Impact of Online Firm Generated Content (FGC) on Supply Chain Performance: An Empirical Analysis

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Abstract

Consumer generated contents on social media can provide insights and intelligence for firms to improve their performance. In this paper, we highlight the significance of firm generated content (FGC) on social media in supply chain context. Drawing upon social capital theory, this study uses an advanced sentiment analysis approach to examine the impact of FGC effect on supply chain performance. Information sharing and collaboration are identified as two key FGC elements affecting supply chain performance. We discuss and explain major implications of these FGC elements in this paper. Based on the insight gained from the analyses, this paper not only can help academicians understand how FGC can influence the outcome of a supply chain, but also can guide practitioners to adjust their supply chain strategies to have a sustainable competitive advantage.

1. Introduction

With today's consumers often relying on social media to conduct their information search for various decision making processes, social media has magnified the power of online communication by facilitating multi-way, real-time, convenient, trust worthy information sharing among a large number of firms, producers, consumers, and users with relative ease [1,2,3]. Not surprising, because of these obvious advantages over the traditional media, social media usage has experienced an enormous growth in recent years [4]. Viewed as a broad interdisciplinary concept, social media has found its application in a wide range of business disciplines such as marketing, supply chain management, and information systems [5]. Social media can also be used for information-sharing, relationship-building, and improving communication,

coordination and performance [5]. Firms such as Best Buy and Dell have successfully used social media to reduce costs, motivate employees, improve internal communications, and stimulate innovation [6].

Although social media offers firms an opportunity to monitor and analyze consumer conversations and derive insights from that information to improve their performance, as HBR report [4] indicated, most companies were unaware of where their most valuable customers were talking about them, did not measure effectiveness of social media, were not using social media analytic tools, and were not able to integrate social media into their marketing activities. This leaves a huge opportunity for companies to explore the untapped potential of social media in business discipline as a whole. To the best of our knowledge, there is very little social media research in the supply chain management domain [7, 8].

In this study, we explore the relationship between social media and supply chain performance by empirically testing whether social media usage by supply chain partners in terms of frequency, volume, polarity, and content has significant impact on supply chain performance. Furthermore, most of the studies on social media are cross sectional and based on self-reported data which limits the objectivity of this stream of research [e.g. 9] Taken together, in this study, we try to analyze the effect of firm generated contents (FGC) in social media on SCM using an advanced sentiment analysis approach to explore our research question.

Although previous studies have analyzed various supply chain functions through social capital theoretical perspective, ours is one of the first attempts exploring the impact of social media on supply chain performance through a social capital angle. Additionally, as our findings suggest, by making social networking an integral of the company's interactions with employees and suppliers, managers can better manage the performance of the supply chain members

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and the supply chain performance as a whole. Supply chain managers should consider the advantages of using social media networking to identify and track the relevant information to come up with appropriate solutions to improve the supply chain performance and to mitigate critical supply chain risks.

2. Literature review

2.1. Social media

Social media, in a broad sense, refers to a conversational, distributed mode of content creation, diffusion, and communication among groups. It encompasses a wide range of online, word-of-mouth forums such as blogs, chat rooms, product or service ratings websites, forums, and social networking websites.

By offering a whole new set of possibilities for and challenges before the organizations, social media have revolutionized almost all aspects of an organization's functions [10]. For instance, besides offering market intelligence on consumer behavior and preferences [11], social media has played an important role in demand prediction [e.g. 12, 13], forecasting stock market performance [2, 14], and crowd sourcing ideas for product and service innovation [15]. As Benbya and Van Alstyne[16], and Zwass [17] report, social media is capable of transforming the way of exchange of knowledge and expertise facilitating faster innovation and new product development. Social media has been found to be positively associated with sales processes and relationship sales performance [18], firm profits [19], and customer profitability [20]. Furthermore, social media is changing the way relationships are developed and maintained with geographically disperse talent [21].

In essence, all these studies demonstrate the potential uses and applications of social media and its powerful influence on individual and societal performance highlighting the importance of study of the interaction between social media and business performance an existing business process or phenomenon. This opens up a huge opportunity of social media application in supply chain which has not reaped much of its potential benefits.

2.2. Supply chain and social media

Supply chain management refers to all types of planning and management of activities such as; sourcing, procurement, and logistics across the chain [22]. In a supply chain, managing social relations among the members can be crucial for sharing knowledge and creating value leading to a competitive advantage. Moreover, with opportunities for improvement in supply chain performance via break through technical improvements on a decline, the focus on enhancing supply chain performance by improving relationships among supply chain partners is on the rise [23]. Therefore, exploring the relationship between the social media and various functions of supply chain is a potential area of research [10, 16].

Noting that social media applications in supply chains lags behind other operational functions, Markova and Petkovska-Mirčevska [24] describe supply chain research with reference to some concepts of social media such as social profiles, social applications, brand outposts and communities, and the social ecosystem. Five key benefits of social media usage in supply chain are mentioned in the literature [7]: creating knowledge networks, balancing speed and contemplation, portable information vaults, replacing collaboration with community, and building a platform for innovation.

Social media has been largely used by business to customer (B2C) for brand promotion and marketing products [24] and business to business (B2B) context [18] for improving sales performance. Literature available related to social media usage in supply chain is not exhaustive. O'Leary [8] investigated the impact of social media capabilities on the supply chain and tried to analyze the use of social media in the supply chain to build relationships among supply-chain participants. Our study is different from previous literature because of our supply chain performance focus.

Social factors such as relationships that the supply chain partners develop overtime through their formal and informal interactions are important in supply chain context and these factors can significantly impact its performance [23, 25]. Although the extant literature presents some sporadic evidence of successful application of social media in supply chain context, there is a lack of in-depth analysis of social media impact on supply chain outcomes. This study endeavors to investigate whether social media usage of various supply chain partners has an impact on supply chain performance.

3. Theoretical Background and Hypotheses

Social capital is the collective useful actual or potential relational resources embedded in personal ties of individuals in social organizations [26, 27]. Supply chain is an organization in itself as it has almost all the features of an organization such as an overall vision and shared mission. The concept of social capital can very well be applied to supply chain and social capital of supply chain members or partners can be described

as the network each member in the chain has and the potential and strength of that link or tie. Potential resource in this case can be seen as the knowledge exchanged or gained through interaction with specific members or partners.

Social capital of supply chain partners can influence supply chain performance and also can be a sustainable source of competitive advantage [28]. Social capital in the supply chain plays a key role in developing and managing buyer-supplier relationships [29] and can be a main source of value creation in a supply chain [30]. Krause et al. [31] present evidence of how three forms of social capital: structural, relational, and cognitive in a supply chain can bring about a partner's performance improvements. Wei and Ju [32] report on how a partner's social capital can enhance knowledge creation in supply chains. Yim and Leem [33] demonstrate a case where supply chain social capital affecting supply chain integration significantly influences firm performance. Social capital can be an important component of the successful performance of a service supply chain as a source of both physical and informational resources [34]. These reports indicate importance of social capital on various aspects of supply chain performance. Because the social media helps a member create a profile within a network, articulate a list of other users for sharing a connection, and maintain that link or tie [35], we can argue that social capital of a supply chain member can be increased by use of social media through strengthening of existing relationships [36], improving weak ties [37], as well as enabling collective action [38]. At the same time, better collaboration and communication resulting from the member ties or social capital of the member can improve the supply chain performance.

Recently, there has been a growing interest in understanding how WOM, particularly online WOM or eWOM (which is a form of social media), impacts sales, diffusion, and other business performance measures. For example, Chevalier and Mayzlin [39] show that user-generated online book reviews influence book sales, Godes and Mayzlin [40] examine how online discussion forum activity affects television show ratings, and Trusov et al. [41] examine how referrals (invitations) to join an online social network affect website membership growth. Villannueva et al. [42] report on WOM customer acquisition on customer equity growth. Consistent with the findings on how WOM impacts performance, the WOM literature generally finds social media can affect a product's success in the marketplace. There are also reports of social media usage leading to greater product innovation and enhanced firm performance. Di Gangi and Wasko [15] and Gallaugher and Ransbotham [43]

present evidence of successful use of social media by firms such as Dell and Starbucks for developing online communities to solicit and evaluate ideas from customers for product development. Luo et al. [2] argue that social media may be used to monitor and estimate customer feedback and brand buzz leading to improved firm performance. Rodriguez et al. [18] report a positive relationship between social media usage and sales processes and performance. As such, we posit hypothesis 1:

H1: *The more social media is used by supply chain members, the better the supply chain performance is.*

In this study, we examine two aspects of the usage of social media (e.g. frequency and volume) by the supply chain members. WOM is a social phenomenon and degree of strength of social relations can influence WOM behavior [44]. The members who have frequent interactions in a network are found to have strong ties or relations with each other as they are more likely available to each other for information and resource sharing [45]. Also people tend to interact with other people who are similar to themselves [46] and frequent interactions lead to stronger ties among the individuals [47]. The greater frequency of social contact among members can result in more and better information flow among the members [44]. Peng and Luo [48] report interpersonal ties of managers and top executives of firms improving firm performance. We expect a similar phenomenon in supply chain context in that stronger ties resulting from frequent interactions among supply chain members will lead to better supply chain performance. This is the basis of hypothesis H1a:

H1a: *The higher is the frequency of social media usage by supply chain members, the better the supply chain performance is.*

The volume of social media usage (eWOM) can be considered to be an indicator of the intensity of the eWOM effect. The product and firm performance have been reported to be positively correlated with the volume of usage of social media. Duan et al. [49] found the weekly movie box office sales to be significantly influenced by the volume of online posting, Ample amount of support for a positive relationship between the volume of eWOM and sales performance of firms can be found elsewhere [e.g. 40,50,51]. Therefore, we hypothesize,

H1b: *The higher is the volume of social media usage by supply chain members, the better the supply chain performance is.*

Sharing of information among the supply chain partners on key supply chain processes including point of sales (POS) and adaptation of collaborative practices such as vendor managed inventory (VMI), and collaborative planning, forecasting and replenishment (CPFR), help in improving supply chain performance [52, 53]. Information sharing among chain partners can provide mutual competitive advantages both in terms of creating customer values and reducing supply chain costs. As Inderfurth et al. [54] note, information sharing can reduce the supply chain inefficiencies due to information asymmetry and can control non-cooperative behavior of supply chain members. Also information sharing is one of the essential factors for enhancing channel-wide collaboration across the supply chain [55]. Social media provides opportunity for real-time, convenient, quality information sharing among a wide range of supply chain partners because of its reach, ease of use, fast paced transmission of information [2] and we expect supply chain performance to improve if the supply chain partners share more information regarding supply chain management issues on social media. Therefore we hypothesize,

H2a: The *more the supply chain partners discuss information sharing positively in social media, the higher the supply chain performance is.*

Collaboration in the supply chain context refers to the sharing of supply chain information related to product design, product development, production processes, logistics and distribution strategies, and all forms of planning [56, 57]. Collaboration encompasses factors such as coordination, communication, relationship management, trust and structure [58]. Successful collaboration among supply chain partners can result in improved supply chain performance such as: efficiency, effectiveness, profitability and a stronger and long-lasting relationship among the partners [59]. Collaboration through delicate, complex social relations depends on a medium in which these relations work [60]. Socially related factors contributing to collaboration include: formal and informal communications, trust, motivation, and social ties [61]. Social media usage can influence successful online collaboration through social relations among supply chain partners. We expect that greater collaboration among supply chain partners on social media will lead to better supply chain performance. This leads to the following hypothesis.

H2b: The *more the supply chain partners discuss collaboration positively in social media, the higher the supply chain performance is.*

Trust and commitment are the two fundamental components of improving the relationship that leads to cooperation among partners [62]. Trust is often developed on individual contact, recurrent exchanges of information, and socialization among groups and individuals [63]. Social media, social networking sites in particular, can strengthen weakening ties and promote collective action based on common interest, activities, and goals [37, 36]. Social capital of the user increases by increased participation in online and offline socialization [64]. Social media can help build social capital of a user through building of trusting relationships in the network. In the supply chain context, trust has been expressed as the degree to which supply chain partners have the intention and capacity to work for the improvement of overall supply chain performance [62]. Also trust is the degree of buyer's confidence and reliance in supplier's expertise that is required to perform an activity effectively [65]. Online relationships and communications are positively associated with an individual's social trust [66]. Social media usage has been found to be strongly associated with maintaining or strengthening existing offline relationships of communities [35]. Therefore, we assume that more the supply chain partners talk about trust on social media, more likely they will develop greater mutual trust among themselves which will lead to better supply chain performance. This is stated in the following hypothesis.

H2c: The m*ore the supply chain partners discuss trust positively in social media, the higher the supply chain performance is.*

Supply chain integration has been found to be associated with improved supply chain performance [67, 68]. A strong relationship among partners, in the form of mutual trust and collaboration may ensure integration of various supply chain functions such as design, purchasing, production, distribution [69] and as Wu et al. [70] find, commitment of supply chain partners can enhance the integration of supply chain management processes. Allen and Meyer [71] describe commitment from three aspects: affective commitment; normative commitment; and continuance commitment. In order to have mutual sharing goals and values, supply chain partners must have normative commitment that can increase coordination and integration [72]. Identifying with others, gaining a sense of belongingness and insight into the circumstances of others are some of the major reasons for using the social networking sites. Social media, specifically several social networking sites can help create personal identity by providing multiple channels for relational feedback and peer acceptance [38]. In

this way social media can facilitate development of affective and normative commitment of users and can promote trust and improve supply chain performance. We argue that if supply chain partners talk more about commitment of partners to common supply chain goals and objectives on social media then it can improve supply chain performance. This is the basis for our next hypothesis.

H2d: The *more the supply chain partners discuss commitment positively in social media, the higher the supply chain performance is.*

4. Methodology

4.1. Data Gathering

We randomly sampled 1040 publicly traded firms (for supply chain performance data availability) for this study from six industries (i.e. pharmaceutical, retailing, software, financial, healthcare, and hospitality industries) and used the stratified sampling method as subpopulations (i.e. industries) within an overall population vary in our case. These six industries are chosen because social media is expected to have a huge impact on them. We then gather information about these sample firms from social media on the daily basis for consecutive 9 months (July 1, 2011 – March 31, 2012). The social media source includes forums, blogs, and Twitter messages. Almost all the sampled firms in our study have presence on all three considered social media sites. In our analyses, we included all the firms that have presence on at least two social media sites. We used the Bloomberg Supply Chain Database for identifying the supply chain members of the sampled firms. Bloomberg tracks over 28,000 public companies and using the database we are able to create "supply chain maps" that show major customers, and major suppliers.

We separate social media into three different categories including blog, forum, and micro blog due to the distinctive nature of each of them. For instance, forums are more interactive than both blogs and Twitter, and Twitter messages are also limited in length and content. For blog, we chose *Google Blog Search*, which provides fresh, relevant search results from millions of feed-enabled blogs. In other words, users can search for blogs or blog posts, and can narrow their searches by dates and more. For forum, we use a forum search engine (a.k.a. *Boardreader*), which is developed to address the shortcomings of current search engine technology to accurately find and display information contained on web's forums and message boards. Finally, Twitter, the most well-known

micro blogs, is selected as the third social media type. Data from few other social media sites were not considered because of their secured nature.

Four different web crawler algorithms were created to download relevant conventional media, blog, forum, and tweeter automatically due to the varying nature of the four data sources (e.g., different webpage layout, different formatting markup and different hidden advertisements, which are the main challenges for automatic text extraction.) A customized HTML parser based on Python was designed and imported as a "noise" filter to remove the noise information such as sidebars, headers, and footers and recognize useful text paragraphs from large chunks of HTML code. The filter uses information about the density of text vs. HTML code to work out if a line of text is worth of outputting. Different from the common html parser, the advantage of this filter is that it can be applied to an arbitrary html code but we do not have to know exactly the page layout or the noise tags used. For each blog, forum and conventional media, we obtained the title, date, author, source domain, and main content of article. For each tweeter content, we obtained Twitter identifier, the date-time of the submission (GMT+0), submission type, and the text content of the tweet which is limited to 140 characters by design. In order to avoid spam messages and other advertising tweets, we filtered tweets that included URLs.

4.1.1. Sentiment Analysis. For the past few years, sentiment analysis has greatly assisted decision makers in extracting opinions from unstructured human-authored documents [73]. Sentiment analysis and opinion mining tools allow firms to understand product sentiments, brand perception, new product perception, and reputation management [74]. This type of technology reduces the need to have people read dozens or even hundreds of documents to extract business opinions on a variety of topics and for different purposes. As such it is a viable tool in analyzing the big data including social media. Major steps of sentiment analysis include: finding relevant contents, finding the overall sentiment, quantifying the sentiment, and aggregating all sentiments to form an overview [74]. To gain a better understanding of social media impact on supply chain management, we employ the sentiment analysis approach to extract opinions of supply chain partners on supply chain management content expressed in the social media. This approach provides a measure of supply chain management that can then be used to examine supply chain management practice and its relationship to SCM performance.

There are three key processes involved in our approach: pretreatment, SCM dimension classification,

and sentiment polarity classification. In the pretreatment process, we clean up the raw FGC and then store them as the refined corpus in a computable format. In this research, first, we clean the raw content by deleting blank records and duplicated ones. Next, sentences are recognized from pieces of reviews and all the words in each sentence are normalized before storing. In the second process, we decide if the sentences refined by first step fall into one of specific SCM category/dimension. During this process, both domain knowledge and machine learning algorithm set will provide effective support for natural language processing directed at the interpretation. Furthermore, we create the sentiment classifier in the third process and assign sentiment polarity for each unit of analysis, in this case each sentence. In this process, the associated sentiment training corpus will also be integrated into the support set.

Using text classification algorithm, we mine FGC toward SCM dimensions (e.g., information sharing, collaboration, trust, and commitment). Finally, a SCM opinion matrix is derived to show firms' sentiment on each dimension (a score from -1 to 1), where a score of 1 means the consumer has the most positive view of that respective dimension, and -1 denotes the most negative sentiment. The overall sentiment score of dimension i is calculated by the following formula:

$$S_i = \frac{N_{pi} - N_{ni}}{N_{pi} + N_{ni}} \tag{1}$$

where N_{pi} denotes the number of positive sentences in dimension i and N_{ni} denotes the number of negative sentences in dimension i. Some of previous study use ternary classification to represent sentiment polarity, positive and negative [75].

The sentiment analysis in this study is conducted using the Naïve Bayes (NB) process [76, 77, 78]. In the first pretreatment process, after raw material cleanup and sentence tokenization, we stored 544,072 sentences covering 83,657 pieces of FGC (see Table 1). We then train the classification system with external knowledge. The external knowledge, in our context, includes the four key words list to represent the four dimensions of SCM. These keywords are selected manually by reading 1,000 comments which were randomly chosen from 83,657 firm comments. We choose the words to represent each dimension based on previous research and experts' domain knowledge. We used two experienced coders (one from SCM industry and one is senior SCM researcher) come up with codes (bag of words). In addition, we

import Cornell movie-review dataset[1] for sentiment signals in the third process. Moreover, we compute the accuracy of classifier on the test set and use the F-measure to evaluate the performance based on precision and recall [75].

$$F - measure = \frac{2*Precision*Recall}{Precision + Recall} \tag{2}$$

$$Precision = \frac{TP}{TP+FP} \tag{3}$$

$$Recall = \frac{TP}{TP+FN} \tag{4}$$

where TP is the number of true positive, FP is the number of false positives, and FN is the number of false negatives. In this study, the proposed four dimension classification algorithm retrieves a 0.70 F-measure and positive-negative sentiment classification algorithm retrieves a 0.91 F-measure on the test set. On average, F-measure of quaternary (four dimension classification case) and binary (positive-negative sentiment classification case) is around 0.60 and 0.80 respectively [73]. Therefore, our classification is fairly accurate. Table 1 shows the sentiment analysis results.

Table 1. Sentiment analysis results

Dimensions	No. of positive	No. of negative	No. of Sentences	%
Information sharing	153,457	33,732	187,189	34%
Collaboration	128,456	53,516	181,972	33%
Trust	70,819	35,627	106,446	20%
Commitment	51,671	16,794	68,465	13%
Total			544,072	100%

4.2. Variable Measures

Traditionally, firms estimated word of mouth (WOM) through surveys to measure the customer satisfaction, loyalty, probability of purchase, and recommendation. Through the sentiment analysis approach, we tried to measure directly online the social media metrics such as activity (frequency of interaction), tone (sentiment), participation (comments, feedbacks, opinions), and qualitative attributes

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[1]Cornell University is a pioneer in sentiment analysis, and has maintained a vocabulary of sentiment words (e.g., dislike, enjoy) even though it is originally derived from movie reviews. It is now regarded as the de facto sentiment vocabulary list for sentiment analysis.

(meaning of the contents of participation). *Frequency* is measured by how often social media are used among the supply chain partners. *Volume* is measured by the total number of reviews, comments, or postings by the supply chain partners. A higher volume is indicative of a greater member opinion or reaction to products, supply chain issues of the firms in the chain. *Content*s were measured in terms of word and phrases that contained information sharing, collaboration, trust, and commitment. Supply chain performance (SCP) is the dependent variable in our model. Although many measures of supply chain performance have been suggested in the literature, for this study, we considered inventory turnover as the indicator of supply chain performance in our model as it is the most widely used performance measure in supply chain management research [79]. Inventory turnover indicates how many times a company's inventory is sold and replaced over a particular period. It is calculated as the ratio of cost of goods sold (COGS) and average inventory. Inventory turnover data for our sampled companies were derived from the Wharton Research Data Services (WRDS) data base. We control for a set of exogenous variables such as firm size and industry type. Firm size is measured by the total number of employees in an individual supply chain partner. The industry type was controlled by the SIC code. Table 2 lists out the variable descriptions and measures.

Table 2. Variable Descriptions

Variables	Description and Measure
SCP	Supply Chain Performance
$InfoSenti_i$	Sentiment score of *Perceived Information Sharing* for SCM partners of firm *i*.
$CollSenti_i$	Sentiment score of *Perceived Collaboration* for SCM partners of firm *i*.
$TrusSenti_i$	Sentiment score of *Trust* for SCM partners of firm *i*.
$CommSenti_i$	Sentiment score of *Commitment* for SCM partners of firm *i*.
$Volume_i$	Volume of FGC generated by SCM partners of firm *i*.
$Frequency_i$	Frequency of FGC generated by SCM partners of firm *i*.
$EmpNum_i$	Firm Size (# of Employees)
$IndNum_i$	Industry (SIC code)

5. Results

Multiple linear regression analysis was used to develop a set of two models for predicting supply chain performance. Model 1 applied four SCM dimensions information sharing, collaboration, trust, and commitment derived (mined) from FGC as well as volume and frequency of FGC generated by SCM partners to predict SCM performance, while only SCM dimensions were used as predictors of SCM performance in Model 2.

$$SCP_1 = \beta_0 + \beta_1 InfoSenti_i + \beta_2 CollSenti_i + \beta_3 TrusSenti_i + \beta_4 CommSenti_i + \beta_5 Volume_i + \beta_6 Frequency_i + \varepsilon_i \qquad (1)$$

$$SCP_2 = \beta_0 + \beta_1 InfoSenti_i + \beta_2 CollSenti_i + \beta_3 TrusSenti_i + \beta_4 CommSenti_i + \varepsilon_i \qquad (2)$$

Results of Model 1 are shown in Table 3 while results of Model 2 are presented in Table 4. The adjusted R Square value tells us that this model accounts for 62.9% of variance in supply chain management, thus showing very good predictability. In addition, Table 3 also reports an F value of 39.096, which assesses the overall significance of the model. Since $p < 0.05$, our model is thus significant.

The Standardized Beta Coefficients give a measure of the contribution of each variable to the model. A large value indicates that a unit change in this predictor variable has a large effect on the criterion variable. The t- and Sig (p) values give a rough indication of the impact of each predictor variable – a big absolute t value and small p value suggests that a predictor variable is having a large impact on the criterion variable. Table.3 indicates that two of the SCM dimensions (information sharing with $\beta = 0.538$; $t = 7.027$ and collaboration with $\beta = 0.241$; $t = 3.953$ are significant as such H2a and H2b are supported. However H1, H1a, H1b, H2c, and H2d were not supported. By the same token, Model 2 also supports H2a and H2b. The robustness of our models is tested by checking for possible multicollinearity. The variance inflation factor (VIF) for all independent variables are shown in Table 3 and 4 are below 5 indicating no significant muticollinearity problem to affect the regression estimation. Also, low standard errors of the coefficients of the independent variables indicate that our results are least likely to be affected by multicollinearity.

Table 3. Results (Model 1)

Model variables	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant	-.140	.432		-.325	.746		
Info	.606	.086	.538	7.027	.000	.470	2.130
Coll	.205	.052	.241	3.953	.000	.738	1.355
Trust	.081	.071	.080	1.131	.260	.547	1.828
Comm	.114	.076	.122	1.510	.133	.422	2.370
Volume	.054	.076	.049	.718	.474	.595	1.682
Freq	-.056	.076	-.057	-.740	.461	.470	2.130

a. Dependent Variable: SCP
b. Adjusted R^2 = .629
c. F value = 39.096; p = .000

Table 4. Results (Model 2)

Model variables	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	-.094	.409		-.230	.819		
Info	.604	.080	.536	7.544	.000	.540	1.852
Coll	.200	.051	.235	3.903	.000	.752	1.330
Comm	.101	.073	.108	1.381	.170	.442	2.261
Trust	.087	.070	.086	1.239	.217	.566	1.768

a. Dependent Variable: SCP
b. Adjusted R^2 = .632
c. F value = 59.038; p = .000

6. Discussion

We detected the existence of the FGC effects in supply chain domain. Specifically we identified the impact of FGC in terms of four supply chain dimensions including information sharing, collaboration, trust, and commitment. Among these dimensions, information sharing was found to have the most significant impact on supply chain performance. These findings are consistent with earlier reports [e.g. 52,53,54]. Social media offers tremendous opportunity for firms and consumers to share valuable contents and sharing of information relevant to supply chain such as information related to demand, point of sales, quality and flexibility of product and service, and supply chain channels. Sharing of information on firm level in a supply chain can enable firms develop their social capital to have a sustainable competitive advantage [28]. Gathering information on how firms converse regarding particular products and develop a collective opinion using their social capital can be particularly helpful in the new product development process in a supply chain. FGC on social media can have a huge impact on a firm's supply chain reputation. Sharing mutual goals and objectives among supply chain members through engagement with its stakeholders at every level of interaction on social media can help build and maintain the firm's supply chain reputation. The area of forecasting and inventory management in supply chain can benefit from FGC on popular social media such as Facebook and Twitter. By tracking and

translating buzz in FGC such as demand variation of a product the detrimental bullwhip effect in supply chain can be reduced.

Collaboration is another key driver to supply chain success. We found significant impact of FGC on collaboration on supply chain performance. For an effective collaboration, a firm should consider the buzz, opinions, voices, and experiences of all the stakeholders about the supply chain. An effective collaboration can help reduce the Bullwhip effect which is primarily attributed to uncertainty in demand and inaccurate customer demand forecast. FGC can be a good source for early indicators of actual customer demand. Supply chain managers can make an accurate demand forecast by analyzing FGC in terms of numbers and sentiment of mentions for a particular product or type of products and their response to the current demand forecasts. This kind of supply chain intelligence derived from FGC can improve collaboration in the network leading to greater dynamic response to changes in demand and supply chain profitability. In addition, because the FGC on social media can provide more social and interactive user experiences with real time tracking and resolution of issues among supply chain partners, this could certainly lead to faster consensus among them and a better collaboration.

We did not gather support for our hypothesis that higher amount of discussion of trust in the FGC on social media leads to improved supply chain performance. Although trust may not have a significant direct impact on supply chain performance, trust within the supply chain network is extremely essential as sharing of resources leads to greater common resource and in the absence of trust among the partners resource sharing can be significantly reduced. This is in fact the basic premise of social capital theory that states the greater the trust and reciprocity among members are, the greater the common resource or social capital of an individual member will be [80]. Trust can help create a stronger network through coordinated actions [81] and a higher level of trust among the supply chain members can lead to greater information sharing and collaboration that have substantial impact on supply chain performance.

Putnam [81] claims that social capital is created through an individual's active participation in a network and it can be argued that more is the interaction and trust among the supply chain partners, greater is the commitment of an individual member to share the resources. Because the social capital is a cooperative resource and it increases with its use, hence commitment of a member to the supply chain can enhance social capital of the entire supply chain network. Commitment was not found to have a

significant impact on supply chain performance in our models. However, commitment can indirectly influence the performance of the supply chain. Supply chain performance is closely linked to sharing of resources among its members. Lack of commitment among members towards the supply chain sometimes could lead to non-sharing of relevant information or resource. FGC on social media can enhance commitment of the supply chain members by its potential reach, ease of use, and convenience.

Within the context of social capital theory, the social properties relevant to FGC on social media include reach, engagement, and influence [82]. Reach refers to the degree of effective dissemination of certain FGC or potential spread that FGC in the network. Engagement corresponds to the extent of participation and involvement of firms in the network such as volume and frequency of FGC. Influence refers to the degree of mobilization that a firm can generate in other members in the supply chain network. In order to assess the social capital of a firm generated through FGC on social media, it is essential to measure and analyze attributes such as sentiment, velocity, perception, comments and trackbacks of other firms and also of competitors on social media. Our data do not gather support for any significant impact of volume and frequency of FGC on supply chain performance. This is agreement with earlier observations by researchers [50,83,84] that measuring WOM in terms of its frequency, volume, and reach fails to address WOM's power and scope and more often than not this method produces mixed results [85]. Furthermore, researchers [e.g. 86,87,88] insist that it is extremely important to examine the social dimensions, words, phrases, language, and expressiveness of the WOM. Investigation of the WOM or FGC on social media can enhance the effectiveness of simple volume measures of these contents [85].

We used the advanced sentiment analysis tools to identify subjective information such as opinions and views of firms from massive amount of social media data. This information combined with other data streams can provide firms with an in-depth understanding of the market trend and more real-time business intelligence that can be used in operations, planning, production, and control processes across a supply chain. Setting up a specific supply chain Facebook page or establishing a supply chain group on LinkedIn can improve the collaboration among various members of the supply chain. Also FGC on Social media can be used as multimedia areas where supply chain members can post useful links and materials to share for developing their internal supply chain network.

7. Contributions, Limitations, and Future Research

The current study provides several potential contributions. First, we extend the supply chain research in several ways. Although the social capital theory has found its applications in supply chain management research, little application is found in FGC domain. To the best of our knowledge, the current study is the first attempt to investigate the effect of FGC in social media on supply chain performance using social capital theory. Second, most research has studied consumer generated content in social media or WOM as a function of brand experiences, and factors such loyalty, quality, satisfaction, commitment, trust, involvement, and perceived values have been reported to be some of the key drivers of WOM [89]. We extend the social media research, FGC or WOM research from firms' perspective, in supply chain context. Researchers have urged to consider not only the volume and valence of WOM, but also to analyze specific content details by systematically and effectively examining by contemporary methods [85]. Our study is in line with those recommendations. The effects of social media have been studied in areas of business such as marketing, finance, and new product development, but not yet extensively in supply chain domain. Ours study is a first study in this direction that we attempted to analyze the impacts of some of the above mentioned key drivers of WOM on the outcome of a supply chain.

Our findings have few practical implications. Managers should realize that social media usage is a form of social interaction and they should consider the advantages of using social media networking to identify and track the relevant information from the FGC to develop appropriate supply chain strategies. For example, managers can derive intelligence from the FGC to mitigate several issues such as supplier risk. Although exploratory in nature, this study reports a significant relationship between several key dimensions of supply chain such as information sharing and collaboration and supply chain performance. This relationship can be used to develop a predictive model for supply chain performance. Additionally, by making social networking an integral part of the company's interactions with employees and suppliers, managers can better manage the performance of the suppliers. Outsourcing is a common trend in today's business. Use of FGC in social media can help the managers observe and determine changes in the global market trend to choose appropriate strategy for their firms. FGC in Social media can also be used by sourcing professionals for branding themselves as industry leaders.

This study has several limitations and suggests a few opportunities for future research. First, our research question was very broad and kind of exploratory in nature. It was primarily because we thought in the absence of a strong literature on social media and supply chain management, it would be appropriate to conduct this type of study as the first step. Future research can concentrate in depth on impact of social media on specific issues in supply chain management. Second, we attempted to explore the relationship between social media usage and supply chain performance. The relationship cannot be concluded as a phenomenon of causality as there may be other confounding factors affecting the relationship. It was difficult to isolate the effect of those confounding factors in the context of our study. An experimental study on our concept may improve the internal validity of the findings. In addition, we considered only a few key SCM factors that affect SCM performance in our model. Further studies might include other drivers of supply chain performance while studying the FGC. Also it will be interesting to explore the mediating or moderating effects between the variables in the model. In terms of external validity of this study, we sampled firms from a population of publicly traded companies as data for our analysis were publicly available. Future studies with sample from a wide range of firms would increase the generalizability of the findings.

8. Conclusions

Social media has become an important part of modern society including the business world. We believe that supply chain management as a field can benefit from a thorough understanding of FGC on social media and deriving a meaningful relationship between the FGC and supply chain performance. This study explores relationships between FGC from supply chain members on several SCM dimensions and supply chain performance. The findings suggest that information sharing and collaboration are two of the major FGC significantly impacting supply chain performance. Although trust and commitment of supply chain members are not significant in our developed model, they should not be ignored by supply chain managers. The insights derived from this study can not only help academicians understand how FGC can influence the outcome of a supply chain, but also guide practitioners to adjust their supply chain strategies to achieve a sustainable competitive advantage.

9. References

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