator for knowledgeable users. However it is also important to acknowledge that not all innovative consumers are active in communities, and some could primarily innovate at home for their own personal benefit (Von Hippel et al. 2012).

Part of the 'Responsibility' characteristic was helping others resolve problems and find solutions. Which indicated that those who were providing help were possibly more knowledgeable. Identifying users who report feeling responsible for the community, and are motivated to help others can provide a good indication of the community health. It has been suggested that the level of contribution in a community acts as a proxy for the state of health of a virtual community (Koh & Kim 2004), and the greater the sharing, the greater the attraction for other consumers, who then go on to contribute themselves, and so on (Hagel & Armstrong 1997).

However, previous scholars have had success with analysing text contributions. It could be that the user's contribution is best analysed by the content and not the frequency. Or that the data collected needs to be mapped directly to innovative users, and analyses from the 'ground up', in order to determine how the contributions differ between ordinary consumers, idea-generators, innovators and user-entrepreneurs. It should also be noted that this investigation was based on the assumption that innovative consumers are frequent posters, which has been observed in previous research. However, there was no evidence to say that non-frequent posters were more or less innovative. It could therefore, be as important to analyse the non-frequent posters when searching for innovative consumers.

However, access to a large number of consumers via virtual communities remains one of the key benefits when looking to identify innovative consumers. Analysing each contribution will not allow for an efficient search - efficiency is not increased a great deal if a manual process is still required to analyse text data – whilst it is useful, it remains time consuming. As briefly mentioned above innovativeness was a self-reported measure, and a more objective measure may converge differently with weblog data.

To further understand how virtual communities can help in the identification of innovative consumers there was a need to gain some expert insights. The final part of this investigation aims to understand how virtual community managers identify innovative consumers, to gain perspective on the relevant processes used by those who have access to data and the community.

11.The application and impact of innovative consumer identification research

Consumer innovation research has shown that consumers can be a source of innovation. Early work surrounding user-innovation focused on revealing the innovations from consumers (Von Hippel 1976). This was followed by the identification and measurement of different characteristics associated with consumers/individuals who were seen as a potential resource in the innovation process (Von Hippel & Urban 1988; Morrison et al. 2004; Jeppesen & Laursen 2009; Luthje 2004). In parallel, methodologies were tested and developed to identify users with these characteristics in different environments – more recently within virtual communities (Belz & Baumbach 2010; Von Hippel et al. 2009; Marchi et al. 2011). The resulting body of research surrounding the identification and application of innovative consumers provides a rich resource for organisations to learn from, to gain greater consumer insight and identify potentially disruptive innovations (Eisenberg 2011).

As has been seen in previous chapters, there are still some unexplored areas of innovative consumer identification. In Chapter 10 weblog data and its application in identifying consumers was explored showing that frequency data may not be the most suitable option. However, given the success in previous research analysing the text contribution from virtual communities, there are still options for using weblog data to make identification more efficient and suitable in large online communities. Therefore the next logical step is to understand how virtual communities, specifically platform managers, currently identify the consumer. This section aims to examine the value and identification processes of innovative consumers from an industry perspective. Virtual community managers were interviewed to understand the extent to which the academic research is currently applied and understand the methods used internally by those who manage these

large virtual communities to contribute and add value to existing research. As there is little to no research documenting virtual community managers' approach to consumer identification, this investigation will provide a foundation of knowledge to learn from, specifically how consumer identification is conducted from inside an organisation which runs a virtual community.

The development of web technologies, enabling organisations to connect to a greater number of consumers in real-time from all around the world, makes this research more relevant and applicable today. The barriers to engage with consumers are lower allowing both SMEs and large corporations to benefit from utilising consumers to inform the next generation of products and services (Marchi et al. 2011; Füller et al. 2008; Franke et al. 2006).

In emerging markets where technology is developing at a faster pace and many organisations are still growing, consumer innovation research could particularly provide valuable information to assist organisations in improving their product offering (Al-Zu'bi & Tsinopoulos 2012), increasing consumer satisfaction (Franke & Von Hippel 2003; Schreier & Pruegl 2008; Franke et al. 2006), and in understanding consumers' developing needs. Organisations who do utilise innovative consumers and adopt user-identification methods may particularly reduce the costs of understanding consumer needs compared to traditional marketing approaches (Von Hippel & Herstatt 1992) and ultimately benefit from increased profits when utilising innovative consumers in the NPD process, who have been shown to create valuable products (Lilien et al. 2002).

Given the range of benefits available to organisations, this study aims to investigate the extent to which organisations with virtual communities utilise consumer innovation research to aid their growth in a developing marketplace. It is of interest to consider the extent to which academic practices and recommendations are

adopted, or partially adopted. Secondly, this investigation will aim to understand the methods used by virtual community managers for identifying innovative consumers and to find out if they practice methods that are not documented in the current literature.

The current body of research on this topic has multiple examples of organisations utilising innovative consumers with positive outcomes. These examples and case studies showcase activities that are often implemented with the aid of academic scholars. However, there is a lack of evidence that organisations continue to use these processes and practices of consumer identification and integration independently afterwards. Some case studies do highlight organisations acting independently to utilise consumer innovators however it is not fully understood whether organisations are adopting these methods, and practicing user-innovation identification and integration, as part of their standard operational models.

11.1. Design

To investigate the application of user-innovation research in virtual communities, a series of semi-structured interviews was utilised to gain insights from managers of these communities. As this was an exploratory investigation, semi-structured interviews were chosen to guide the discussions, so as to provide freedom to discuss different areas in more or less depth while keeping the interview focused on key topics, such as: methods of identification, the application of weblog data in the process of analysing consumers, and the reason for identifying specific consumers.

11.1.1. Research setting

The research setting for this study was the 3D modelling and printing community or 'maker community' as it is often called – the same community as used for the

study detailed in Chapter 9. This community has grown significantly in recent years due to the development of the web and 3D printing technology. Specifically, the development of web technology has facilitated the development of open source modelling software and communities who share information and 3D models via virtual communities. Additionally, the development of rapid-prototyping machines and then later self-replicating machine (RapRap), help lay the foundations for the maker community as the 3D models could then be turned from digital to physical artefacts.

11.1.2. Participants

Participants comprised managers of six 3D modelling and printing communities and one mobile technology community. The communities examined here provide a varied sample of the different types of virtual communities on the scales of maturity and size. The virtual communities and associated organisations were founded between 2004 and 2013; the smallest community contained five contributors, while the largest community claimed approximately 1.3 million members. As the sample was small and varied the findings would, therefore, provide a foundation of knowledge for understanding the practices and interest of virtual 3D communities, and highlight any possible differences related to community size and maturity. The Mobile Nations community which was included was built around the discussion of mobile technology, such as mobile applications and smartphones, and met the same criteria as the maker communities stated above, and was therefore considered suitable for this study.

11.1.3. Procedure

A list of virtual 3D communities was compiled from online sources and searches using a search engine, as no official listing could be located. The list created for the previous investigation within Chapter 9 (see Section 16.1) was also used here. The virtual communities on this list were selected to be contacted for this investigation

if they enabled users to showcase their innovations; had a visible and active user community; the ability for users to contribute to the community (text or image uploads), and visible data collection points (such as user engagement statistics, including number of posts, comments, likes and 3D model uploads), which were often publicly displayed on user profiles.

All community managers were contacted via email and then followed up with a phone call if there was no response from the email communication. Six community managers from the 3D virtual community list agreed to the interviews, and were given the option to remain anonymous - all community managers chose to participate anonymously.

In addition to the six 3D virtual communities, a mobile technology community was contacted, which agreed to the interview, to provide insight into the possible differences in community manager interests in a different industry. Limited availability of the community managers meant the interviews were conducted over a significant period, between July 2014 and January 2015. The audio for each interview was recorded and later transcribed into QSR Nvivo.

11.1.4. Materials

The interviews were conducted online using video conferencing software (Skype), as many of the community offices were located overseas. The interviews were semi-structured, and consisted of the following topic areas: community size, activity and purpose; user labels or titles (such as top contributor, or opinion-leaders); community characteristics and observations of different user behaviour; measuring community characteristics and behaviour; the relationship between the quality of information contributed to by the community and the platform success; engagement between the community and the platform management, and user-

innovation academic research. For the full interview documentation and questions see Appendices (see Section 16.3).

11.2. Results and discussion

A framework analysis was used to code the data into relevant discussion topics, identify themes and highlight any underlying factors or additional topics that could provide additional insight into the interests and activities in the context of this research. Initially, the interviewees were asked about their virtual community, its characteristics and the types of community members that exist within the community. Community managers all described their community as a mixture of hobbyists and professionals, however all strive for professional quality content, and that those 'professionals' are often submitting content to these communities in their spare time, as one community manager said, "*it is not going to be their primary job submitting stuff to our platform*" (Community 1). A view shared between all community managers.

11.3. Consumers and their content

Firstly, it was important to understand if community managers were interested in identifying consumers from their community and if they invested time into this activity. All community managers disclosed that they were interested in identifying certain relevant individuals and/or content - specifically original content. The identification of original, relevant content, regardless of the consumer's skills and ability was important to community managers: "*A big one for us is original content; people making their own designs...*" (Community 1). Another community manager commented on their perception of users: "*...I don't identify them [the community members] as individuals - they are identified by their work.*" (Community 4)

The managers looked for content to promote to the rest of the community, either on the community blog, forums or other communication channels such as social media. However, in all communities the management desired to showcase professional looking original content, which required a subjective identification process, underpinned by the manager's knowledge of the community.

"Maybe someone might post every day and that would be great, you know, I would like that, but what matters just as much to me is someone who posts content that is really detailed and relevant." (Community 7).

The majority of community managers interviewed were interested in identifying users. Specifically, five out of the seven community managers stated that they had an objective to identify and promote content, and it was implied that time was allocated to this on-going activity.

11.4. Knowledge

Including the mobile technology community, four community managers disclosed that they actively searched for members of the community for collaborative purposes. Community managers looked for members who were producing high quality content, and were seen to be reliable (determined by the frequency of engagement in the community), and knowledgeable beyond technical or product knowledge. Perceived consumer knowledge extended to understanding the communities 'brand' image, and an understanding of the interests of other consumers within the community.

"I want friendly people who are responsible. But mostly what I look for is, do they understand 3D printing? Do they have good designs? Do they have a good idea of what people want? Because a lot of people have a lot of skills but don't necessarily

know what consumers want and they design something for the sake of designing, which doesn't necessarily produce the best results.” (Community 2)

11.5. Knowledge sharing

Community members shared knowledge in the community making it more attractive to others both within the community and outside of it.

“Yes definitely, the more knowledge I can share the better. It makes our community stronger and more of a go-to place.” (Community 3)

"The lower people are aspiring to move up - well everyone is aspiring to move up - but what I find is those at the top, in terms of ... a professional achievement, are often prepared to give back, so there's a strong element of good will in the community who say, 'I have got to where I am through hard work and through a lot of generosity from my peers and the people I aspire to work with. Besides, I will give some of that knowledge back'..." (Community 4).

11.6. Collaboration

In some instances, the community managers looked for individuals with specific skills who they could collaborate with to produce content. In one instance the community manager evaluated how likely they were to collaborate with others: *“Community members are coming in and the things that I do look at are their proclivity for collaboration, and how likely they are to work with another community member on an idea.” (Community 5).*

11.7. Recognition

When seeking community recognition a community member's primary motive was to obtain recognition and exposure: "I think with the current upcoming generation of emerging artists they all know to be noticed is an early step to being employed, so many of them will post their work across a series of forums and gallery sites to get their work seen and to build a professional reputation and profile." (Community 4), This was supported by another community manager who described the users in their community who also sought recognition: "These are people who are generally speaking, designers, who are looking to get exposure for their designs... these people are looking for exposure and a cool place to have their designs hosted." (Community 1). A Third community manager shed light on why users were interested in recognition: "For our users, it is more about career path..." (Community 4) suggesting that being members of a community was a way to further career prospects or to get into a specific industry sector.

11.8. Identification methods for consumers and content

When searching for consumers and content within their virtual community, managers tended to rely on qualitative data – text contributions – to evaluate the relevance of the contribution. Text contributions, often in the form of descriptions of 3D models, self-disclosed profile information (background, skills, interests) or comments made by other consumers, usually played a pivotal role in the identification process, providing the community managers with the necessary information to know if the consumer or content was relevant. In large communities, it would not be possible to read every contribution. Therefore managers sometimes used engagement statistics to help identify consumers and content. For example, the consumer may be receiving a lot of attention from other community members or may be posting frequently, if certain levels of engagement were observed then the management would investigate further. One community manager stated that "*Probably by necessity, it is weblog data...*" that was used to identify interesting

consumers and content, which could be an effective method for understanding what the community was interested in, as the community members “*vote with their feet...*” (Community 4).

"Well, actually one of the obvious ones and the one I start with most of the time is simply the number of posts. It doesn't reveal the whole story, but it is an alert to myself and other team members, to take a look at this member." (Community 3)

Engagement statistics alone did not provide the community managers with enough information, which could be influenced by social media and the consumer’s own network.

"I can see very well who is posting a lot, but just because someone is posting a lot doesn't mean it is quality, sometimes it is. I am not trying to insult my top posters, but at the same time what is more important is the quality of the content, and what are they actually saying, that's why I read through all the content, even if it's just a user with one post, but that one post could be mind-blowing." (Community 7)

The community managers were aware that engagement statistics were not the best method of identification as it was possible to exclude less frequent or new users: *"...sometimes you find someone who is not a frequent poster who is just a bank of knowledge, and other times you find someone who is a frequent poster and they are a bank of knowledge. So if you just limit yourself, and say you are only going to prioritise these type of posts. In theory, it may sound like it works, but in practice it's tricky"* (Community 7).

11.9. Validating characteristics

While the process of reading text contributions was a manual and laboured activity, it did allow the community manager to learn about the consumers and their

contribution. This also relied on consumers actually disclosing information about themselves and/or their contributions.

"The case is with most online communities, it's about self-disclosure, that really allows you learn who that person is, so it comes from that one-on-one interaction in forums and private messages, but you can really learn a lot about how a person behaves, in the context of invention, based on the types of ideas they submit... the types of comments they leave say a lot about their expertise and their level of knowledge in given product categories...it is another way to identify subject matter experts who can be actively recruited for collaboration." (Community 5).

It could also be important for a community manager to look at how other consumers responded to contributions, to validate knowledge:

"...those that don't have the knowledge and are wise enough to know they don't they usually stay quiet. Occasionally those that don't have the knowledge but think they do make some noise and they get jumped on fairly quickly." (Community 4)

Some community managers, who actively looked for community members to collaborate with, invested time in asking their members to tell them about their skills to help create a list of subject area specialists.

"It's uncertainty, we wanted to verify it - we didn't have a system in place to check what is being said, but at the time there weren't the tools...so we took it upon ourselves to verify, because I really wanted to identify the group of experts we could push projects to. So, they could utilise their expertise for the platform...I had to ask them outright." (Community 5)

“The subject matter expertise project was really a way to validate the skill sets community members will list on their profile page, because we are giving them the freedom to say what they are skilled in, there is a potential for them to highlight false-positives, so this project had the potential to find the list and truly find out who is truly an expert, and who isn't. We can look down this list and see people who are genuinely engineers or industrial designers.” (Community 5).

Key findings

Text contributions: These provided community managers with the information needed to understand consumers and the relevance of their contribution.

Qualitative examples

“...I read through all the content, even if it just a user with one post, but that one post could be mind-blowing.” (Community 7)

“... from just reading the way somebody just puts together a post...you can tell, wow, this was really well thought out, really well-written, really well put together, I need to pay attention to this users.” (Community 3)

“I generally try to focus more on actually reading what people have to say and not let a computer read it for us.”(Community 7)

“...[if] I am seeing some really great comments he's put on other submissions, or good critical feedback, I will reach out to this person...” (Community 5)

“... I think every person has something to contribute, so there might be people who talk more, or people who talk less, but I don't really rank them. It's more about the quality of the content than it is about the amount of posts.” (Community 7)

Engagement statistics:
Infrequently used by
community managers but
could be biased and influenced
by other factors

"It is surely biased, and since it is a small community there are some people who have a lot of friends in this community... I see those who have a lot of 'likes' don't have the most beautiful profiles but have a lot of friends. (Community 6)

"...sometimes a person might be super, super popular, but they are not spending all their time on social media... This is something that is welcome to the community as a whole and this user may be relevant to me as well, and could become popular if I cover them." (Community 7)

"...I would say that is probably a better approach, the more personal approach; it's very easy for us to look at numbers and try and make guesses on that..." (Community 1)

"its a bit of a self-perpetuating cycle really - the more famous you are the more famous you get." (Community 4)

"Their post count doesn't necessary mean all good things. I think in those cases I know I can't trust that data 100% ...that's when I go in and do a bit more manual digging to see what I can find." (Community 3)

"Time on the platform, if anything, helps get you followers, and helps make it easier for you to be at the top of that pyramid and get the reviews for your ideas, it will also influence the number of votes you get - which is why I don't make our decision entirely on votes." (Community 5)

11.10. Engaging the community broadly

The community manager has a responsibility to ensure that the barriers to entry are kept low in many of the communities, as they understand that all consumers can contribute good content: *“...I mean I don’t want to make celebrities out of these guys, at the end of the day it’s about encouraging everyone to participate, and I don’t want to put off smaller people...”* (Community 1). Therefore the community managers, to some degree, are required to look for interesting content from a wide variety of consumers, not just top-posters or innovative consumers.

“Maybe someone might post every day and that would be great...but what matters just as much to me is someone who posts content that is really detailed and really relevant ...that’s why on our blog actually a lot of articles I write feature people who might not be the most talkative, but they’re quiet because they’re thinking a lot... and they’re probably the people the community might want to listen to and might want to hear because you don’t necessarily see them posting in the forums every day as they’re too busy making things.” (Community 7).

The process of identifying content and consumers was a subjective one and influenced by the community managers experience and knowledge of the community, and the community objectives. While both quantitative and qualitative data were used to identify and validate a consumer's knowledge and expertise and related content of interest, the community managers tended to favour qualitative data as this provided more insight, even though it was a laboured process.

11.11. Innovative community members

Within the communities, there were members who could be likened to the innovative consumer. Community managers were aware of the different types of

community members; they were differentiated on ability and knowledge, and varied skill sets, and were often favoured by the community:

"I often view our user group in a pyramid structure, where at the top there are fewer people with high level of ability, and a lot more people at the bottom of the pyramid with a lower level of ability." (Community 4)

"Yes, any of the team that are in the collaboration list are lead-users in terms of technical [ability], are desired by the rest of the community...[one community member] has very good product knowledge and a good sense of what goes into manufacturing. He takes it upon himself to educate the community." (Community 5)

When exposed to information about innovative consumers, the majority of community managers felt that there were innovative consumers within their community and could often work with the management team with relative ease. These could be team members who produced content for the community or had been part of the team who founded the community. Those who were seen as consumer innovators (or lead-users) within the community were already known to the management, and often already worked with them collaboratively on various projects including NPD. This indicated that the community management understood the value of identifying and working with innovative consumers.

11.12. Education and intervention

From the perspective of the community manager, the more time members spent in the community, the more they became accustomed to the technology. With time, consumers also became familiar with types of contributions that appealed to the community, and members' abilities and confidence could increase. In this process of learning, the community managers acted as key instructors, providing feedback

on contributions that enabled members to produce more relevant and higher quality content. This was seen as a positive investment of the community manager's time: *"I am more than happy to bring them up to speed if it's going to mean more quality content for us in the future."* (Community 1)

Key findings

Consumer profiles:
Each community manager profiled consumers differently, with a strong indication that the majority of users were hobbyists

Qualitative examples

"... there are varying degrees of designers so that you can be published, rookie designers, all the way up to expert level" (Community 1)

"...the community is broken into three types of people, the inventors, they are the drivers behind a lot of the activity... the influences, the people who are contributing to the development of the products and there are also the customers, who are purchasing...there is an overlap in all three groups - it's like a Venn diagram." (Community 5)

"Erm, it's a bit of both, hobbyists, I would say the majority are probably on that level, people who don't necessarily have extensive design experience...I also get professional designers submitting their work. It is not going to be their primary job submitting stuff to our platform..." (Community 1)

"A lot of them are professional designers, but this would be a secondary income, like selling on eBay or Etsy." (Community 2)

Profiling 'top' consumers: Innovative consumers exist within the community and could be identified by observable characteristics and behaviour.

"... there is obviously a difference between designing a 3D model and designing something that can be printed, so the guys at the top who are so-called experts, would be people who are very good 3D modellers...but then also are very good at designing with 3D printing in mind. So those two in conjunction I'll put you up at the top of the list..." (Community 1)

"...they [the top users] come to us with some fully formed, a mostly-baked idea to begin with, as opposed to someone who has just joined and has been poking around [the community] and submits the first thing that comes to mind." (Community 5)

"The lower people are aspiring to move up - well, everyone is aspiring to move up - but what I find is those at the top, in terms of artist and professional achievement, are often prepared to give back, so there's a strong element of good will in the community..." (Community 4)

Top consumers:
Community managers
felt that innovative
consumers existed
within their
community and
organisation.

"I do have a couple; there are a couple who stand out in mind, 3 or 4 people who submit regularly, and have very robust content pages. To be honest, it would probably be our team of internal designers who would be the real leads if you know what I mean...and they're producing really top quality content ... you could view them as Lead-user in some way, and then the external community there are definitely a couple that stands out, who tend to inspire and influence other designers who have a lot of cool objects up on their pages" (Community 1)

"Especially, I am thinking about my moderation teams here, since I've activated different permissions on all of our sites for certain team members. If they are active on site A, and I give them permissions for sites B, C, D, and E, I find they are helping out there when they can too. " (Community 3)

"...they [the core founders and team] are surely lead-users, but they are already known to the decision makers within the community" (Community 6)

Increasing skills and
abilities: Community
managers observed
changes in the

"... you kind of move through the ranks...as you become more and more familiar with the technology, and better, and better, at designing for 3D printing" (Community 1)

member's abilities,
knowledge and quality
of contribution.

"... over time they get better and better at the process and eventually they'll have those wins... When they are really stuck in the process and stick to the process, they stand a real chance of success." (Community 5)

"I think people move up the pyramid. And they sort of gain confidence." (Community 4)

Intervention and education: Community managers intervened and educated users to help influence the quality of contribution.

"...I have always had heavily moderated forums and I have headed towards professional digital art as opposed to more hobbyist type art sites..." (Community 4)

"...when say if I get a new designer, submit a couple of designers, they'll either be print ready or I will provide them with feedback, so I'll say this is a good design but it needs to be fixed in this way, in order to make it print ready, so I essentially act as tutors in that regard. " (Community 1)

Some community managers spend time moderating and even improving their members profile pages - one community manager revealed, *"...if they [the community members] just use keywords and have a lot of mistakes, I usually just take over the situation and re-write some sentences in order to make them better... as it's about skills, not English."* (Community 6).

Intervening and guiding the community can ensure there is a more consistent level of quality in each contribution thereafter: *"...I do a lot of education as well, I don't expect everyone to come to us to have the certain skill or knowledge, and we're also learning, so I learn a lot from the designers as well. Before they launch a product, I definitely work with them to make sure the photos are good, that the pricing makes sense, and all the different customisation options are printable. So there is definitely a lot of hand holding before launch - after launch not so much..."* (Community 2).

The reason behind these interventions and guidance is also related to the newness of the industry: *"I found a lot of designers don't fully understand 3D printing yet, and what is good to print, what makes business sense, what people actually want. I found it was better for us to work with a small handful of designers and walk them*

through how customisation works, how 3D printing works.” (Community 2). In the majority of cases it was new users who required the guidance and education: “...if I get a new designer, submit a couple of designs, they'll either be print ready or I will provide them with feedback... in order to make it print ready, so I essentially act as a tutor in that regard.” (Community 1).

The mobile technology community, the comparative industry community, did not guide consumers. However, they would still intervene if a community member did not contribute useful, relevant, information:

"...the super engaged members, in most cases, are welcome, and are looked upon positively, but there are instances as well...they [some community members] are there for the wrong reasons, they may post a lot or do a lot of stuff and be super engaged, but they are not exactly a productive community member. That's when I have to step in and either rehabilitate the users; I guess I could call it that, or part ways with them if they are not actually contributing anything useful to the community." (Community 3).

The intervention of community managers could be seen as a one-to-one communication with community members, yet in larger communities screening processes had been implemented to manage a group of contributors at once. The intervention points provided an opportunity for community managers to understand their community and spot innovative or interesting consumers early, and an opportunity to provide consumers with guidance that could influence their ability to innovate. This stage where managers communicate to consumers could also be utilised to encourage members to identify other consumer needs, areas of dissatisfaction and skills to then produce content directly for other community members.

"...when they [community members] do learn what type of products really fit with the brand - this is probably the hardest thing to communicate...we recently put in a screening process where we have a 48 hours period before your idea is published to the site, and that's been a great way for us to train community members in terms of the types of products we accept." (Community 5)

11.13. General discussion

This investigation was the first to pull together different perspectives of virtual community managers concerning innovative consumer identification, highlighting the practices, concerns and reasoning behind consumer identification from an industrial perspective. This study showed that virtual communities, and more specifically the community managers, were interested in identifying innovations to show to their community, and identifying innovative and knowledgeable consumers from the community to collaborate with and/or create content.

Currently, community managers included in this sample appeared to be little influenced by the existing innovative consumer's research. Therefore, there seems to be a great deal of scope for community managers to look towards consumer innovation research for inspiration on alternative ways to identify consumers and content. Today, in domains of 3D modelling and mobile application technology, it seems unlikely that community managers would independently adopt methods of identification such as pyramiding (Von Hippel et al. 2009). The community managers interviewed within this study were not only looking for 'top' members, but they were also interested in content from a wide range of consumers. As they described, good quality content does not always come from those who are frequently engaged, but can come from new and quiet members too.

Some community managers had taken approaches similar to screening, to validate users' abilities and skills, when they are looking to collaborate. In the majority of instances, the community managers wanted to keep the barriers to entry low to increase the number of contributions and consumer collaborators. Interestingly the community managers of both small and large communities felt confident they already knew the innovative community members. Notably, the identification of lead-users or more knowledgeable consumers was only relevant to certain community managers in platforms capable of facilitating collaborative activities with community members.

As observed in previous chapters and highlighted at the start of this study, an increasing number of scholars are looking at the identification of innovative consumers in virtual communities, and many have focused on more automated methods. However, it was clear that the community managers, when identifying users or content, were using qualitative data from the consumers about their contributions. However, in larger communities, numerical data could be applied to filter down members to a more manageable number. This finding supports previous findings in this research and discussion in Chapter 10, relating to the application of web-log data, on how it can be utilised to identify types of consumers.

This study highlights that community managers perceived that not all innovative and relevant users were frequent posters, which supports the findings from the previous investigation into weblog data within Chapter 10. Community managers did not primarily look at the frequency of posts when in the process of identifying innovative users. This contrasts with previous findings on innovative user engagement in virtual communities, which advocated automated methods and found innovative consumers often contribute more frequently than other users (Füller et al. 2007; Marchi et al. 2011). Engagement statistics were not able to reveal the whole picture or tell the necessary story for the community manager to

determine if the content or the consumer was appropriate in relation to what or who they were looking for.

In support of previous findings, the community managers in this study did indicate that community members who were highly engaged contributed valuable knowledge (Belz & Baumbach 2010; Jeppesen & Laursen 2009), and could take the role of an opinion leader (Franke & Shah 2003). They highlighted however that this was not an effective indicator when looking for original, innovative or high-quality content and that examination of content was needed. It might be more suitable for the community managers to look at the use of vocabulary as an indicator for interesting content and consumers (Marchi et al. 2011).

It is clear that community managers perceived certain consumers within their virtual communities as innovative consumers, such as lead-users, through their perceived characteristics and behaviours such as product knowledge, knowledge sharing (Jeppesen & Laursen 2009), and perceived motivations related to recognition (Jeppesen & Frederiksen 2006). However, the majority of community managers were actually interested in keeping the barriers to entry low and aimed to identify interesting content from users of all levels of ability. It seemed that there was a desire for an inclusive community given an awareness that community members' skills developed over time.

The identification of consumers and content seemed high on the agenda for the community managers who were interviewed. However, this was clearly balanced with maintaining low barriers to entry and educating members/screening content. An organisation in this setting, specifically those communities within this study, could learn from current consumer innovation research – specifically, they could invest time into identifying innovative consumers to create content which would assist in increasing product variety (Al-Zu'bi & Tsinopoulos 2012).

Including a virtual community from a mobile technologies industry alongside the analysis of the 3D communities enabled a comparison that highlighted that community managers in different industries were challenged by similar issues, in relation to consumer identification, and they shared similar practices. This indicated that the findings of this study, while only a small sample, could apply to organisations managing virtual communities in other industries as well. It should also be noted that further research would be required to understand the wider generalisability of these findings. Specifically, as the data was bounded within the 3D printing industry, this could arguably mean the community managers spend less or more time with the community members training them and engaging with them. However the findings provide a foundation of knowledge, which can be expanded on in future research; the utilisation of a larger sample from a wider variety of industries would provide further insight into consumer and content identification in virtual communities.

In this study there were community managers who were solely looking for content, and were less interested in a consumer's skills and abilities. A focus on content requires community managers to have extensive knowledge about current and past contributions to ensure it is original - an activity that tends to be very laboured as each contribution requires a visual inspection.

Showcasing contributions and collaborating with community members were activities that were valued by the organisation running the communities, as it satisfied those community members who engaged to gain exposure and recognition, or to share and acquire knowledge. Therefore, the identification activities (of both consumers and content) by community managers played an important part in the success of the platform and the satisfaction of members. Without identification and display of content, consumers may not be attracted to

the community. Consumers were there to acquire knowledge were interested in knowing that the community could help with their problems.

11.14. Conclusions

There were many opportunities for community managers to learn from consumer innovation research, specifically about different methods of identifying innovative consumers. Improving processes here could improve the variety and attractiveness of the content in the platform (Franke & Von Hippel 2003; Schreier & Pruegl 2008; Franke et al. 2006), which could then attract more users, and user contributions.

The main current method of identification for content and consumers has been through the analysis of their text contributions. Therefore research surrounding the analysis of the text in relation to identifying relevant content might have the biggest impact and would be more likely adopted by community managers. It could, therefore, be valuable to invest time in understanding how this could be automated, to assist the manager in locating interesting and relevant content and users.

12. Discussion

The series of investigations conducted here has contributed new knowledge to consumer innovation research in a number of different areas that collectively provides an answer to the research question: *How can external organisations use virtual communities to help them efficiently identify innovative consumers?*

12.1. Approaching consumer identification

This research provides a new perspective on how organisations should approach identification of innovative consumers within virtual communities for the relevant stage of the NPD process within which they want to include consumers. Clarification is also provided on what is ambiguous terminology within the consumer innovation, entrepreneurial, and information systems literature, on consumer labels. By gathering existing literature, and analysing how types of consumers mapped onto the existing stages of a NPD process, it was possible to provide a novel contribution to the literature on how an organisation could *approach* identification of innovative consumers in a virtual community more efficiently.

This investigation indicated that ordinary consumers, often considered typical target market consumers, were best suited to the early idea generation stage, as they were useful when an organisation was looking to explore ideas for new products in a conceptual way. Beyond ordinary consumers, those with higher levels of technical knowledge were suitable for stages where more viable solutions were required. In the later stages of the NPD process, when the product was being developed, tested with consumers, or being prepared for market launch, lead user and entrepreneurial consumers were more appropriate, as they had greater

experience with the consumer community and with developing their own products and solutions. Matching consumers to NPD stage was not present in the previous literature, and the collation of this information and its application is an original contribution within consumer innovation research. This new knowledge can also contribute to the developing research around innovative consumers in analogous subject areas, including information systems and marketing.

Furthermore, the variety of labels used to describe types of consumers previously provided little insight into how they differentiated. This investigation provided insight on what the differences are between key types of consumers that have been successfully integrated into the NPD process. Chapter 8 therefore provides valuable information for organisations when identifying innovative consumers, who often find that doing so is a balancing act between opening up the NPD process and removing some of control over those processes (Parmentier & Mangematin 2014). Trying to balance openness and control can lead to conflict (Dahlander 2005), therefore Chapter 8 provides guidance on how to enable openness of a stage and identify the right consumer(s) to provide high quality input and feedback. This guidance can also have a positive impact on cost, as identification can be expensive (Von Hippel & Herstatt 1992; Parmentier & Mangematin 2014). By providing guidance and highlighting key identification characteristics to differentiate consumers, organisations can approach the identification of a consumer in a more efficient way.

12.2. The influence of social systems

The second stage of the overall investigation focused on the choice of virtual community. This investigation provided the first evidence that showed that different types of consumers are more or less likely to be located in different types of virtual communities. For the first time virtual communities were considered part of the identification process, not only in relation to their purpose (e.g. to enable

customers to discuss specific products and services), but also to their functionality which, in this study, has shown how it could be linked to their motivations to engage. This would then enable scholars and organisations to approach virtual communities with more knowledge or the potential types of consumers that are likely to exist. Combined with the findings from Chapter 8, this will enable a better understanding of what type of consumers can be found where, and how they are best suited for the NPD process. Essentially organisations need to consider the virtual communities functionality, and can then select communities most suited to their choice of consumers, and the consumer social systems (Rogers 2003) thereby creating a more efficient identification method.

Further observations in this investigation include the motivation to engage because consumers felt a sense responsibility to help others solve problems, find solutions and respond to questions. This reflects the profile of innovative consumers who share knowledge and actively engage with the community (Jeppesen & Laursen 2009; Füller et al. 2007), and are also often seen as altruistic (Bryant et al. 2005; Füller et al. 2007; Belz & Baumbach 2010).

This study finds that what influences a consumer's choice of community is multifaceted, by observing consumers' motivations and investigating how communities affect a consumer's willingness to engage in open innovation provides a greater depth of knowledge which, in turn, enables practitioners to make better decisions regarding which communities to consider when seeking to identify consumers.

As discussed above, the structure and functionality built into virtual communities could, therefore, be influencing the choice of the community for consumers. An alternative theoretical explanation could be that the ideologies, behaviour norms and overall social system embedded within the community impacts the member's

values and behaviour towards innovation, and external collaboration (Rogers 2003; Ajzen 1991).

Taking into consideration the framework developed in Chapter 8 on the connections between consumer characteristics, and their ability to contribute to stages of the NPD process, this information can be utilised to inform efficiency when choosing a suitable community to collaborate and identify consumers from. For example, later stages of the NPD process may require more entrepreneurial skills, and knowledge from consumers who have innovated and diffused the innovation within their community. It is questionable as to whether these types of consumers (user-entrepreneurs) will be willing to collaborate regardless of the community they exist within. If they are still actively diffusing, or capitalising on their innovation, then collaborating with organisations may be considered a conflict of interest. However organisations and scholars alike are able to capitalise on this information to inform greater efficiency when using virtual communities for innovative consumer identification.

12.3. Data driven decisions

Leading from this investigation, the application of the weblog data was analysed to understand how this could be used to help organisations identify relevant consumers willing to collaborate. This stage in the research showed that a consumer's responsibility to other consumers has a positive and significant relationship with both the number of comments and posts made by community members, and the positive and significant relationships between product knowledge and the number 'likes' within the community. Additionally the number of communities was also an indicator for responsible users, and a marginally significant relationship was identified with product knowledge. The study finds that using a consumer's digital footprint could help improve the efficiency and reliability of the search for innovative consumers in larger virtual communities, specifically for

the purpose of filtering down the number of potentially suitable consumers, which was confirmed when interviewing a community manager, as discussed in Chapter 11.

The significance of this investigation is the focus on the data points. Posts, comments and likes are synonymous in many virtual communities and even social networks. This study therefore provides a foundation of knowledge for organisations making data driven decisions during the consumer identification process, and contributes to the new knowledge and perspective created by this research to understand how virtual communities can inform greater efficiency within the identification process within multiple networks, and not solely on one.

12.4. Sticky knowledge

Von Hippel (1998) used the term 'sticky' to describe, "difficult-to-transfer local information about a particular application being solved". In the same study he identified that the consumers, rather than the organisations, were the designers of the application in question. This notion of sticky information can be applied to community managers, who hold valuable information which would be potentially difficult to transfer.

Interviews with managers of virtual consumer communities helped in understanding how consumer identification is undertaken in practice, so as to learn more effective means of identification from those at the centre of the virtual community. Not only did the investigation find that a manual approach was considered the most effective for identification of innovative consumers, as it allowed for specific observations about the consumers, but also found that the community manager could act as a key asset in the process as they have 'sticky' knowledge about the community that they have built up over time.

It is important to gain insight into industry practices and thus the final study gained the perspectives of virtual community managers in relation to innovative consumer identification. Scholars tend to conduct research studies infrequently, whilst industry professionals, such as community managers, conduct searches for particular types of consumers more frequently and on a larger scale. This industry perspective is therefore, valuable in understanding how to make the identification process more efficient.

The findings from the interviews conducted with virtual community managers indicated that when looking at data in the community, the text contributions were the best way to understand a consumer. Frequency data was often used by necessity in larger communities but was perceived as limited in what it could say about a person. However, many of the community managers already claimed to know who their innovative consumers were, as their primary role was often to engage in the community and through this process, they actually knew the community very well. No structured methods of identification were explicitly highlighted by community managers, as the community manager would immerse themselves in the community, thus gaining an understanding of the various types of consumers.

The findings of the investigations conducted provide insight into the process of efficiently and accurately identifying innovative consumers. The clarity provided by analysing the current literature on the type of consumers and their application in the innovation process can inform a more specific and accurate search. While innovative consumers may exist in all communities, the investigation has shown that it is possible to understand consumer preferences towards different communities. The data generated by the consumer's behaviour in the virtual community is yet to be fully understood and requires further research, specifically analysing multiple data points. However, the use of simple metrics could be used

to help filter members who are knowledgeable or those who engage because they feel responsible to their community. Reflecting on these findings, and previous research in combination with the interviews with virtual community managers, the most effective use of data from a virtual community to identify innovative consumers may actually be their text contributions, alongside the community manager's knowledge.

12.5. Source of efficiency

While an online environment clearly provides greater access to consumers and frameworks that can help guide the right consumers to ideal stages in the NPD process; the type of community can also indicate the likelihood that innovative consumers will be present, and they enable researchers to analyse consumer's contributions non-intrusively, via text contributions, albeit subjectively interpreted. However, it would appear the best asset within a virtual community to improve the identification of innovative consumers is the community manager. The final investigation, while within only a small sample of interviewees, indicated that a community manager – a person embedded in the community, but with access and ability to search the data in the community – can easily identify which consumers exhibit innovative characteristics.

This research was conducted to answer the questions: *How can external organisations use virtual communities to help them efficiently identify innovative consumers?* And while the different stages of the research have individually provided new insight, new knowledge and empirical evidence that can be used to approach consumer identification using virtual communities efficiently, the answer to this question - the source of efficiency, the person who can guide an organisation to innovative consumers - in this context is the community manager, or more specifically their knowledge of the community.

12.6. Implementation and considerations

The findings of the investigation have also opened up ground for enhancing the identification process, and approach on a larger scale. The potential changes and observations that could improve how innovative consumer identification is approached and applied are discussed below, alongside guidance for utilising virtual communities efficiently.

Firstly, consider the type of innovative consumer that is required. As identified in the first study, not all are alike, and their abilities differ. By consulting the model developed from existing literature in Chapter 8, suitable types of consumers can be selected for the relevant stage of innovation process that will help to guide and inform the process with greater ease and clarity.

Secondly, consider the virtual community size, industry, structure and functionality that will be used to locate innovative consumers. Self-governed communities and hosted communities may have different barriers to entry for consumers, and the structure may affect the possibility of accessing and utilising consumers.

Lastly, consider how consumers will be screened to be deemed at the right level of innovativeness and appropriateness for the NPD stage in question. Questionnaires, using existing tested measures can be used. However, a non-intrusive approach with minimal 'self-reporting' could be advised, as people can act differently online compared to offline (Suler 2004). It may be possible to use the available weblog data.

However, other factors need to be considered in relation to using virtual communities for innovative consumer identification, for example: Rindfleisch et al. (2008) discuss how the Internet can empower individuals in three ways: access to knowledge, the ability to apply this knowledge and thirdly by enriching the creative

abilities and learning from one another. In the context of innovative consumers in virtual communities, these three points represent dynamics, which need to be taken into consideration if virtual communities are to be valuable assets for innovative consumer identification. A consumer, regardless of type, can learn and acquire knowledge at different rates, and knowledge sharing in a community is often a core activity (Adamic et al. 2008; Jeppesen & Laursen 2009; Matzler et al. 2008). Therefore consumers within virtual communities could become more innovative over time, and contribute more towards the innovation process given the right knowledge. Indeed, it was discovered in this research that community managers often engage in activities to educate consumers.

12.7. Theoretical perspective

The focus of this research has been on efficiency - identifying those innovative consumers in a more effective way from virtual communities. But is this required? Rogers (Rogers 2003) discusses the time it can take for an innovation to reach market adoption, which arguably means that there is no requirement for a more efficient means of identification if the product takes possibly months or years to reach adoption. However, with the increased development of technology and communication around the world, the sooner innovations and innovative consumers are identified, the sooner this process can begin. In a comparative market, timing may be a critical factor.

The future of innovation on virtual communities is also uncertain. The growing threat of net-neutrality and internet moderation could result in the decline in virtual communities, and the sharing of ideas and knowledge, if too much restriction is implemented or if bandwidth is restricted by large organisations. Understanding the effects that internet moderation and net-neutrality could have on consumer access, will enable organisations to either choose a suitable virtual community, or design

their own to ensure the participants of the community can act aligned with the organisation's abilities, values and ideologies.

Capturing an individual's intention to engage in the community for the purposes of changing a product, solving a need, or creating something, could act as a significant indication of a consumer's innovativeness.

The findings that relate to the theory of planned behaviour, and those associated with the Diffusion of Innovation theory are brought together in the form of the community manager. They sit at the centre of these social systems and their actions could influence individuals' intentions to behave in a certain way, whether that is to innovate or adopt an innovation.

The development of virtual communities over the past 30 years has changed dramatically, and it is appropriate to acknowledge that they are likely to continue to change and evolve, which would attract a greater number of consumers, or change how consumers engage online altogether. The future is unknown. Our biggest online environments are social networks, yet their value and benefits are not necessarily being fully recognised by organisations (Roberts & Candi 2014), as they develop and compete for consumers' attention they could become the main place in which to identify innovative consumers within the next few years. This is also related to the concept of the 'user', which has been the pinnacle focus over many years within consumer innovation research. However collaborating online and co-designing with consumers also means accepting that you are potentially collaborating with individuals who are not consumers. The faceless world of online engagement means, for better or worse, that almost anyone can contribute. Therefore the concept of the user employed within consumer innovation literature is becoming less of a concern, as there is no validation to ensure they are a user. In this investigation the term consumer encompassed those who consumed the

products and services in question. The concept of a user, when engaging in virtual communities is becoming ever more heterogeneous.

Virtual communities have improved the efficiency and accuracy of innovative consumer identification, but the complexity of virtual communities means that greater research is required to understand how further web log data can be used. Using a virtual community for innovative consumer identification provides greater access to consumers. However, an in-depth knowledge of the community, from the platform structure to the 'types' of consumers who exist in the community, seems to currently be required to be able to fully utilise the community and its data. There is a potential for investigating automated methods of identifying innovative consumers using the data currently valued by community managers, but this is likely to be specific to each community.

Notably, different virtual communities can attract or discourage innovative consumers, which opens the door for further research to understand in greater detail how specific functionality or appearance of virtual communities affects who engages with that community and in relation to this the quality of the information pool within the community. It is clear that the data collected in virtual communities can provide guidance and insight into a consumer's characteristics. However, the extent to which certain common data points logged can be transferred and utilised by scholars and organisations alike in the identification of innovative consumers appears currently limited. The value of the data will come when it can be successfully mapped to innovative consumers, thereby providing a means to identify a specific consumer from the data. However it has been noted that not all innovative consumers behave the same therefore, variations in behaviour would also need to be accounted for.

The value of a virtual community, compared to a physical community, when identifying innovative consumers is primarily the access to larger groups of consumers, over wide geographical areas and access to community data, collected non-intrusively. Currently, it takes an individual to embed themselves in a virtual community to fully understand the complexities, and many facets of the community and the consumers that exist there. Until it is possible to understand and discover generalisable interpretations of data that can be applied to multiple virtual communities, the recommendation would be to place community managers at the centre of the identification process.

Identification of innovative consumers within virtual communities is a relatively new area within the product management and consumer innovation literature. The earliest collection of studies used weblog data from virtual communities published at the start of the millennium; these utilised different sources of data including both text and frequency data. However, there is still a lot of potential within virtual communities, and the data they hold, to bring interesting content and particular consumers to attention, with less effort than is currently required.

13. Conclusion

This study contributes to the consumer innovation literature, the co-creation research stream, and research on virtual community consumer behaviour. The research is founded on the increasingly important role of the consumer, and their collaborations with organisations to enhance innovation performance (Von Hippel 1978b; Thomke & Von Hippel 2002; Gruner & Homburg 2000; Edvardsson et al. 2010; Ryzhkova 2015), and identification of these innovative consumers from virtual communities.

While several studies have demonstrated that innovative consumers exist within virtual communities, and have attempted to present methods of identification

specific to these environments (Füller et al. 2017; Füller et al. 2008; Luthje & Herstatt 2004; Marchi et al. 2011; Füller et al. 2007), it was still largely unclear how an organisation could efficiently utilise these large virtual communities, often containing millions of members.

The remaining question was whether virtual communities could be used to inform a more efficient method of innovative consumer identification? The present work adds to the current knowledge and fills this gap by postulating and empirically validating how virtual communities can be used to assist the identification of innovative consumers. The studies here increase understanding on how to approach the task of identification from two angles: the requirements for specific consumers at specific stages, and the choice of virtual communities. The work also provides a validation for effective methods of identification within virtual communities from the community manager's perspective and the application of weblog data in the process of finding consumers who are willing to collaborate.

The results of this study make it possible for organisations, and scholars alike, to approach identification of innovative consumers in virtual communities with a new perspective - from the choice of consumer, the type of virtual community and the data to utilise and analyse. This investigation is the first to take into account how organisations should approach consumer identification using virtual communities. The research focused on a new area such as the influences behind why different consumers choose to exist in different virtual communities. This research also focussed on the need for organisations to consider a consumer willingness to engage as a fundamental measure, and is the first to analyse this as a characteristic in the context of comparing types of virtual communities. The investigation also takes the data on a consumer's willingness to collaborate, motivations to engage in a community and other consumer characteristics associated with innovative consumers, and analyses the data within virtual

communities created as part of a consumer digital footprint to help understand the usefulness of this data source. Lastly, this research is the first to provide insight into consumer identification from the perspective of a community manager on the subject of innovative consumer identification.

The findings offer a valuable insight into how virtual communities can be utilised and approached differently. Data highlights that organisations need to focus on communities that facilitate those who are willing to collaborate and should select the right consumers for the specific stages to ensure a valuable return on investment of their efforts. Furthermore the utilisation of data and the application of the community manager will provide organisations with a much more valuable insight into the community and could reduce the need to invest heavily in identification and understanding the community, when this sticky knowledge may already exist with the community manager.

The Diffusion of Innovation theory highlights the important impact of the social system in a community (Rogers 2003). In relation to this investigation, knowledge of the social system, which will differ between types of virtual communities, could be pivotal to the identification of innovative consumers for the purposes of collaboration with external agents. The second stage of this investigation showed that innovative consumers gravitate towards different types of communities, and their behaviour and ideologies could arguably be influenced by these environments. Therefore organisations will need to evaluate the virtual communities in the sample to see how the different social systems may impact the identification process, depending on the type of consumer required.

Moreover the normative beliefs of the community will be important to understand (Ajzen 1991), as beliefs which are concerned with the likelihood that important relevant individuals or groups approve or disapprove of performing a given

behaviour. Community managers or other members within the social system could have a dominating effect, or influence normative beliefs, which could affect a consumer's willingness to take part, disclose an innovation, or even discuss their needs.

14. Limitations and future research

Further research to consider would include a framework for virtual communities. Similar to that within Chapter 8, a more in-depth analysis of community types, functionality, and the types of consumers that exist within each community would be useful when planning consumer identification. Within this framework, and the research, would be an understanding of the types of social systems, values, ideologies, and other influential factors that could inhibit successful identification.

Common terminology needs to be considered within further research, and a clear understanding of 'type' of innovative consumer needs to be adopted to ensure that organisations and scholars alike are able to accurately search for the appropriate type of consumer for the specific stage within the innovation process. This applies to both physical and virtual communities; such information, specifically the differentiating characteristics, could save time and help reach larger numbers of the community, simply by reducing the number of questions that need to be asked of individuals.

To efficiently and accurately search for innovative consumers, an understanding of where innovative consumers are likely to exist is required. Specifically, are they attracted to simple communities, which do not contain distractions created by various functionality but are focused on community engagement. Furthermore, when functionality such as selling mechanisms exists, the environment could become more competitive and restrict the free-flow of information and sharing of knowledge (Franke & Shah, 2003). Therefore, further investigation into the effects of virtual communities needs to be conducted, now that we can see from this research that the functionalities of virtual communities can affect a consumer's choice of community, and specifically those who are willing to collaborate.

Therefore when identifying innovative consumers from virtual communities, the findings here can provide a framework and guidance on the types of consumers who can contribute to the NPD process, which communities they are likely to be located within, how weblog data can assist, and finally which data sources to use to understand an individual's innovativeness. However, there is not a one-size-fits-all approach. Considerations need to be taken when planning the identification. Who is being identified, where will they be identified, and how will they be identified, are all key facets that need to be carefully considered for an efficient, accurate and successful innovative consumer search.

The community manager in the identification process is under-utilised. For any additional research, practitioners would be strongly advised to examine community managers' abilities to identify innovative consumers, measure the accuracy of these abilities and compare the time to achieve this in comparison with other methods. Furthermore, capturing more data could also be beneficial, specifically recording the data contributions of known innovative consumers, along with automatically analysing textual data they contribute in order to create a data profile of an innovative consumer. The development of more case studies to profile innovative consumers in a wider variety of virtual communities is required to build up a spectrum of how they differ on various characteristics, such as their level of engagement, across different fields.

Furthermore, while this was not examined within the research it would be beneficial to consider for future research, how a consumer's ability to be successful in specific virtual communities could depend on their perceived behavioural control, which could influence their choice of virtual community (Ajzen 1991). They may gravitate towards virtual communities that exhibit lower barriers to entry, or communities where their work is not exposed in a professional or competitive way.

15. References

- Adamic, L.A. et al., 2008. Knowledge Sharing and Yahoo Answers: Everyone Knows Something. In WWW 2008 / Refereed Track: Social Networks & Web 2.0 -Analysis of Social Networks & Online Interaction. pp. 665–674.
- Adamson, R.E., 1952. Functional Fixedness as Related to Problem Solving: A Repetition of Three Experiments. *Journal of Experimental Psychology*, 44(4), pp.91–288.
- Ajzen, I., 1991. The Theory of Planned Behavior. *Organisational behaviour and human decision processes*, 50, pp.179–211.
- Al-Zu'bi, Z.M.F. & Tsinopoulos, C., 2012. Suppliers versus Lead Users: Examining Their Relative Impact on Product Variety. *Journal of Product Innovation Management*, 29(4), pp.667–680. Available at: <http://doi.wiley.com/10.1111/j.1540-5885.2012.00932.x>.
- Amabile, T.M., 1985. Motivation and creativity: Effects of motivational orientation on creative writers. *Journal of Personality and Social Psychology*, 48(2), pp.393–399.
- Anderson, A.R. & Miller, C.J., 2003. “Class matters”: human and social capital in the entrepreneurial process. *The Journal of Socio-Economics*, 32(1), pp.17–36. Available at: <http://www.sciencedirect.com/science/article/pii/S105353570300009X>.
- Andrews, D.C., 2002. Audience-specific Online Community Design. *Communications of the ACM*, 45(4).
- Apostolou, G. & Reinders, A.H.M.E., 2016. How do users interact with photovoltaic-powered products? Investigating 100 “lead-users” and 6 PV products. *Journal of Design Research*, 14(1), pp.66–93.
- Arazy, O. & Nov, O., 2010. Determinants of wikipedia quality: the roles of global and local contribution inequality. *ACM Conference on Computer Supported Cooperative Work*.
- Archak, N., 2010. Money, Glory and Cheap Talk: Analyzing Strategic Behavior of Contestants in Simultaneous Crowdsourcing Contests on TopCoder.com. In WWW 2010. North Carolina, USA, pp. 21–30.
- Bach, P.M. & Twidale, M., 2010. Social Participation in Open Source: What It Means for Designers. *interactions*, 17(3), pp.70–74. Available at: <http://doi.acm.org/10.1145/1744161.1744177>.
- Balaji, S. & Murugaiyan, M.S., 2012. Waterfall vs v-model vs agile: A comparative study on SDLC. *International Journal of Information Technology and Business Management*, 2(1), pp.26–30.
- Baldwin, C., Hienerth, C. & Von Hippel, E., 2006. How user innovations become commercial products: a theoretical investigation and case study. *Research Policy*, 35(9), pp.

1291–1313. Available at: <http://linkinghub.elsevier.com/retrieve/pii/S0048733306000989>.

- Baldwin, C. & Von Hippel, E., 2011. Modeling a paradigm shift: from producer innovation to user and open collaborative innovation. *Organization Science*, 22, pp.1399–1417.
- Barcellini, F., Prost, L. & Cerf, M., 2015. Designers' and users' roles in participatory design: What is actually co-designed by participants? *Applied Ergonomics*, 50(Supplement C), pp.31–40. Available at: <http://www.sciencedirect.com/science/article/pii/S0003687015000228>.
- Battistella, C. & Nonino, F., 2011. Exploring the Impact of Motivations on the Attraction of Innovation Roles in Open Innovation Web-Based Platforms. In MCPC.
- Baym, N.K., 2000. *Tune in, log on: Soaps, fandom and online community*, Sage Publications, Inc.
- Belz, F.-M. & Baumbach, W., 2010. Netnography as a Method of Lead User Identification. *Creativity and Innovation Management*, 19(3), pp.304–313. Available at: <http://doi.wiley.com/10.1111/j.1467-8691.2010.00571.x> [Accessed April 2, 2013].
- Berger, C. et al., 2005. Co-designing modes of cooperation at the customer interface: learning from exploratory research. *European Management Review*, 2, pp.70–87.
- Berger, C. & Piller, F., 2003. Customers as co-designers. *Manufacturing Engineer*, pp.42–45.
- Bilgram, V., Brem, A. & Voigt, K.-I., 2008a. User-Centric Innovations in New Product Development — Systematic Identification of Lead Users Harnessing Interactive and Collaborative Online-Tools. *International Journal of Innovation Management*, 12(3), pp.419–458.
- Bilgram, V., Brem, A. & Voigt, K.-I., 2008b. User-Centric Innovations in New Product Development — Systematic Identification of Lead Users Harnessing Interactive and Collaborative Online-Tools. *International Journal of Innovation Management*, 12(3), pp.419–458.
- Binik, Y.M. et al., 1997. From the couch to the keyboard: Psychotherapy in cyberspace. In *Culture of the Internet*. Lawrence Erlbaum Associates, pp. 71–102.
- Bock, G.-W. & Kim, Y.-G., 2001. Breaking the myths of rewards: an exploratory study of attitudes about knowledge sharing. In PACIS 2001.
- Bogers, M. & West, J., 2012. Managing distributed innovation: strategic utilization of open and user innovation. *Creativity and Innovation Management*, 21, pp.61–75.
- Bonner, J. & Walker, O., 2004. Selecting influential business-to-business customers in new product development: Relational embeddedness and knowledge heterogeneity considerations. *Journal of Product Innovation Management*, 21(3), pp.155–169.
- Bowen, D.E., 1986. Managing customers as human resources in service organisations. *Human Resource Management*, 25, pp.371–383.
- Breach, G. & Jenkins, R., A New Approach to the Process of Identifying Lead Users in Open Source Software Communities.

- Brown, J.S. & Duguid, P., 2000. *The social life of information*, Harvard Business School Press.
- Bryant, S.L., Forte, A. & Bruckman, A., 2005. *Becoming Wikipedian: Transformation of Participation in a Collaborative Online Encyclopedia*.
- Burke, M., Marlow, C. & Lento, T., 2009. *Feed Me: Motivating Newcomer Contribution in Social Network Sites*. In CHI 2009.
- Butler, B. et al., 2007. *Community Effort in Online Groups: Who Does the Work and Why?*, pp.1–32.
- Carbonell, P., Rodríguez-Escudero, A.I. & Pujari, D., 2009. *Customer involvement in new service development: an examination of antecedents and outcomes*. *Journal of Product Innovation Management*, 26(5), pp.536–550.
- Carver, C., 1999. *Building a Virtual Community for a Tele-Learning Environment*. *IEEE Communications Magazine*, pp.114–118.
- Cha, M. & Gummadi, K.P., 2010. *Measuring User Influence in Twitter: The Million Follower Fallacy*. In *Proceedings of the Fourth International AAAI Conference on Weblogs and Social Media*. pp. 10–17.
- Chai, K., Potdar, V. & Chang, E., 2009. *User contribution measurement model for web-based discussion forums*. In *3rd IEEE International Conference on Digital Ecosystems and Technologies*. Ieee, pp. 347–352. Available at: <http://ieeexplore.ieee.org/lpdocs/epic03/wrapper.htm?arnumber=5276787>.
- Cheng, R. & Vassileva, J., 2006. *Design and evaluation of an adaptive incentive mechanism for sustained educational online communities*. *User Modeling and User-Adapted Interaction*, 16(4), pp.321–348.
- Chesbrough, H., 2003. *Open Innovation: The New Imperative for Creating and Profiting from Technology*., Harvard Business School Press.
- Cobb, A., 2000. *Acculturation and accommodation in qualitative and quantitative research*. *Journal of Professional Nursing*, 16(4), p.188.
- Constant, D., Sproull, L. & Kiesler, S., 1996. *The Kindness of Strangers: The Usefulness of Electronic Weak Ties for Technical Advice*. *Organization Science*, 7(2), pp.119–135.
- Conway, S., 1995. *Informal boundary-spanning communication in the innovation process: an empirical study*. *Technology Analysis and Strategic Management*, 7, p.327.
- Cooper, R.G. & Kleinschmidt, E.J., 1986. *An investigation into the new product process: Steps, deficiencies, and impact*. *The Journal of Product Innovation Management*, 3(2), pp.71–85.
- Crowther, A., 2006. *Beyond high tech: early adopters of open innovation in other industries*. *R & D Management*, 36(3), pp.229–236.
- Csikszentmihalyi, M., 1996. *The Flow of Creativity*, New York, NY: Harper Collins.

- Dahan, E. & Hauser, J., 2002. The virtual customer. *Journal of Product Innovation Management*, 19(5), pp.332–353.
- Dahlander, L., 2005. Appropriation and appropriability in open source software. *International Journal of Innovation Management*, 9(3), p.259.
- David, P.A. & Shapiro, J.S., 2008. Community-based production of open-source software: What do we know about the developers who participate? *Information Economics and Policy*, 20(4), pp.364–398. Available at: <http://www.sciencedirect.com/science/article/pii/S0167624508000553>.
- Davidsson, P. & Honig, B., 2003. The role of social and human capital among nascent entrepreneurs. *Journal of Business Venturing*, 18(3), pp.301–331. Available at: <http://linkinghub.elsevier.com/retrieve/pii/S0883902602000976> [Accessed March 5, 2012].
- Davis, F., 1993. User acceptance of information technology: system characteristics, user perceptions and behavioral impacts International. *Journal of Man-Machine Studies*, 38, p.475.
- Dennis, A.R., Poothari, S.K. & Natarajan, V.L., 1998. Lessons from the early adopters of Web groupware. *Journal of Management Information Systems*, 14(4), pp.65–86.
- Droge, C., Stanko, M.A. & Pollitte, W.A., 2010. Lead Users and Early Adopters on the Web: The Role of New Technology Product Blogs. *Journal of Product Innovation Management*, 27, pp.66–82.
- Duverger, P. & Hassan, S.S., 2008. Defectors as a new source of radical service innovation ideas,
- Dyer, J.H., Gregersen, H.B. & Christensen, C.M., 2009. Five “discovery skills” separate true innovators from the rest of us. *Harvard Business Review*, (December).
- Edvardsson, B. et al., 2010. Service innovation and customer co-development. *Handbook of Service Science*, pp.561–577.
- Eisenberg, I., 2011. Lead-user research for breakthrough innovation. *Research Technology Management*, pp.50–58.
- Ellonen, H. & Kosonen, M., 2010. Treat your customers as equals! Fostering customer collaboration through social media. *International Journal of Electronic Marketing and Retailing*, 3(3), pp.221–240.
- Engel, J., Kegerreis, R. & Blackwell, R., 1969. Word-of-mouth communication by the innovator. *Journal of Marketing*, 33(3), pp.15–19.
- Enkel, E., Kausch, C. & Gassmann, O., 2005. Managing the risk of customer integration. *European Management Journal*, 23(2), pp.203–213.
- Enos, J.L., 1962. *Petroleum progress and profits: A history of process innovation*, Cambridge, MA: MIT Press.
- Erickson, T., 1997. Social interaction on the Net: Virtual community as participatory genre. 30th Annual Hawaii International Conference on System Sciences.

- Fernback, J., 1999. There is a there there: Notes toward a definition of cyber community. In *Doing Internet research: Critical issues and methods for examining the Net*. Thousand Oaks: Sage Publications.
- Figallo, C., 1998. *Hosting Web communities: Building relationships, increasing customer loyalty, and maintaining a competitive edge*, New York: John Wiley & Sons, Inc.
- Filipczak, B., 1998. Trainers on the Net: A community of colleagues. *Training*, 35(2), pp.70–76. Available at: <http://wdr.doleta.gov/opr/fulltext/document.cfm?docn=5945>.
- Fournier, S. et al., 2001. *Building Brand Community on the Harley-Davidson Posse Ride*. Harvard Business School Case, reprint.
- Franke, N. & Von Hippel, E., 2003. Satisfying heterogeneous user needs via innovation toolkits: The case of Apache security software. *Research Policy*, 32, pp.1199–1215.
- Franke, N., Von Hippel, E. & Schreier, M., 2006. Finding commercially attractive user innovations: A test of lead user theory. *Journal of product innovation management*, 23, pp.301–315.
- Franke, N., Keinz, P. & Schreier, M., 2008. Complementing Mass Customization Toolkits with User Communities: How Peer Input Improves Customer Self-Design. *Journal of Product Innovation Management*, 25(6).
- Franke, N. & Piller, F., 2004. Value creation by toolkits for user innovation and design: the case of the watch market. *Journal of Product Innovation Management*, 21(6), pp. 401–415.
- Franke, N., Schreier, M. & Kaiser, U., 2010. The “i designed it myself” effect in mass customization. *Management Science*, 56(1), pp.125–140.
- Franke, N. & Shah, S., 2003. How communities support innovative activities: an exploration of assistance and sharing among end-users. *Research policy*, 32(1), pp.157–178. Available at: <http://linkinghub.elsevier.com/retrieve/pii/S0048733302000069>.
- Franz, K., 1999. *Narrating automobility: Travelers, tinkerers, and technological authority in the twentieth century*.
- Frattini, F. et al., 2014. The role of early adopters in the diffusion of new products: differences between platform and non-platform innovations. *Journal of Product Innovation Management*, 31(3), pp.466–488.
- Fredberg, T. & Piller, F., 2011. The paradox of tie strength in customer relationships for innovation: a longitudinal case study in the sports industry. *R & D Management*, 41(5), pp.470–484.
- Freeman, C., 1968. *Chemical Process Plant: Innovation and the World Market*. National Institute Economic Review, 45, pp.29–57.
- Füller, J. et al., 2006. Community based innovation: How to integrate members of virtual communities into new product development. *Electronic Commerce Research*, 6(1), pp.57–73.

- Füller, J. et al., 2004. Community Based Innovation A Method to utilize the Innovative Potential of Online Communities. , 0(C), pp.1–10.
- Füller, J. et al., 2017. The Role of Professionalism in Innovation Contest Communities. Long Range Planning, 50(2), pp.243–259. Available at: <http://www.sciencedirect.com/science/article/pii/S002463011500093X>.
- Füller, J. et al., 2014. User Roles and Contributions in Innovation-Contest Communities. Journal of Management Information Systems, 31(1), pp.273–308. Available at: <http://www.tandfonline.com/doi/abs/10.2753/MIS0742-1222310111>.
- Füller, J., 2006. Why Consumers Engage in Virtual New Product Developments Initiated by Producers. Advances in Consumer Research, 33, pp.639–646.
- Füller, J., Faullant, R. & Matzler, K., 2010. Triggers for virtual customer integration in the development of medical equipment – From a manufacturer and a user’s perspective. Industrial Marketing Management, 39(8), pp.1376–1383. Available at: <http://www.sciencedirect.com/science/article/pii/S0019850110000532>.
- Füller, J. & Von Hippel, E., 2008. Costless Creation of Strong Brands by User Communities: Implications for Producer-Owned Brands. , pp.1–30.
- Füller, J., Jawecki, G. & Mühlbacher, H., 2007. Innovation creation by online basketball communities. Journal of Business Research, 60, pp.60–71.
- Fuller, J. & Matzler, K., 2007. Virtual product experience and customer participation – a chance for customer-centred, really new products. Technovation, 27, pp.378–387.
- Füller, J., Matzler, K. & Hoppe, M., 2008. Brand Community Members as a Source of Innovation. Journal of Product Innovation Management, 25, pp.608–619.
- Furlong, M.S., 1989. An electronic community for older adults: The SeniorNet Network. Journal of Communication, 39(3), pp.145–153.
- Gassmann, O., 2006. Opening Up the Innovation Process: Towards an Agenda. R&D Management, 36(3), pp.1–14.
- Gruner, K. & Homburg, C., 2000. Does customer interaction enhance new product success? Journal of Business Research, 49(1), pp.1–14.
- Guo, W. et al., 2017. User roles and contributions during the new product development process in collaborative innovation communities. Applied Ergonomics, 63, pp. 106–114. Available at: <http://dx.doi.org/10.1016/j.apergo.2017.04.013>.
- Hagedoorn, J., 2002. Inter-firm R&D partnerships: An overview of major trends and patterns since 1960. Research Policy, 31(4), pp.477–492.
- Hagel, J. & Armstrong, A., 1997. Net gain: Expanding markets through virtual communities. Boston, Harvard Business Press.
- Hahn, J., Marconnet, A. & Reid, T., 2016. Using DIY Practitioners as Lead Users: a Case Study on the Hair Care Industry. Journal of Mechanical Design, (c). Available at: <http://mechanicaldesign.asmedigitalcollection.asme.org/article.aspx?doi=10.1115/1.4034086>.

- Handy, C., 1995. Trust and the virtual organization. *Harvard Business Review*, 73(3), pp.40–48.
- Hedberg, H. & livari, N., 2009. Integrating HCI Specialists into Open Source Software Development Projects. In C. Boldyreff et al., eds. *Open Source Ecosystems: Diverse Communities Interacting: 5th IFIP WG 2.13 International Conference on Open Source Systems, OSS 2009, Skövde, Sweden, June 3-6, 2009*. Proceedings. Berlin, Heidelberg: Springer Berlin Heidelberg, pp. 251–263. Available at: https://doi.org/10.1007/978-3-642-02032-2_22.
- Henard, D. & Szymanski, D., 2001. Why some new products are more successful than others. *Journal of Marketing Research*, 38, pp.362–375.
- Herring, S.C., 1996. Two variants of an electronic message schema. In S. C.Herring (Ed.), *Computer-mediated communication: Linguistic, social and cross-cultural perspectives*, pp.81–106.
- Hesse, B.W., 1995. Curb Cuts in the Virtual Community: Telework and Persons with Disabilities. *Proceedings of the 28th Annual Hawaii International Conference on System Science*.
- Hienerth, C., Von Hippel, E. & Potz, M., 2007. Exploring key characteristics of lead user workshop participants: Who contributes best to the generation of truly novel solutions? In DRUID. Denmark.
- Hienerth, C. & Lettl, C., 2011. Exploring How Peer Communities Enable Lead User Innovations to Become Standard Equipment in the Industry: Community Pull Effects. *Product development & Management Association*, 28, pp.175–195.
- Hiltz, S.R., 1984. Online communities: A case study of the office of the future. In Norwood , NJ.
- Hiltz, S.R. & Wellman, B., 1997. Asynchronous learning networks as a virtual classroom. *Communications of the ACM*, 40(9), pp.44–49.
- Von Hippel, E., 1978a. A customer active paradigm for industrial product idea generation. *Research Policy*, 7(3), pp.240–266.
- Von Hippel, E., 2005. *Democratizing Innovation*, Cambridge, MA: MIT Press. Available at: <http://www.springerlink.com/index/10.1007/s11301-004-0002-8> [Accessed March 3, 2013].
- Von Hippel, E., 1998. Economics of Product Development by Users : The Impact of “ Sticky ” Local Information. *Management science*, 44(5), pp.629–644.
- Von Hippel, E., 2017. *Free Innovation*, Cambridge, MA: MIT Press.
- Von Hippel, E., 2007. Horizontal innovation networks - by and for users. *Industrial and Corporate Change*, 16(2), pp.1–28.
- Von Hippel, E., 1986. Lead Users: An Important Source of Novel Product Concepts. *Management science*, 32(7), pp.791–805.

- Von Hippel, E., 1978b. Successful Industrial Products from Customer Ideas. *The Journal of Marketing*, 42(1), pp.39–49.
- Von Hippel, E., 1976. The dominant role of users in the scientific instrument innovator process. *Research policy*, 5, pp.212–239.
- Von Hippel, E., 1977. Transferring process equipment innovations from user-innovators to equipment manufacturing firms. *R & D Management*, 8.
- Von Hippel, E., Franke, N. & Wilhelm Prugl, R., 2009. Pyramiding efficient search for rare subjects. *Research Policy*, 38(9), pp.1397–1406.
- Von Hippel, E. & Herstatt, C., 1992. From experience: Developing new product concepts via the lead user method: A case study in a “low-tech” field. *Journal of Product Innovation Management*, 9, pp.213–221.
- Von Hippel, E., de Jong, J.P.J. & Flowers, S., 2012. Comparing Business and Household Sector Innovation in Consumer Products: Findings from a Representative Study in the United Kingdom. *Management Science*, 58(9), pp.1669–1681. Available at: <http://mansci.journal.informs.org/cgi/doi/10.1287/mnsc.1110.1508>.
- Von Hippel, E. & Katz, R., 2002. Shifting innovation to users via toolkits. *Management science*, 48(7).
- Von Hippel, E. & Von Krogh, G., 2003a. Open Source Software and the “Private-Collective” Innovation Model: Issues for Organization Science. *Organization Science*, 14(2), pp.208–223.
- Von Hippel, E. & Von Krogh, G., 2003b. Special issue on open source software development. *Research Policy*, 32, pp.1149–1157.
- Von Hippel, E. & Oliveira, P., 2009. Users as Service Innovators: The Case of Banking Services.
- Von Hippel, E., Thomke, S. & Sonnack, M., 1999. Creating Breakthroughs at 3M Job Sculpting: The Art of Retaining Your Best People A New Way to Manage Process Knowledge. *Harvard Business Review*.
- Von Hippel, E. & Urban, G.L., 1988. Lead user analyses for the development of new industrial products. *Management science*, 34(5), pp.569–82.
- Hoffman, D.L. & Novak, T.P., 1996. Marketing in hypermedia computer-mediated environments: Conceptual foundations. *Journal of Marketing*, 60, pp.50–68.
- Hogg, M.A., 1996. Group structure and social identity. In *Social groups and identities: Developing the legacy of Henri Tajfel*. Butterworth-Heinemann, pp. 65–94.
- Hollander, S., 1965. *The sources of increased efficiency: A study of DuPont rayon plants*, Cambridge, MA: MIT Press.
- Horrigan, J. & Rainie, L., 2001. Online communities: networks that nurture long-distance relationship and local ties. Pew Internet and American Life Project.

- Hovorka, D. S., & Lee, A. S. (2010). Reframing interpretivism and positivism as understanding and explanation: Consequences for information systems research. *Iciss*, 1–13. Retrieved from http://works.bepress.com/dirk_hovorka/33/
- Igbaria, M., 1999. The driving forces in the virtual society. *Communications of the ACM*, 42(12), pp.64–70.
- Jacobsen, L.F., Tudoran, A.A. & Lähteenmäki, L., 2017. Consumers' Motivation to Interact in Virtual Food Communities – The importance of self-presentation and learning. *Food Quality and Preference*, p. Available at: <http://www.sciencedirect.com/science/article/pii/S0950329317301520>.
- Jaworski, B. & Kohli, A., 1993. Market orientation: antecedents and consequences. *Journal of Marketing*, 57(3), pp.53–70.
- Jensen, C. & Scacchi, W., 2007. Role migration and advancement processes in OSSD projects: a comparative case study. 29th International Conference on Software Engineering, Minneapolis, Minnesota, USA.
- Jeppesen, L.B., 2005. User toolkits for innovation: consumers support each other. *Journal of Product Innovation Management*, 22(4), pp.347–362.
- Jeppesen, L.B. & Frederiksen, L., 2006. Why Do Users Contribute to Firm-Hosted User Communities? The Case of Computer-Controlled Music Instruments. *Organization Science*, 17(1), pp.45–63. Available at: <http://orgsci.journal.informs.org/cgi/doi/10.1287/orsc.1050.0156> [Accessed March 4, 2012].
- Jeppesen, L.B. & Laursen, K., 2009. The role of lead users in knowledge sharing. *Research Policy*, 38(10), pp.1582–1589. Available at: <http://linkinghub.elsevier.com/retrieve/pii/S0048733309001681> [Accessed November 15, 2012].
- Jeppesen, L.B. & Molin, M.J., 2000. Technology Analysis & Strategic Management Consumers as Co-developers: Learning and Innovation Outside the Firm. , (June 2012), pp.37–41.
- Jones, Q., 1997. Virtual-communities, virtual-settlements and cyber-archeology: A theoretical outline. *Journal of Computer-Mediated Communication*, 3.
- Jones, Q. & Rafaeli, S., 1999. User Population and User Contributions to Virtual Publics: A Systems Model. *Proceedings of the ACM International Conference on Supporting Group Work*.
- Jones, S.G., 1995. *Understanding community in the information age.*, London: Sage Publications.
- Katz, R. & Allen, T.J., 1982. Investigating the not invented here (NIH) syndrome: a look at the performance, tenure, and communication patterns of 50 R&D project groups. *R & D Management*, 12.
- KIM, J.H., BAE, Z.-T. & KANG, S.H., 2008. The role of online brand community in new product development: case studies on digital product manufacturers in Korea.

- International Journal of Innovation Management, 12(3), pp.357–376. Available at: <http://www.worldscientific.com/doi/abs/10.1142/S1363919608002011>.
- Koh, J. & Kim, Y.G., 2004. Knowledge sharing in virtual communities: an e-business perspective. *Expert Systems with Applications*, 26(2), pp.155–166. Available at: <http://linkinghub.elsevier.com/retrieve/pii/S0957417403001167> [Accessed March 23, 2014].
- Kolekofski, K.E. & Heminger, A.R., 2003. Beliefs and attitudes affecting intentions to share information in an organizational setting. *Information & Management*, 40, pp.521–532.
- Kotler, P., 1986. Prosumers - a New Type of Consumer. *Futurist*, 20(5), pp.24–25.
- Kristensson, P., Gustafsson, A. & Archer, T., 2004. Harnessing the creative potential among users. *Journal of Product Innovation Management*, 21, pp.4–14.
- Lakhani, K.R. & Wolf, R.G., 2005. *Why Hackers Do What They Do: Understanding Motivation and Effort in Free / Open Source Software Projects*. MIT Press, pp.1–27.
- Langlois, R.N. & Robertson, P.L., 1992. Networks and innovation in a modular system: Lessons from the micro- computer and stereo component industries. *Research Policy*, 21, pp.297–313.
- Lauritzen, G.D., 2017. The Role of Innovation Intermediaries in Firm-Innovation Community Collaboration: Navigating the Membership Paradox. *Journal of Product Innovation Management*, 34(3), pp.289–314. Available at: <http://dx.doi.org/10.1111/jpim.12363>.
- Lee, F.S.L., Vogel, D. & Limayem, M., 2003. Virtual Community Informatics: A review and research agenda. *Journal of Information Technology Theory and Application*, 5(1), pp.47–61.
- Lee, K.R., 1996. The role of user firms in the innovation of machine tools: The Japanese case. *Research Policy*, 25, pp.491–507.
- Lerner, J. & Tirole, J., 2000. The Simple Economics of Open Source,
- Lettl, C. & Gemünden, H.G., 2005. The entrepreneurial role of innovative users. *Journal of Business & Industrial Marketing*, 20(7), pp.339–346. Available at: <http://www.emeraldinsight.com/10.1108/08858620510628579> [Accessed March 27, 2013].
- Lilien, G.L. et al., 2002. Performance Assessment of the Lead User Idea Generation Process for New Product Development. *Management Science*, 48(8), pp.1042–1059.
- Lincoln, Y. & Guba, E., 2000. Paradigmatic controversies, contradictions, and emerging confluences. In *Handbook of qualitative research*. Thousand Oaks, CA: Sage, pp. 163–188.

- Lowes, R.L., 1997. Here come patients who've "studied" medicine on-line. *Medical Economics*, 74(2), pp.175–187.
- Luthje, C., 2004. Characteristics of innovating users in a consumer goods field An empirical study of sport-related product consumers. *Technovation*, 24, pp.683–695.
- Luthje, C. & Herstatt, C., 2004. The Lead-User Method: An Outline of Empirical Findings and Issues for Future. *R & D Management*, 34, p.553–68.
- Luthje, C., Herstatt, C. & Von Hippel, E., 2006. User-innovators and "local" information: The case of mountain biking. *Research policy*, 34, pp.951–965.
- Madhavan, R. & Grover, R., 1998. From embedded knowledge to embodied knowledge: new product development as knowledge development. *Journal of Marketing*, 62, pp.1–12.
- Magnusson, P., 2009. Exploring the contributions of involving ordinary users in ideation of technology-based services. *Journal of Product Innovation Management*, 26, pp. 578–593.
- Mahajan, V., Muller, E. & Srivastava, R.K., 1990. Innovation Adopter Models Categories by Using Diffusion. *Journal of Marketing Research*, 27(1), pp.37–50.
- Mahr, D. & Lievens, A., 2012. Virtual lead user communities : Drivers of knowledge creation for innovation. *Research Policy*, 41(1), pp.167–177. Available at: <http://dx.doi.org/10.1016/j.respol.2011.08.006>.
- Malhotra, Y. & Galletta, D.F., 2003. Role of Commitment and Motivation in Knowledge Management Systems Implementation: Theory, conceptualisation, and Measurement of Antecedents of Success. In 36th Hawaii International Conference on System Sciences.
- Marchi, G., Giachetti, C. & de Gennaro, P., 2011. Extending lead-user theory to online brand communities: The case of the community Ducati. *Technovation*, 31(8), pp.350–361. Available at: <http://linkinghub.elsevier.com/retrieve/pii/S0166497211000599> [Accessed March 19, 2012].
- Martineau, E. & Arsel, Z., 2017. Managing Communities of Co-creation around Consumer Engagement Styles. *Journal of the Association for Consumer Research*, 2(2), pp. 179–195. Available at: <https://doi.org/10.1086/691145>.
- Matthing, J., Kristensson, P. & Johansson, N., 2008. Key strategies for the successful involvement of customers in the co-creation of new technology-based services. *International Journal of Service Industry Management*, 19(4), pp.474–491.
- Matzler, K. et al., 2008. Personality traits and knowledge sharing. *Journal of Economic Psychology*, 29(3), pp.301–313. Available at: <http://linkinghub.elsevier.com/retrieve/pii/S0167487007000499> [Accessed November 8, 2012].
- Matzler, K. et al., 2013. Predicting new product success with prediction markets in online communities. *R & D Management*, pp.420–432.

- McLure Wasko, M. & Faraj, S., 2000. "It is what one does": why people participate and help others in electronic communities of practice. *The Journal of Strategic Information Systems*, 9(2–3), pp.155–173. Available at: <http://linkinghub.elsevier.com/retrieve/pii/S0963868700000457>.
- Mickelson, K.D., 1997. *Seeking social support: Parents in electronic support groups*, Lawrence Erlbaum Associates.
- Mills, P.K., Chase, R.B. & Margulies, N., 1983. Motivating the client/employee system as a service production strategy. *Academy of Management Review*, 8, pp.301–310.
- Mitchell, E.S., 1986. Multiple triangulation: A methodology for nursing science. *Advances in Nursing Science*, 8(3), pp.18–26.
- Moore, G.A., 2002. *Crossing the chasm: Marketing and selling disruptive products to mainstream customers*. In New York, NY: Harper.
- Morrison, P.D., Roberts, J.H. & Von Hippel, E., 2000. Determinants of User Innovation and Innovation Sharing in a Local Market. *Management science*, 46(12), pp.1513–1527.
- Morrison, P.D., Roberts, J.H. & Midgley, D, F., 2004. The Nature of Lead Users and Measurement of Leading Edge Status. *Research policy*, 33(2), pp.351–362.
- Nambisan, S., 2002. Designing virtual customer environments for new product development: toward a theory. *Academy of Management Review*, 27, pp.392–413.
- Nambisan, S. & Baron, R., 2007. Interactions in virtual customer environments: implications for product support and customer relationship management. *Journal of Interactive Marketing*, 21, pp.42–62.
- Nambisan, S. & Baron, R.A., 2009. Virtual Customer Environments: Testing a Model of Voluntary Participation in Value Co-creation Activities. *Journal of Product Innovation Management*, 26(4), pp.388–406. Available at: <http://dx.doi.org/10.1111/j.1540-5885.2009.00667.x>.
- Nambisan, S. & Nambisan, P., 2008. How to profit from a better virtual customer environment. *MIT Sloan Management Review*, 49(3), pp.53–61.
- Nelson, R. & Winter, S., 1982. *An Evolutionary Theory of Economic Change*, Harvard University Press.
- Nov, O., 2007. What Motivates Wikipedians? *Communications of the ACM*, 50(11).
- Öberg, C., 2010. Customer roles in innovations. *International Journal of Innovation Management*, 14(6), pp.989–1011.
- Ogawa, S., 1998. Does sticky information affect the locus of innovation? Evidence from the Japanese convenience- store industry. *Research Policy*, 26, pp.777–790.
- Olson, E. & Bakke, G., 2001. Implementing the Lead User Method in a High Technology Firm: A Longitudinal Study of Intentions versus Actions. *Journal of Product Innovation Management*, 18(2), pp.388–395.

- Organ, D.W., 1989. Organizational Citizenship Behaviour: The Good Soldier Syndrome. *The Academy of Management Review*, 14(2), pp.294–297.
- Ozer, M., 2009. The roles of product lead-users and product experts in new product evaluation. *Research Policy*, 38, p.1340–1349.
- Parjanen, S., Hennala, L. & Konsti-Laakso, S., 2012. Brokerage functions in a virtual idea generation platform: possibilities for collective creativity. *Innovation Management Policy & Practice*, 14, pp.363–374.
- Parks, M.R. & Floyd, K., 1995. Making friends in cyberspace. *Journal of Computer Mediated Communication*, 1(4). Available at: <http://jcmc.indiana.edu/vol1/issue4/parks.html>.
- Parmentier, G. & Gandia, R., 2013. Managing sustainable innovation with a user community toolkit: the case of the video game trackmania. *Creativity and Innovation Management*, 22(2), pp.195–208.
- Parmentier, G. & Mangematin, V., 2014. Orchestrating innovation with user communities in the creative industries. *Technological Forecasting & Social Change*, 83, pp.40–53. Available at: <http://dx.doi.org/10.1016/j.techfore.2013.03.007>.
- Piller, F. et al., 2010. A typology of customer co creation in the innovation process Introduction : The Idea of Open Innovation, Available at: <http://ssrn.com/abstract=1732127>.
- Piller, F.T. & Walcher, D., 2006. Toolkits for idea competitions: a novel method to integrate users in new product development. *R and D Management*, 36(3), pp.307–318. Available at: <http://doi.wiley.com/10.1111/j.1467-9310.2006.00432.x>.
- Plant, R., 2004. Online communities. *Technology in Society*, 26(1), pp.51–65.
- Poetz, M.K. & Schreier, M., 2012. The Value of Crowdsourcing : Can Users Really Compete with Professionals in Generating New Product Ideas ?*. *Product Development & Management Association*, 29(2), pp.245–256.
- Porter, M.E., 1985. *Competitive Advantage*, New York, NY: Free Press.
- Prahalad, C. & Ramaswamy, V., 2000. Co-opting customer competence. *Harvard Business Review*, 78, pp.78–87.
- Prahalad, C.K. & Ramaswamy, V., 2004. *The Future of Competition: Co-Creating Unique Value With Customers*, Harvard Business School Press.
- Priem, R.L., Li, S. & Carr, J.C., 2012. Insights and new directions from demand-side approaches to technology innovation, entrepreneurship, and strategic management research. *Journal of Management*, 38, pp.346–374.
- Quercia, D. et al., 2011. In the Mood for Being Influential on Twitter.
- Raasch, C., Herstatt, C. & Lock, P., 2008. The dynamics of user innovation: Drivers and impediments of innovation activities. *International Journal of Innovation Management*, 12, pp.377–398.

- Ramaswamy, V., 2008. Co-creating value through customers' experiences: the Nike case. *Strategy & Leadership*, 36(5), pp.9–14.
- Rashid, A.M. et al., 2006. Motivating participation by displaying the value of contribution. In *Proceedings of the SIGCHI conference on Human Factors in computing systems - CHI '06*. New York, New York, USA: ACM Press. Available at: <http://portal.acm.org/citation.cfm?doid=1124772.1124915>.
- Rheingold, H., 1993a. A slice of life in my virtual community. In *Global networks: Computers and international communication*. Cambridge, MA: The MIT Press, pp. 57–80.
- Rheingold, H., 1993b. *The virtual community: Homesteading on the electronic frontier*, Reading, MA: Addison-Wesley Publishing Company.
- Richardson, M., Dominowska, E. & Ragno, R., 2007. Predicting clicks: estimating the click-through rate for new ads. *Proceedings of the 16th ...*, pp.521–529. Available at: <http://dl.acm.org/citation.cfm?id=1242643>.
- Ridings, C., Gefen, D. & Arinze, B., 2002. Some antecedents and effects of trust in virtual communities. *Journal of Strategic Information Systems*, 11(3), pp.271–295.
- Ridings, C.M. & Gefen, D., 2004. Virtual Community Attraction: Why People Hang Out Online. *Journal of Computer-Mediated Communication*, 10(1), p.0. Available at: <http://dx.doi.org/10.1111/j.1083-6101.2004.tb00229.x>.
- Rindfleisch, A. et al., 2008. Cross-sectional versus longitudinal survey research: concepts, findings, and guidelines. *Journal of Marketing Research*, 45(2), pp.261–279.
- Rindfleisch, A., 2010. Customer co-creation: A typology and research agenda. *Review of Marketing Research*, 6, pp.84–106.
- Roberts, D., Hughes, M. & Kertbo, K., 2014. Exploring consumers' motivations to engage in innovation through co-creation activities. *European Journal of Marketing*, 48(1/2), pp.147–169. Available at: <https://doi.org/10.1108/EJM-12-2010-0637>.
- Roberts, D.L. & Candi, M., 2014. Leveraging Social Network Sites in New Product Development: Opportunity or Hype? *Journal of Product Innovation Management*, 31, pp.105–117. Available at: <http://dx.doi.org/10.1111/jpim.12195>.
- Roberts, D.L., Piller, F.T. & Lüttgens, D., 2016. Mapping the Impact of Social Media for Innovation: The Role of Social Media in Explaining Innovation Performance in the PDMA Comparative Performance Assessment Study. *Journal of Product Innovation Management*, 33, pp.117–135. Available at: <http://dx.doi.org/10.1111/jpim.12341>.
- Rochford, L. & Rudelius, W., 1997. New product development process: Stages and successes in the medical products industry. *Industrial Marketing Management*, 26(1), pp.67–84.
- Rogers, E.M., 2003. *Diffusion of innovations*, New York: Free Press.
- Romero, D. & Molina, A., 2011. Collaborative networked organisations and customer communities: value co-creation and co-innovation in the networking era.

- Production Planning & Control, 22(5–6), pp.447–472. Available at: <http://dx.doi.org/10.1080/09537287.2010.536619>.
- Rosson, M.B., 1999. I get by with a little help from my cyber-friends: Sharing stories of good and bad times on the Web. *Journal of Computer Mediated Communication*, 4(4). Available at: <http://jcmc.indiana.edu/vol4/issue4/rosson.html>.
- Roth, W. D., & Metha, J. A. L. . (2002). The Rashomon Effect: Combining Positivist and Interpretivist Approaches in the Analysis of Contested Events. *Sociological Methods & Research*, 31(2), 131–173. <http://doi.org/10.1177/0049124102031002002>
- Rothaermel, F.T. & Sugiyama, S., 2001. Virtual internet communities and commercial success: individual and community-level theory grounded in the atypical case of TimeZone.com. *Journal of Management*, 27(3), pp.297–312. Available at: <http://jom.sagepub.com/cgi/doi/10.1177/014920630102700305>.
- Ryan, R. & Deci, E., 2000. Intrinsic and Extrinsic Motivations: Classic Definitions and New Directions. *Contemporary educational psychology*, 25(1), pp.54–67. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/10620381> [Accessed March 19, 2014].
- Ryzhkova, N., 2015. Does online collaboration with customers drive innovation performance? *Journal of Service Theory and Practice*, 25(3), pp.327–347.
- Sale, J. E. M., Lohfeld, L. H., & Brazil, K. (2002). Revisiting the quantitative-qualitative debate: Implications for mixed-method research. *Quality and Quantity*, 36,43–53
- Sawhney, M. & Prandelli, E., 2000. Communities of Creation: Managing Distributed Innovation in Turbulent Markets. *California Management Review*, 42(4), pp.24–54. Available at: <https://doi.org/10.2307/41166052>.
- Sawhney, M., Verona, G. & Prandelli, E., 2005. Collaborating to create: The Internet as a platform for customer engagement in product innovation. *Journal of Interactive Marketing*, 19(4), pp.4–17. Available at: <http://www.sciencedirect.com/science/article/pii/S1094996805700785>.
- Scheid, F., 1997. Four Roles Lead Users Have to Play in the Multi-Actor Innovation Process. , pp.1–32.
- Schrammel, J., Köffel, C. & Tscheligi, M., 2009. How Much do You Tell? Information Disclosure Behaviour in Different Types of Online Communities. , pp.275–284.
- Schreier, M. & Pruegl, R., 2008. Extending lead-user theory: antecedents and consequences of consumers' lead user-ness. *Journal of Product Innovation Management*, 25, p.331–346.
- Schreier, M. & Prugle, R., 2006. Learning from leading-edge customers at The Sims : opening up the innovation process using toolkits. *R & D Management*, 36, pp. 237–250.
- Schuurman, D., Mahr, D. & Marez De, L., 2013. User characteristics for customer involvement in innovation processes : deconstructing the Lead User- concept.

- Schweisfurth, T.G., 2017. Comparing internal and external lead users as sources of innovation. *Research Policy*, 46(1), pp.238–248. Available at: <http://www.sciencedirect.com/science/article/pii/S0048733316301755>.
- Schweisfurth, T.G. & Raasch, C., 2015. Embedded lead users — The benefits of employing users for corporate innovation. *Research Policy*, 44(1), pp.168–180. Available at: <http://dx.doi.org/10.1016/j.respol.2014.09.007>.
- Shah, S., 2000. Sources and Patterns of Innovation in a Consumer Products Field: Innovations in Sporting Equipment. *Management*, 18, pp.1–27.
- Shah, S. & Tripsas, M., 2012. When Do User Innovators Start Firms? A Theory of User Entrepreneurship Sonali Shah,
- Shah, S.K., Smith, S.W. & Reedy, E.J., 2012. Who are User Entrepreneurs? Findings on Innovation, Founder Characteristics, and Firm Characteristics, Available at: <http://ssrn.com/abstract=2018517>.
- Shah, S.K. & Tripsas, M., 2007. The accidental entrepreneur: the emergent and collective process of user entrepreneurship. *Strategic Entrepreneurship Journal*, 140(November), pp.123–140.
- Slater, S.F. & Mohr, J.J., 2006. Successful Development and Commercialization of Technological Innovation: Insights Based on Strategy Type. *Journal of Product Innovation Management*, 23(1), pp.26–33. Available at: <http://doi.wiley.com/10.1111/j.1540-5885.2005.00178.x>.
- Slaughter, S., 1993. Innovation and learning during implementation: A comparison of user and manufacturer innovations. *Research Policy*, 22, pp.81–95.
- Smith, A., 1776. *An inquiry into the nature and causes of the wealth of nations.*, London: Penguin.
- Sproull, L. & Faraj, S., 1997. Atheism, sex and databases: The Net as a social technology. In *Culture of the Internet*. Lawrence Erlbaum Associates, pp. 35–51.
- Sreenivasan, S., 1997. New neighbourhood, no money down. *The New York Times*. Available at: <http://www.nytimes.com/1997/03/17/business/new-neighborhood-no-money-down.html>.
- Stewart, K.J. & Gosain, S., 2006. The Impact of Ideology on Effectiveness in Open Source Software Development Teams. *MIS Quarterly*, 3224(April 2005).
- Suler, J., 2004. The Online Disinhibition Effect. *CyberPsychology & Behaviour*, 7(3), pp.321–327.
- Thoits, P.A., 1982. Conceptual, methodological, and theoretical problems in studying social support as a buffer against life stress. *Journal of Health and Social Behaviour*, 23, pp.145–159.
- Thomke, S. & Von Hippel, E., 2002. Customers as innovators. A new way to create value. *Harvard Business Review*, 80(4), pp.74–81.

- Tietz, R. et al., 2004. The process of user-innovation: A case study on user innovation in a consumer goods setting,
- Tu, Q. et al., 2004. Measuring Modularity-Based Manufacturing Practices and Their Impact on Mass Customization Capability: A Customer-Driven Perspective. *Decision Sciences*, 35(2), pp.147–168.
- Ulrich, P. V & Anderson-connell, L.J., 2003. Consumer co-design of apparel for mass customization. *Journal of Fashion Marketing and Management*, 7(4), pp.398–412.
- Utz, S., 2000. Social information processing in MUDs: The development of friendships in virtual worlds. *Journal of On-line Behaviour*. Available at: <http://www.behavior.net/JOB/vlnl/utz.html>.
- Voss, C., 1985. The role of users in the development of applications software. *Journal of Product Innovation Management*, 2, pp.113–121.
- Wadell, C.S., G.O., B.J. & Magnusson, M., 2013. Exploring the incorporation of users in an innovating business unit. *International Journal of Technology Management*, 61, pp.293–308.
- Watson, G. & Johnson, D., 1972. *Social psychology: Issues and insights*. In Philadelphia: J. B. Lippincott.
- Wellman, B., 1997. An electronic Group is virtually a social network. *Culture of the Internet*, pp.179–205.
- Wellman, B. et al., 1996. Computer networks as social networks: Collaborative work, telework, and virtual community. *Annual Review of Sociology*, 22, pp.213–238.
- Wellman, B. & Gulia, M., 1999a. The network basis of social support: A network is more than the sum of its ties. In *Networks in the global village: Life in contemporary communities*. Westview Press, pp. 83–118.
- Wellman, B. & Gulia, M., 1999b. Virtual communities as communities. In *Communities in cyberspace*. New York, pp. 167–194.
- Wellman, B., Urban, C. & Studies, C., 1996. *Perspective on Collaborative Work and Virtual NETWORKS: Community. Network*.
- Wiertz, C. & de Ruyter, K., 2007. Beyond the Call of Duty: Why Customers Contribute to Firm-hosted Commercial Online Communities. *Organization Studies*, 28(3), pp. 347–376. Available at: <http://oss.sagepub.com/cgi/doi/10.1177/0170840607076003> [Accessed May 7, 2014].
- Wind, J. & Rangaswamy, A., 2001. Customerization: The Next Revolution in Mass Customization. *Journal of Interactive Marketing*, 15, pp.13–22.
- Witell, L. et al., 2011. Idea generation: customer co- creation versus traditional market research techniques. *Journal of Service Management*, 22(2), pp.140–159.
- Wu, S.-C. & Fang, W., 2010. The effect of consumer-to-consumer interactions on idea generation in virtual brand community relationships. *Technovation*, 30(11–12), pp. 570–581.

Zhang, Y. & Hiltz, S.R., 2003. Factors that Influence Online Relationship Development in a Knowledge Sharing Community. In Ninth Americas Conference on Information Systems. pp. 410–417.

16. Appendices

16.1. Virtual community sample

Table 14: A full list of virtual communities where respondents resided.

Complexity	Community name	Responses
Complex Communities (greater functionality, more than text-mediated communications)	3d artist	1
	3D content Central	2
	3D Warehouse	1
	3Dtotal	1
	Blender Artists	4
	Blendswap	1
	Creative Crash	2
	DAZ 3D	1
	Ddd	1
	GrabCAD	14
	Hash Animation: Master Forums	9
	imaterialise	1
	Maxarea.cz	1
	My mini factory	3
	Ponoko	2
	Renderosity	2
	Sculpteo	1
Shapeways	5	
Sketchfab	2	
The foundry	2	
Thingiverse	27	
Turbosquid	11	

	3D CAD	1
	3D printing group	1
	3ders.com	1
	3dprintforums.com	1
	3DS Max	1
	Autodesk Area	2
	AutoDesSys Forums	1
	cg architect	1
	CGMeetUp	1
	CGPersia	1
	CGSociety	17
	CGtalk	11
	Cheetah3d	1
	Clara.io	1
	Digital Tutors	2
	Facebook	5
	FormZForum	2
Simple Communities (Limited to basic text mediated communications)	Google Groups	2
	Grasshopper	4
	Hackerspace	2
	Hive13	1
	LightWave 3D	5
	Linkedin	2
	Miters	1

Mobile Nations	303
Newtek Discussion Forums	3
Pinterest	1
Polycount	7
reddit.com/r/3Dprinting/	1
reprap.org	2
Seemecnc	1
simply maya	1
Smcars.net	1
Solidworks	1
Twitter	1
Wiki Ultimaker	1
ZBrushCentral	3
Total	488

16.2. Questionnaire items

Table 15: Full set of questions for virtual community investigation.

Descriptive Statistics	N	Mean	SD
[Willingness1] I would be interested in participating in the development of other technology products (not mobile phones or applications)	355	4.98	1.464
[Willingness2] I would be interested in participating in the development of new mobile applications	349	5.01	1.464
[Willingness3] I would be interested in participating in the development of new mobile hardware products	349	5.11	1.471
[User_experience1] I invest a lot of time in using mobile products	352	5.51	1.354

[User_experience2] I have a lot of experience with mobile products	353	5.2	1.496
[Product_knowledge1] Compared to others I consider myself an expert	364	3.74	1.638
[Product_knowledge2] I possess profound knowledge relevant for the creation of new mobile products	356	4.01	1.707
[Product_knowledge3] I consider myself very knowledgeable about mobile phone applications	355	4.72	1.538
[Product_knowledge4] I consider myself very knowledgeable about mobile phone hardware	356	4.87	1.53
[Product_knowledge5] I consider myself very knowledgeable about mobile phone software	356	4.81	1.513
[Personal_gain1] I often benefit from contributing to collaborative work in the community	377	4.49	1.514
[Personal_gain2] I often use the community to promote my own work	377	3.51	1.757
[Personal_gain3] I find the community useful for showcasing my work and skills	388	4.73	1.489
[Personal_economic1] If someone in the community requires professional services I will often approach them	387	4.06	1.647
[Innovativeness3] I have original ideas	347	5.35	1.3
[Innovativeness2] I consider myself to be creative and original in my thinking and behaviour	348	5.36	1.297
[Innovativeness1] I am an inventive kind of person	351	5.17	1.423
[Social_motive1] I regularly log onto the community to maintain my relationship with the other users	357	4.08	1.66
[Social_motive2] I often log onto the community to maintain my relationship with other members	367	3.88	1.695
[Social_motive3] It is important for me to join community and group discussions)	415	4.6	1.592
[Social_motive4] My friendship and membership with the community is important to me	389	4.65	1.494
[Reputation1] I engage in the community forum to help build my reputation amongst other members	357	4.24	1.643
[Reputation2] I participate in the community to increase my 'likes', 'votes' or 'rank' from other members	364	3.19	1.715
[Reputation3_remove] I am discouraged to communicate with members who do not acknowledge my posts or comments	411	3.89	1.663

[Reputation4] Recognition from the community is important to me	390	4.51	1.574
[Reputation5] I am encouraged to contribute more when other members of the community acknowledge my posts	412	5.29	1.436
[Responsibility_Care_motive1] I have a responsibility to acknowledge and reply to other users comments and posts when I can	421	4.89	1.617
[Responsibility_Care_motive2] As a community member I feel responsible for helping other members resolve problems and find solutions to their questions and discussion topics	367	5.21	1.379
[Responsibility_Care_motive3] When asked I will help other members of the community	358	5.58	1.117
[Learn_motive1] I engage with the community to help increase my knowledge and understanding about product development	361	5.71	1.329
[Learn_motive2_remove] I find other members of the community are willing to answer my questions and assist me if I need help	363	5.67	1.172
[Learn_motive3] I often go to the community for assistance with product development rather than seek professional help	392	5.19	1.583
[Cost_benefit1] I would continue to use the community if it wasn't free as it enables me to make the most of other mobile products and technology	384	3.34	1.797
[Enjoy1_remove] I have read the community discussions for fun and enjoyment	407	5.32	1.409
[Enjoy2] I engage in discussions for fun and enjoyment	417	5.12	1.51
[Dissatisfaction1] I often get irritated by the lack of advancements in mobile technology	353	3.88	1.571
[Dissatisfaction2] In my opinion there are still unresolved problems with mobile technology	349	4.84	1.502
[Dissatisfaction3] The current mobile technology available to buy is sufficient for my needs	353	5.03	1.432
[Dissatisfaction4] I am dissatisfied with some of the mobile technology currently available	354	4.3	1.504
[Giving1] I enjoy sharing my ideas with other community members	350	5.15	1.319
[Giving2] I often give advice to other members of the community	357	4.68	1.558
Ac6 (I often communicate through the community forum with other members)	351	4.53	1.63

Ac5 (I often contribute new ideas and solutions)	419	4.67	1.624
A2 I often give feedback to other members about their ideas and suggestions about mobile products	348	4.78	1.347
Ac4 (I frequently discuss issues and experiences when using mobile technology with other community members)	361	4.84	1.483
Ac1 (I often start new discussions to help encourage more discussions between users)	357	3.61	1.662
Valid N (listwise)	295		

16.3. Interview structure and questions

Aims and objective: What current knowledge do the platform managers have on the Lead-user theory; What methods, practices or theories do they use in understanding or categorising behaviour of their users; If and what benefits come from identifying and categorising users for the platform management; Do they agree that increasing user knowledge, to inform 'better quality' contributions, affects the health of the platform; Do they trust the weblog data is representative of the user in regards to their resourcefulness as an opinion-leader or innovator.

Interview structure: Length: approximately 2 hours; Audio recorded.

Checklist: Participant consent forms (including the use of audio recording and names). Two audio recording devices and video if applicable .

Questions / guidance:

- How do platform owners identify lead users?
- Introduction sheet explaining lead-user / lead-user theory
- The introduction of the platform and community:
- What is the community purpose/how would you describe the platform?
- What is your role in the community?
- Discussion 1: Labelling groups of users.
- Question 1: Do you explicitly or implicitly discuss, label or give names to 'types' of users within the community?

- If yes: How are these groups defined, what attributes/characteristics differentiate them?
- Question 2: Do the groups (or community if no labelling occurs) have individual roles within the community?
 - What are the roles of these users?
 - How are they perceived by the other community members?
- Questions 3: Could you place importance on groups of members within the community, such as 'top contributors' or 'opinion-leaders'?
- Discussion 2: Identifying and measuring user behaviour
- Question 4: (introduce the interviewee to lead-user characteristics) Do you actively measure/identify any of these characteristics (including proxies) within your community?
 - Do you classify engagement of users (active, responsive, social, etc.)?
- Question 5: How important is the knowledge/information generated by the community to the community and success of the platform?
- Question 6: What attributes/characteristics are important to understanding about your community?
 - (i.e. do you notice any differences between top contributors/innovative users and more passive users?)
 - How do you use this information (e.g. incentivise or showcase users)?
- Question 7: Do you feel that increasing users knowledge/understanding [about the product/brand] will increase the value/resourcefulness of their contributions?
- Question 8: Do you have preferences/opinion for measuring user behaviour and attributes (self-reported Vs. weblog data)
 - How much trust do you have in the data collected / Do you feel it is representative of the user's behaviour?

- Question 9: What are the main motivations, you feel motivate contribution from users? (Professional Vs. Hobbyists / fun / showcasing work)
- Discussion 3: Utilising lead-users
- Question 10: Do you have any communication with users, specially with 'important attributes' outside platform related discussions?
- Question 11: Do you consult the 'important' users when decision making about topics that could affect the platform or community?
- Question 12: What other (if not done so before) applications do the important user have in the community?
- Question 13: Considering your prior knowledge about lead-users, do you feel any differently about their value/application within your community since having this discussion?

16.4. Industry domains

Table 16: A sample of Industry domains where consumer innovation has been observed.

Industry	Products	Research
Sports	Extreme sport	(Franke & Shah, 2003)
	Outdoor Sports	(Luthje, 2004)
	Mountain biking	(Luthje et al., 2006)
	Kite surfing	(Tietz et al., 2004) (Franke et al., 2006)
	Rodeo kayaking	(Baldwin et al., 2006) (Hienerth & Lettl, 2011)
	Sailing	(Raasch et al., 2008)
	Juvenile products	(Shah & Tripsas, 2007) (Füller 2006) (Poetz & Schreier, 2012)
Children	Watches	(Franke & Piller, 2004)

Fashion	Jewellery	(Füller, 2006)
	Woman's clothing	(Ulrich & Anderson-connell, 2003)
	Sport shoes	(Füller et al., 2007) (Berger & Piller, 2003)
Transport	Ducati	(Marchi et al., 2011)
	Volkswagen	(Füller et al., 2008)
	Audi	(Johann et al., 2006)
	Ford	(Wu & Fang, 2010)
Banking	Retail and Commercial	(Hippel & Oliveira, 2009)
	Open source	(Breach & Jenkins n.d.) (von Hippel & Von Krogh, 2003a) (von Hippel & Von Krogh, 2003b)
Software	Printed CAD software	(von Hippel & Urban, 1988)
	Application Software	(Voss, 1985)
	Security Software	(Franke & von Hippel, 2003)
	Computer Games	(Jeppesen & Molin, 2000) (Schreier & Prugle, 2006)
	Music Software	(Jeppesen & Frederiksen, 2006)
	Library Information Systems	(Morrison et al., 2000)
	Custom software	(Archak, 2010)
Industrial	Chemical industry	(Hollander, 1965) (Freeman, 1968)
	Scientific instruments	(Von Hippel, 1976)
	Semi conductors	(Hippel, 1977)
	Machine tooling	(Lee, 1996)

	Pipe hanger hardware	(Hippel & Herstatt, 1992)
	Petroleum processes	(Enos, 1962)
Property	Convenience stores	(Ogawa, 1998)
	Residential construction	(Slaughter, 1993)
Medical	Neurosurgery navigation system	(Hienerth & Lettl, 2011)
	Orthopaedics navigation system	(Hienerth & Lettl, 2011)
	Implant surgery	(Hienerth & Lettl, 2011)
	Neurosurgery robotics	(Hienerth & Lettl, 2011)
Communication	Nokia	(Mahr & Lievens, 2012)
Technology	Stereo components	(Langlois & Robertson, 1992)
Internet services	Blogs	(Droge et al., 2010)

16.5. ANOVA

Table 17: ANOVA Output for motivations and consumer characteristics.

Characteristics		df	Mean Square	F	Sig.
Product Knowledge	Between Groups	1.000	0.042	0.026	0.872
	Within Groups	366.000	1.637		
	Total	367.000			
Willingness	Between Groups	1.000	25.265	14.68	0
	Within Groups	359.000	1.721		
	Total	360.000			
Innovativeness	Between Groups	1.000	19.763	15.15	0
	Within Groups	352.000	1.304		

	Total	353.000			
	Between Groups	1.000	18.383	12.566	0
Dissatisfaction	Within Groups	357.000	1.463		
	Total	358.000			
	Between Groups	1.000	30.183	19.12	0
Personal gain	Within Groups	401.000	1.579		
	Total	402.000			
	Between Groups	1.000	0.125	0.08	0.778
Responsibility	Within Groups	432.000	1.566		
	Total	433.000			
	Between Groups	1.000	13.343	7.153	0.008
Reputation	Within Groups	372.000	1.865		
	Total	373.000			

16.6. ANOVA descriptives

Table 18: ANOVA descriptives, means and standard deviation.

Characteristics		N	Mean	SD	Std. Error
	1	294	4.711	1.250	0.073
	2	74	4.684	1.392	0.162
Product	Total	368	4.705	1.278	0.067
Knowledge	Model			1.280	0.067
	Fixed Effects				
	Random Effects				.06671a
	1	287	5.182	1.291	0.076

		2	74	4.527	1.391	0.162
Willingness	Total		361	5.048	1.337	0.070
	Model	Fixed Effects			1.312	0.069
		Random Effects				0.374
		1	280	5.167	1.186	0.071
		2	74	5.748	0.956	0.111
Innovativeness	Total		354	5.288	1.165	0.062
	Model	Fixed Effects			1.142	0.061
		Random Effects				0.330
		1	285	4.447	1.235	0.073
		2	74	3.887	1.105	0.128
Dissatisfaction	Total		359	4.332	1.229	0.065
	Model	Fixed Effects			1.210	0.064
		Random Effects				0.318
		1	318	4.065	1.286	0.072
		2	85	4.735	1.139	0.124
Personal gain	Total		403	4.206	1.284	0.064
	Model	Fixed Effects			1.256	0.063
		Random Effects				0.382
		1	342	5.139	1.229	0.066
		2	92	5.098	1.333	0.139
Responsibility	Total		434	5.131	1.250	0.060
	Model	Fixed Effects			1.251	0.060

		Random Effects			
				.06007a	
	1	297	3.663	1.361	0.079
	2	77	4.130	1.383	0.158
Reputation	Total	374	3.759	1.377	0.071
	Model	Fixed Effects		1.366	0.071
		Random Effects		0.261	

16.7. Negative binomial regression results for 'Joined date' of users

Table 19: Negative binomial regression results for 'Joined date' of users.

Joined date (no. of months)	Coef.	Std. Err.	z	P>z
Personal Gain	-0.072	0.079	-0.92	0.358
Responsibility	0.021	0.081	0.27	0.789
Reputation	-0.031	0.069	-0.45	0.65
Product Knowledge	0.163	0.089	1.83	0.068
Willingness	0.033	0.065	0.51	0.61
Innovativeness	0.023	0.068	0.34	0.734
Dissatisfaction	-0.047	0.064	-0.74	0.461
_cons	2.884	0.555	5.19	0
/lnalpha	-0.729	0.137		
alpha	0.481	0.066		

Likelihood-ratio test of alpha=0:
 $\chi^2(01) = 1218.23$ Prob>= $\chi^2 =$
0.000

16.8. Identification methods

Table 20: A summary of different identification methods.

Measure	Data	Data type	Author
Activity	No. of comments (more is better)	Frequency	Agarwal et al., 2008
	No. of contributions	Frequency	Fuller 2007
Influence	No. of inlinks (more)	Frequency	Agarwal et al. 2008
	Length of post (the longer attracts more posts)	Frequency	Agarwal et al., 2008
Ahead of trend	Contents of forum contributions	Text	Belz and Baumbach, 2010
Dissatisfaction with current products	Contents of forum contributions	Text	Belz and Baumbach, 2010
	Contents of forum contributions	Text	Fuller, 2007
Product knowledge	Contents of forum contributions	Text	Belz and Baumbach, 2011
	Contents of forum contributions	Text	Fuller, 2007
	Use of Vocabulary	Text/frequency	Marchi et al, 2011
Use experience	Contents of forum contributions	Text	Belz and Baumbach, 2012
Involvement	Contents of forum contributions	Text	Belz and Baumbach, 2013
Recognition	Contents of forum contributions	Text	Jeppensen and Fredrikson, 2006
	Contents of forum contributions	Text	Fuller, 2007

Knowledge giving	Contents of forum contributions	Text	Fuller, 2007
	No. of contributions	Frequency (coded from text data)	Jeppensen and Laursen, 2009
Responsiveness	Percentage of posts that are 'answers' compared to total posts	Frequency (coded from text data)	Jeppensen and Laursen, 2009
Opinion-leadership	Contents of forum contributions	Text	Fuller, 2007
Innovativeness	No. of contributions	Frequency	Fuller, 2007
	No. of contributions	Frequency (coded from text data)	Marchi et al, 2011
Intrinsic motives	Contents of forum contributions	Text	Fuller, 2007
Expected benefits (willingness)	No. of contributions per section	Frequency	Marchi et al., 2011
Brand alignment	Use of Vocabulary/statements	Text/frequency	Marchi et al., 2011

16.9. Multivariate multiple regression

Table 21: Multivariate multiple regression of all innovative consumer characteristics regressed onto all motivations to engage.

Variables	Coef.	Std. Err.	t	Sig
Product knowledge (predictor variable)				
Reputation	0.187	0.058	3.230	0.001
Responsibility	0.169	0.070	2.430	0.016
Personal gain	0.037	0.063	0.590	0.552
_cons	2.991	0.329	9.100	0.000
Willingness to collaborate				

Reputation	0.085	0.062	1.370	0.172
Responsibility	0.360	0.075	4.820	0.000
Personal gain	-0.028	0.068	-0.410	0.679
_cons	2.936	0.353	8.320	0.000
Innovativeness				
Reputation	0.116	0.054	2.140	0.033
Responsibility	0.045	0.065	0.700	0.487
Personal gain	0.133	0.059	2.250	0.025
_cons	4.068	0.307	13.230	0.000
Dissatisfaction				
Reputation	0.120	0.060	2.020	0.045
Responsibility	0.020	0.072	0.280	0.777
Personal gain	-0.026	0.065	-0.400	0.690
_cons	3.881	0.339	11.460	0.000
Product Knowledge x Complexity				
Reputation	0.290	0.114	2.530	0.012
Responsibility	-0.098	0.138	-0.710	0.478
Personal gain	0.577	0.125	4.630	0.000
_cons	2.734	0.651	4.200	0.000
Willingness to collaborate x Complexity				
Reputation	0.200	0.106	1.880	0.061
Responsibility	0.150	0.128	1.170	0.243
Personal gain	0.492	0.116	4.250	0.000
_cons	2.389	0.604	3.960	0.000

Innovativeness x Complexity				
Reputation	0.210	0.134	1.560	0.119
Responsibility	-0.254	0.162	-1.570	0.117
Personal gain	0.749	0.146	5.110	0.000
_cons	3.925	0.764	5.140	0.000
Dissatisfaction x Complexity				
Reputation	0.204	0.094	2.160	0.031
Responsibility	-0.206	0.114	-1.810	0.071
Personal gain	0.391	0.103	3.800	0.000
_cons	3.831	0.537	7.130	0.000

16.10. Simple slopes graphs

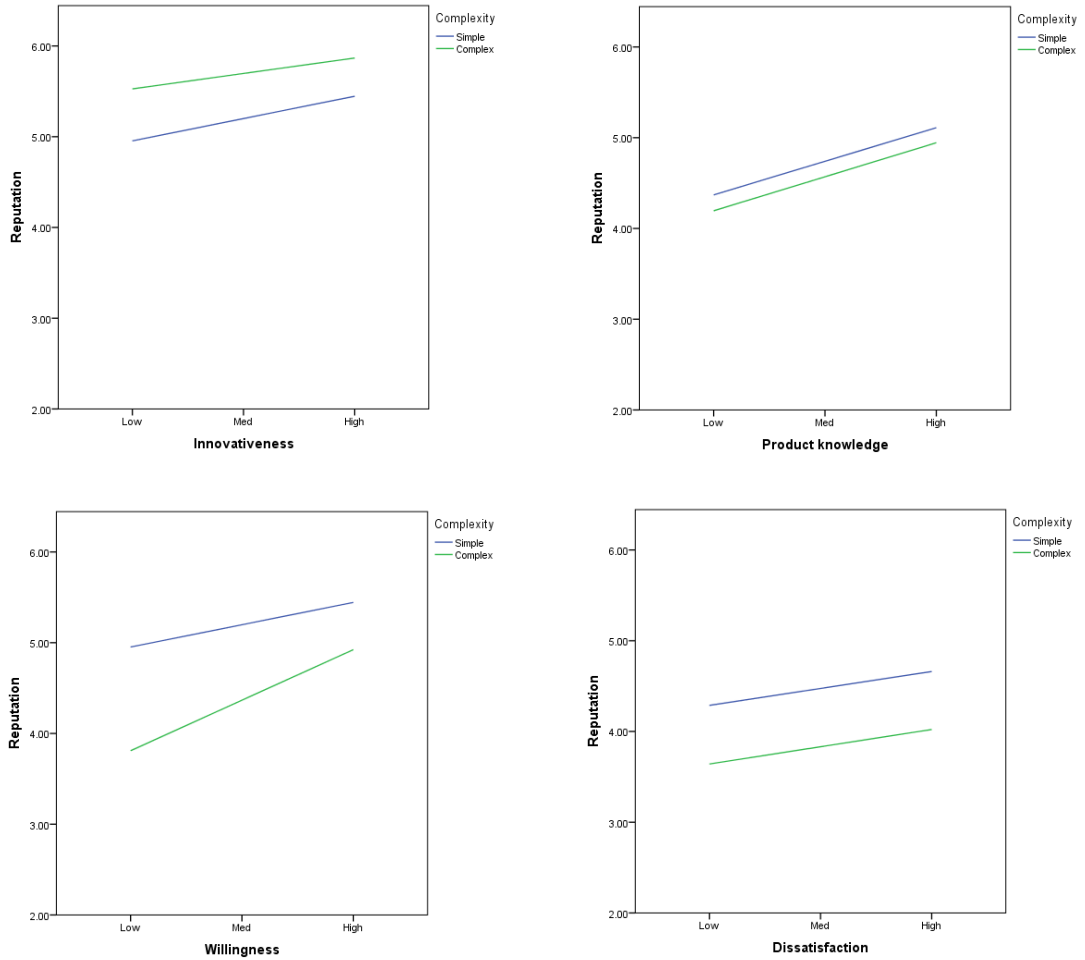


Figure 7: Simple slopes graphs showing the differences in relationships between community types for consumer characteristics and reputation

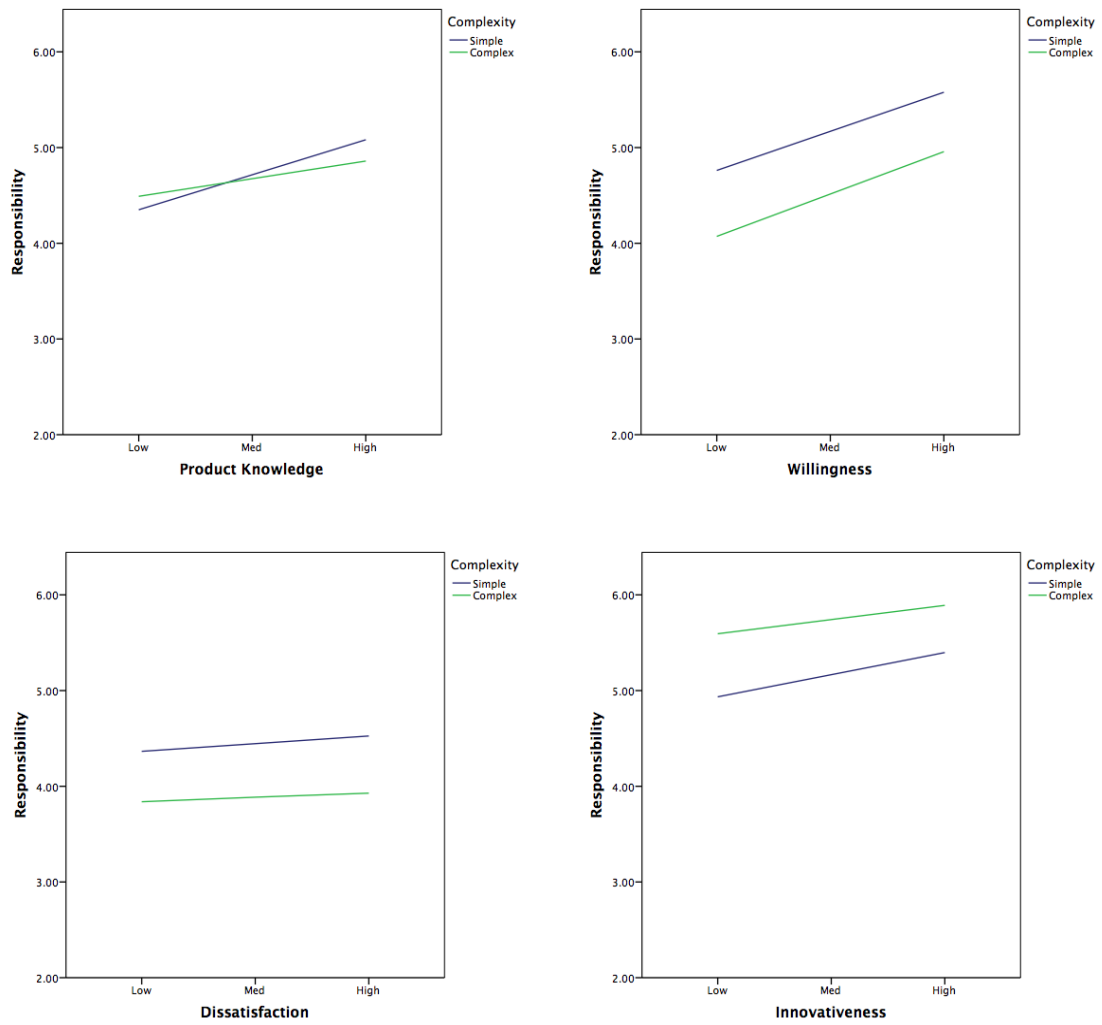


Figure 8: Simple slopes graphs showing the differences in relationships between community types for consumer characteristics and responsibility.

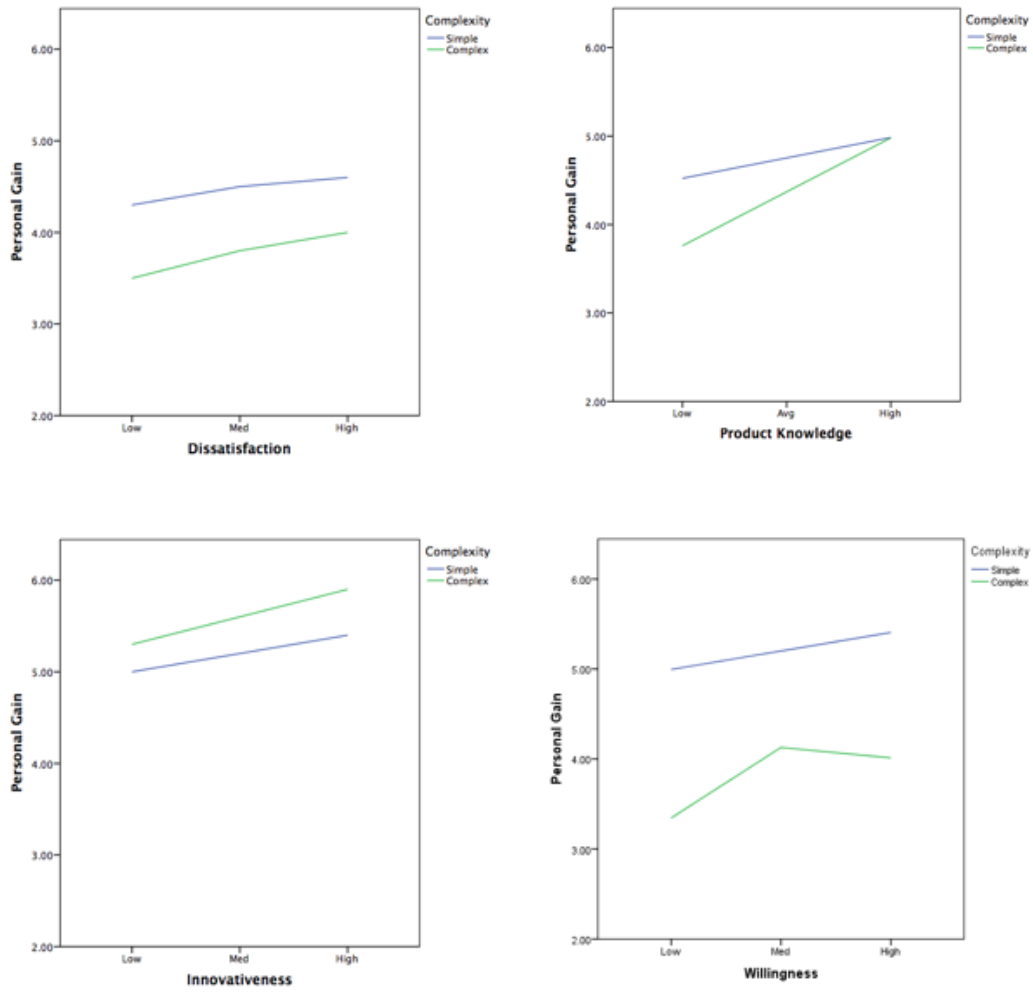


Figure 9: Simple slopes graphs showing the differences in relationships between community types for consumer characteristics and personal gain.