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CROWDSOURCING THROUGH TWITTER FOR INNOVATION

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Abstract This research investigates the role and use of Twitter in business markets and benefits of using open social media channels to crowd source information to support innovation and build relationship in the context of business-to-business (B2B) marketing. This study is based on a combination of methodologies, 52 face-to-face interviews across five countries are compared with a sample of their Tweets using Structural Topic Modelling (STM) which enabled triangulation between stated use of Twitter and respondent's actual Tweets. The research confirmed that individuals used Twitter as a source of information, ideas and innovation within their industry. Twitter enables the building of relevant business relationships through the exchange of new, expert and high quality information within like-minded communities in real time, between companies and their suppliers, customers and also their peers. This research highlights the business relationship building capacity of Twitter as it enables customer and peer conversations that eventually support the development of product and service innovations.

Keywords: social media, innovation, twitter, crowdsourcing, topic modelling.

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1 Introduction

Social media has over the last 15 years gradually become a natural, and important, part of our everyday lives and today different social media channels are used in both professional and private matters. Social media is a "group of Internet-based applications that build on the ideological and technological foundations of Web 2.0, and that allow the creation and exchange of user generated content" (Kaplan and Haenlein, 2010, p. 61; Edosomwan, Kalangot Prakasan, Kouame, Watson and Seymour, 2011; Lashgari, Sutton-Brady, Solberg Søilen and Ulfvengren, 2018). Today there is a vast range of social media platforms stretching from content sharing sites (e.g. YouTube) to full social network sites (e.g. Facebook) (Kaplan and Haenlein, 2010, Withheld, 2017). The foundation of Web 2.0 lies in the collaboration (Berners-Lee, 1999), the interaction and the two-way exchange of information. These factors have been crucial for the success of social media as a dominant platform for communication and media exchange (Edosomwan, Kalangot Prakasan, Kouame, Watson and Seymour, 2011; Lacka and Chong, 2016). The two-way nature of internet based communication technologies, such as social media, makes them, not only, an effective and dynamic medium for business-to-consumer (B2C) exchanges (Leonardi, Huysman and Steinfield, 2013; Tarnovskaya and Biedenbach, 2018) but also for political and social activities. Furthermore, they also enable communication between dispersed and decentralised individuals and entities (Kaplan and Haenlein, 2010; Wang, Rod, Ji and Deng, 2017). Previous research on social media has indicated that businesses experience a positive effect when using social media. The two-way nature of social media makes these channels very effective when aiming for customer engagement since the channels give businesses the possibility to listen, respond and engage in discussion with customers (e.g. Jones, 2010; Tsimonis and Dimitriadis, 2014). However, the effect of social media on branding has been mentioned as complex and unpredictable (Tarnovskaya and Biedenbach, 2018) as in certain the uncontrollability of Twitter for businesses has been seen in the use of hashtags (Withheld, 2014). Regarding B2B exchange on social media, Cawsey and Rowley (2016) propose six components for an effective B2B social media strategy – monitoring the social media space, empowering employees, creating compelling content, stimulating e-WOM, and integrating social media marketing with other marketing more traditional strategies. However, the role of social media as a means for business-to-business communication and the differences in channel effectiveness has not as clearly been investigated (Lashgari, Sutton-Brady,

Solberg Søilen and Ulfvengren, 2018; Withheld, 2017; Hänninen and Karjaluoto, 2017). Previous research suggests that integrating social media into marketing communication is challenging and a social media presence is not effective as a standalone channel but rather should be supported by personalised communication (Hänninen and Karjaluoto, 2017; Valos, Habibi, Casidy, Driesener and Maplestone, 2016). Digitization of communication and the digitalization of society has allowed for a far more holistic impact on businesses than just around their communication and has changed how competitive advantage is gained and sustained (Brynjolfsson and McAfee, 2014; Wang, Rod, Ji and Deng, 2017). Today innovation, and especially open innovation, has been deemed important to cope with the increasing need for quick moves to gain and sustain competitive advantages in the increasingly aggressive and fast paced competitive environment (Chesbrough and Appleyard, 2007; Lee, Park, Yoon and Park, 2010). Simula and Ahola (2014) categorise four distinct crowdsourcing configurations - Internal crowdsourcing, Community crowdsourcing, Open crowdsourcing, and Crowdsourcing via a broker. In this model, community crowdsourcing and open crowdsourcing give scenarios with the focal firm both in (higher) control and with a high degree of openness of their crowdsourcing activities.

2 Crowdsourcing Innovation

One of the ways that companies have found to access knowledge to source innovations is by using social media, such as blogs, to collect innovative ideas from their users (Jussila, Kärkkäinen and Multasuo, 2015). This online exchange has the potential to generate increased "collaboration among the organisation employees and giving the organisation an image of a more 'open to critique and new ideas' kind of organisation" (Scupola and Westh Nicolajsen, 2013, p. 35) and, hence, support the foundations of open innovation. It is also important for companies to include social media in the dialogue with customers and in their marketing mix, as customer engagement through electronic word-of-mouth (eWOM) using Twitter enhances overall engagement and brand loyalty (Jones, 2010; Tsimonis and Dimitriadis, 2014). However, it is noted by Chesbrough (2011) that taking this "relationship" with customers to crowdsourcing comes with a caveat, that the community from which this wealth of ideas is obtained must be properly cared for and engaged, otherwise their willingness to participate will be destroyed. Social media can be utilised across

the stages of innovation from ideation to commercialisation providing creativity, expertise and collective intelligence and different social media channels serve different roles in the innovation process (Jussila, Kärkkäinen and Multasuo, 2015; Lashgari, Sutton-Brady, Solberg Søilen and Ulfvengren, 2018; Mount and Martinez, 2014). Compared to other social media, such as Facebook, Twitter enables the dissemination, feedback and ideation in real time for product development without the interference of algorithmic timeline distortions (Leek, Houghton and Canning, 2017; Mount and Martinez, 2014). The almost instantaneous exchange of information enabled by social media and the ability for this information to contribute to innovation was the impetus for the investigation of the role of the microblogging service Twitter as a possible source of innovation (Kubowicz Malhotra and Malhotra, 2016; Mount and Martinez, 2014). Researching identifying how companies use social media has risen in prominence during the last ten years (Lehtimäki et al. 2009; Withheld, 2017). However, Twitter use in industrial markets is more recent phenomenon with firms using Twitter to manage interactions with customers (Andzulis, Panagopoulos and Rapp, 2012). Companies from different industry sectors tend to use Twitter for different purposes (Xiong and MacKenzie, 2015). According to Swani, Brown and Milne (2014) marketers use Twitter to message differently between the industrial and consumer context. Furthermore, B2B companies tend to use more emotional than functional appeals in their tweets and avoided the "hard sell" (Swani, Brown and Milne, 2014). Leek Canning and Houghton (2016) show how the follower's response to the Twitter messages by utilizing the Task Media Fit Model. With a semiotic single case study Mehmet and Clarke (2016) provide a review of the meanings of specific online virtual conversations (Facebook, Twitter and website). The lack of research around the use of Twitter in the B2B context has led to this research investigating how Twitter is used by small and medium sized firms to support innovation within and between companies.

3 Methodology

3.1 Interviews

Though there is a considerable amount of academic research around text mining and data mining companies Twitter feed (He and Wang, 2016; Liu, Cao and He, 2011; Mehmet and Clarke, 2016; Swani, Brown and Milne, 2014), very little research has been published on the motivations for the use of Twitter in business relationships. The interviews sought to investigate the interviewees' behaviour on Twitter, including what activities they used it for, their motivations behind whom they chose to follow on Twitter and how they used it to grow business relationships and company profile. The interview data is from 52 interviews carried out from August to October 2015 across 5 European countries – Great Britain (12), Germany (11), Sweden (8), Finland (13) and Norway (8). The sample was based on individuals that used Twitter in their role in B2B marketing. While it is a convenience sample the behaviour was surprising similar across cultures and industries. Regarding the official role at the company, 40% were involved in a marketing role, 21% being a founder, 15% chief executive officer and 11% involved in IT related activities. Furthermore, 75% had worked for in their current role for five years or less. The organisations for which the interviewees worked ranged from consultancy or micro businesses employing less than 10 people to large multinational businesses employing over 2,500 people. Of the 52 companies 75% had 100 or less employees, and 57% had 25 or less employees and these were predominantly IT related start-ups.

3.2 Structural Topic Modelling

Text data sourced from social media and other electronic media is usually very large and has higher order dimension. Topic models are probabilistic statistical text mining algorithms for discovering the underlying meaningful text organisation of a document to uncover the main themes in an unstructured collection of text. Hoffman (2001), proposed one of the first such probabilistic topic modelling algorithms, which was then succeeded by Latent Direchlet Allocation (LDA) by Blei et al (2003). Blei et al. (2003), proposed LDA as an unsupervised approach that assumes a document comprises of multiple topics. Topics are defined as a distribution over a set vocabulary of terms (words). Topic modelling algorithm

assumes that a certain number of topics (k) are present in a collection of (n) documents in different proportions. Each term (word) originates from one of the topics, which is identified from the per-document distribution over topics. LDA defines a dirichlet distribution to identify these topics for each document. For the sake of brevity, the technical details of LDA are not mentioned here. The text mining analysis in this study used STM to search for possible topics in a sample of tweets posted by the interviewees. The STM method is particularly useful in this analysis as it allows for inclusion of metadata in the text corpus. This allows STM to model topical prevalence, specified as simple generalised linear model on a number of document-level covariates. The STM method has been gaining popularity in academic research to generate topics from various sources of data like, international newspapers, open ended interview responses, and online class forums as well as Twitter data (Lucas, Nielsen, Roberts, Stewart, Storer and Tingley, 2015; Reich, Tingley, Leder-Luis, Roberts and Stewart, 2015; Roberts, Stewart and Airoldi, 2016). The text corpus used for the topic modelling exercise consists of tweets posted by a group of interviewees from companies with less than 100 employees as companies are categorised as Small or Medium Scale Enterprises (SME)[1]. To investigate SMEs use of Twitter for innovation and crowdsourcing, the data set was divided into companies that used Twitter at least once a month for innovation and less than once a month, based on their responses during the interview. The final sample of 38 companies with 10 having reported using Twitter at least once a month for innovation and crowdsourcing and the rest 28 using it less than once a month. This binary classification for SMEs is used as the covariate in the STM analysis to check if the topic prevalence differs in these two SME classes. The tweet database included the most recent 500 tweets or less (depending on the number of available tweets) per user which were downloaded subsequent to the interviews being conducted. The data sample contains 15,054 multilingual tweets from 38 Twitter handles. As the tweets are posted in various languages (e.g., Finnish, German, Swedish), they are first translated to English using the Google Translate API (via Google Sheets)[2] for the analysis. Although it wasn't possible to double-check all the translations, translations from familiar languages, e.g. Swedish, Finnish, German etc, were randomly checked. For the topic modelling exercise, the dataset is pre-processed to remove non-

[1] This definition is not absolute here, it can vary in different countries based on their categorisation. This was use this for convenience and to account for small companies.

[2] There are some studies which support the use of Google Translate API or similar machine translation tools for text mining (Lucas et. al., 2015 and de Vries, Schoonvelde & Schumacher, 2018).

character text, html code, and common English stop words. The dataset is further stemmed to reduce words to their root form before conducting the analysis. Additionally, the words appearing in less than 10 tweets are dropped from the dataset, which adjusts the vocabulary and the number of tweets resulting in 14704 tweets and 1768 words in the vocabulary.

4. Results and Discussion

4.1 Results from the Interviews

While 85% of interviewees checked their Twitter account daily, only 46% of interviewees tweeted daily. The survey found that Twitter as a channel was primarily used as a communication and information gathering platform by individuals (Hänninen and Karjaluoto, 2017). The interviewees did not consider they had to use Twitter to compete in their industry, and generally were one of the few Twitter uses in their company (Keinänen and Kuivalainen, 2015). When asked what factors the interviewees considered when deciding to follow someone on Twitter (Table 1) being knowledgeable and influential were considered to be important characteristics of those that the interviewees chose to follow (Hänninen and Karjaluoto, 2017).

Table 1: Characteristics Important in the Decision to Follow

How important are the following in your decision to follow someone on Twitter	**Mean**
Their level of authenticity	5.86
Quality of Information they share	5.84
Their relevance to your business	5.67
Their expert knowledge	5.33
Their level of integrity	5.29
Their level of influence in my industry	4.92

Interviewees cited other factors in their decision to follow someone, and these included "level of innovative thought", "new inspiration and ideas" and "learn from others, reciprocation of interests". The authenticity and integrity of the accounts the respondent followed was considered important, as the tweets of the accounts that the interviewees followed appear on their Twitter feed (Valos, Habibi, Casidy,

Driesener and Maplestone, 2016). If the content was inappropriate this reflected poorly on the account owner and company. Similarly, the main reasons the interviewees unfollowed someone on Twitter was the thought that the information provided was no longer of interest, trustworthy or of sufficient quality. The benefits of using Twitter (Table 2) mentioned by the interviewees included the ability to build trust, provided quality information distribution and exchange and linking or collaborating with others in the industry.

Table 2: Importance of the benefits of Twitter

Rate the importance of these possible benefits of Twitter	**Mean**
Builds your company's brand	6.06
Quick way to distribute information	6.04
Builds trust with others	5.87
Put you at the "Top of mind" for your customers	5.56
Linking to others in the industry	5.54
Gathering business intelligence	5.02

These finding is in line with the commitment-trust theory of Morgan and Hunt (1994) and similar to Quinton and Wilson (2016) findings with LinkedIn. When asked to identify the risks of using Twitter, issues such as loss of control of the conversation, being misunderstood and the negativity of others were raised (Mehmet and Clarke, 2016; Valos, Habibi, Casidy, Driesener and Maplestone, 2016). In light of this, it was surprising that when asked if the interviewees had social media guidelines, only 48% said they had a formal written policy, 17% had an informal policy, and 35% said they had no policy at all. This finding is consistent with Iankova, Davies, Archer-Brown, Marder and Yau (2018) who found a lack of formal strategies in B2B firms. The interviewees were asked to describe the types of guidelines they applied when using Twitter; common responses included being conversational, informative, quality content and the use of common sense when posting information. Of their experience of using Twitter 92% of the interviewees agreed that "using Twitter enhances your creditability" and 75% agreed that using Twitter makes it easier to gather information, which is in line with the concept of social enhancement raised by Yavuz and Toker (2014) in the B2C context. The benefits of Twitter included; "quick way to distribute information", it was beneficial when "gathering business intelligence", "create a community - our company started with a tweet to the world", "crowd sourced way of finding interesting stuff" and

"Identifying trends, what's next". The building of personal credibility through social media is usually associated with personal branding rather than the B2B context (Khedher, 2014; Ngai, Tao and Moon, 2015). These results indicate the use of Twitter as a source of credible knowledge, information and innovative ideas and are consistent with the previous research of authors such as Kaplan and Haenlein (2010) and Kietzmann, Hermkens, McCarthy and Silvestre (2011). The instantaneousness of the Twitter feed as conduit for awareness and information exchange supports the findings of Leek, Houghton and Canning (2017), Mount and Martinez (2014), and Park, Lim and Park (2015). These results were the impetus for the investigation of the content of the interviewees' Twitter feeds.

4.3.2 Results from STM Analysis

The topic selection based on topic semantic coherence and exclusivity indicated 20 as the appropriate number of topics for analysing the tweet data. The 20 topics derived from the STM analysis of the Twitter streams are displayed in Figure 1, which provides a list of top topics according to their expected proportion in the tweets posted by the interviewees.

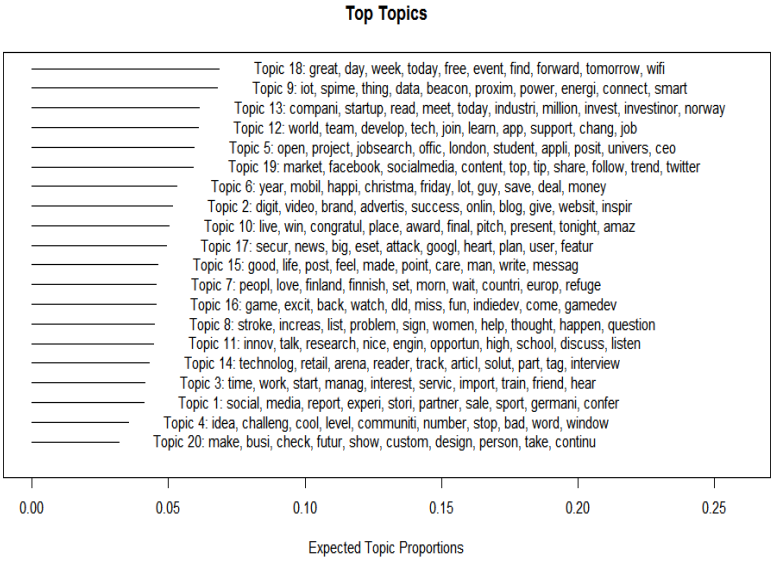

Figure 1: Topics sorted according to their expected occurrence

The topics generated in the analysis are formed of words associated with them. Figure 1 shows top 10 words (according to their probability of occurrence) per topic, which are used to identify the generalised topics. For example, Topic 18 that has the highest proportion in the data has words like "day", "week" and "today" which are associated with describing daily activities or used for posting updates on Twitter. These words identified for each topic can also be linked back to the tweets (documents). On closer inspection of these topics, it is observed that some of the topics as generated by STM have common words. For example, Topic 1 and Topic 19 have words like, "social", "media", "socialmedia". This indicates that there can be some correlation between these topics making them related to each other and hence a further analysis of this likely correlation is conducted to group the topics together as illustrated in Table 3.

Table 3: Labelled topics with top 10 words in each

Group	Assigned Label	Topic	word 1	word 2	word 3	word 4	word 5	word 6	word 7	word 8	word 9	word 10
1	General social media, Online promotion and social media marketing	1	social	media	report	experi	stori	partner	sale	sport	germani	confer
		2	digit	video	brand	advertis	success	onlin	blog	give	websit	inspir
		3	time	work	start	manag	interest	servic	import	train	friend	hear
		6	year	mobil	happi	christma	friday	lot	guy	save	deal	money
		12	world	team	develop	tech	join	learn	app	support	chang	job
		15	good	life	post	feel	made	point	care	man	write	messag
		18	great	day	week	today	free	event	find	forward	tomorrow	wifi
		19	market	facebook	socialmedia	content	top	tip	share	follow	trend	twitter
		20	make	busi	check	futur	show	custom	design	person	take	continu
2	Social well being (Health or Social security)	8	stroke	increas	list	problem	sign	women	help	thought	happen	question
		17	secur	news	big	eset	attack	googl	heart	plan	user	featur
3	Open Innovation & Learning	5	open	project	jobsearch	offic	london	student	appli	posit	univers	ceo
		11	innov	talk	research	nice	engin	opportun	high	school	discuss	listen
4	New idea & promotion	4	idea	challeng	cool	level	communiti	number	stop	bad	word	window
5	About people and society	7	peopl	love	finland	finnish	set	morn	wait	countri	europ	refuge
6	Internet of things and Big Data	9	iot	spime	thing	data	beacon	proxim	power	energi	connect	smart
7	Online Promotion/Announcements	10	live	win	congratul	place	award	final	pitch	present	tonight	amaz
8	About start-ups and investment in the region	13	compani	startup	read	meet	today	industri	million	invest	investinor	norway
9	Retail Technology	14	technolog	retail	arena	reader	track	articl	solut	part	tag	interview
10	Game Development	16	game	excit	back	watch	dld	miss	fun	indiedev	come	gamedev

The mean difference for all 20 topics were compared for two different groups (1) SMEs reporting the use of twitter for innovation activities such as crowdsourcing of ideas or information less than once a month and (2) SMEs that use Twitter for the same at least once a month (SME_Inov). This further analysis based on the SME factors shows that various topics, including Topic 9 (IoT and Big Data) and Topic 14 (Technology in Retail) occur more frequently among these interviewees in the second category of interviewees who use Twitter for crowdsourcing, innovation and gathering ideas. These are insightful results as Topic 4, Topic 7 and Topic 10 about new ideas, promotion and society are also more frequently used by the SMEs using Twitter for innovation. Figure 2 shows the topics that are more associated with each

group. Topic 9 and Topic- 14 are clearly in the second group. These results indicate that the SMEs in our sample are in fact utilising Twitter as a social media channel for open innovation and crowdsourcing, information and feedback. Overall, the topics related to today's advancements in technology, including, IoT, big data, the retail sector and new ideas are among the topics more frequently talked about by SMEs identifying themselves as the ones using Twitter for innovation and crowdsourcing at least once a month.

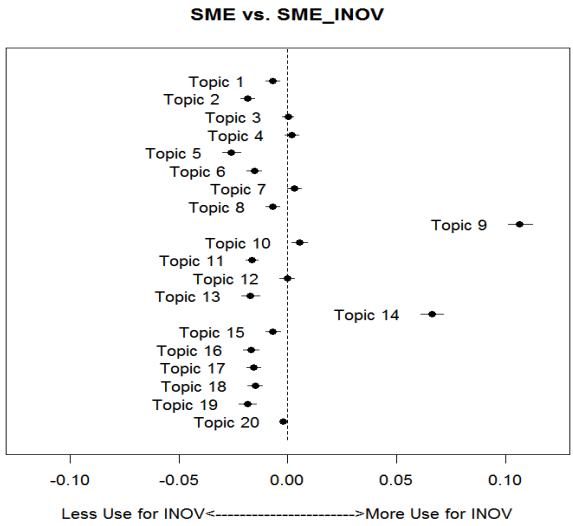

Figure 2: Topical Prevalence Contrast between interviewees reporting use of Twitter for Innovation at least once a month and Total Population

The STM analysis provides some insightful results not only in terms of the words generated for different topics but also the different topical prevalence depending on the purpose and frequency of use of Twitter. Overall, it can be concluded that the results generated using modern text mining method of STM verify the results from the interviews. The analysis successfully identifies words utilised by Twitter users in our sample, which they frequently use to discuss innovation around technological advancements in the European region. The identified topics also show how the technologically advanced fields of IoT and big data are popular among SMEs looking for innovation. Investigating other covariates like industry sector can develop this initial analysis further or the number of followers to create a lexicon

with frequently used words around innovation, crowdsourcing, ideas gathering, and social media marketing.

5 Conclusion

The aim of this research was to investigate how Twitter is used as a medium for innovation by small and medium sized firms and how Twitter is being used to support innovation within and between companies. The major theoretical finding is that the stated use of Twitter in the interviews and actually tweets of the interviewees supported the use of Twitter as a social media channel with the ability to provide companies with a powerful tool to access information and ideas from which to develop innovations and sustain competitiveness (Estellés-Arolas and González-Ladrón-de-Guevara, 2012). Innovation is central to competitive advantage, both for corporations and institutions; and previous research has shown that social media channels have a role to play in the development and support of this innovation (Chesbrough and Appleyard, 2007; Lee, Park, Yoon and Park, 2010). The results strengthen previous findings that the social media channels such as Twitter can be used as a source of information, ideas and innovation (Leek, Houghton and Canning 2017; Mount and Martinez, 2014). The research highlights the value of Twitter as a platform for the exchange of new, expert and high quality information within like-minded communities on topics such as Internet-of-Things (IoT), eHealth, software development and the technology based start-up. The high speed and un-curated exchange of information enabled by Twitter seems to be closely aligned to the organic culture surrounding technology based start-ups. The immediate nature of the Twitter feed enables collaboration in real time between companies and their suppliers, customers and also peers (Edosomwan, Kalangot Prakasan, Kouame, Watson and Seymour, 2011). The importance of peer-to-peer discussion or communications and access to experts and thought leaders for B2B companies was evident from the interview findings (Leonardi, Huysman and Steinfield, 2013). This interaction was also seen as a means of improving personal credibility in an area more closely associated with B2C interactions (Khedher, 2014; Ngai, Tao and Moon, 2015; Tarnovskaya and Biedenbach, 2018). The research illustrated how Twitter could be used to source and the exchange of high quality, relevant and current information as part of the innovation process. The research found that the conversational and egalitarian nature of Twitter enabled interviewees to use it as a channel for customer and peer conversations that supported the development of

product and service innovations. Twitter is a tool that allowed the interviewees to interact with a diverse network that may not be open to them in the offline world and should not be used as a direct marketing channel for products and services. Instead the research found that Twitter was effective for promoting events, recognition of others in the network, for building the brand of individuals and companies by informing and engaging customers and peers in their network on wider topics (Swani, Brown and Milne, 2014; Hänninen and Karjaluoto, 2017). Finally, although the companies interviewed regularly used Twitter for innovation, very few of the companies interviewed had any formal framework for the measurement of return on investment for their use of Twitter. They considered it to be "worthwhile and important to be there" but lacked clearly defined objectives for their participation or the expenditure of time and resources (Iankova, Davies, Archer-Brown, Marder and Yau, 2018). If Twitter is to be used for crowdsourcing, innovation and industry insights, it is suggested that companies create guidelines that facilitate the care and engagement of their Twitter community to ensure their on-going participation (Chesbrough, 2011). The Topic Models created as part of the research provide a lexicon for frequently used words around innovation, crowdsourcing, ideas gathering and social media marketing that could be used to source and engage in conversations around these topics.

Further research needs to be conducted into the application of text analysis methods like sentiment analysis and STM, along with social network analysis can also be implemented to generate further insights to analyse the impact of online platforms in the B2B context. The convivence sample need to be followed up with more extensive survey research.

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