The Use of Social Media in the Supply Chain: Survey and Extensions

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Abstract
This paper investigates capabilities of social media, such as Facebook, Twitter, Delicious, Digg and others, for their current and potential impact on the supply chain. In particular, this paper examines the use of social media to capture the impact on supply chain events and develop a context for those events. This paper also analyzes the use of social media in the supply chain to build relationships among supply chain participants. Further, this paper investigates the use of user supplied tags as a basis of evaluating and extending an ontology for supply chains. In addition, using knowledge discovery from social media, a number of concepts related to the supply chain are examined, including supply chain reputation and influence within the supply chain. Prediction markets are analyzed for their potential use in supply chains. Finally, this paper investigates the integration of traditional knowledge management along with knowledge generated from social media.

Key Words
Supply chain, Social media, Knowledge management, Knowledge discovery, Prediction markets

Acknowledgement
I would like to acknowledge the comments of the two anonymous referees on an earlier version of this paper.
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1. Introduction

Recently, the supply chain industry was criticized for lagging behind other industries in their use of social media (Today's Trucking, 2010). Although some firms are using social media, most of those firms, e.g., Dell and Best Buy, apparently are focusing their primary efforts on the marketing and service uses of social media. Further, according to one survey (eConsultancy 2010), roughly two-thirds of the companies have “… not done that much” with social media. In that same survey, eleven objectives were cited for what the firms expected to derive from social media, and none of those objectives related directly to supply chain efforts. In addition, an analysis of the academic literature related to the relationship between supply chain and social media finds few contributions. Finally, Gartner’s well-known hype cycle for different social media recently suggested that roughly 75% of social media applications were early in the so-called hype cycle of emerging technologies. Thus, it appears that the use of social media in the supply chain is early in the technology life cycle and the use of social media in the supply chain is still an emerging phenomenon.

The Need for Social Media in the Supply Chain

Although supply chains have been criticized for not using social media and social media is still early in its technology life cycle, why would we expect to have social media be helpful to the supply chain? A key reason comes from economic theory. As noted by Hayek (1945) “… knowledge (is) not given to anyone in its totality.” Instead “… the knowledge of the circumstances of which we must make use never exists in concentrated or integrated form, but solely as the dispersed bit of incomplete and frequently contradictory knowledge which all the separate individuals possess.”

Supply chains can be quite large, including a number of vendors, distribution centers, etc. As a result, consistent with Hayek, information and knowledge are distributed throughout the supply chain and no one source has all knowledge about the supply chain and its shipments at any one point in time. As a result, there is an opportunity to gather and use that information distributed among supply chain participants. One such tool is to gather information using social media.

If social media is embedded in the supply chain, the supply chain can gather information from a broad base of different sources, whether it is experts or just supply chain participants. As a result, information is gathered as part of the so-called “wisdom of the crowd” (Surowiecki 2004), in a manner consistent with Hayek’s (1945) concern for information being spread rather than being concentrated. Participants can generate information using social media, and by allowing access to the information that information can be gathered and used across the supply chain. As a result, information is not held and kept in secret. In so doing, social media can work to eliminate or mitigate asymmetries of information.

What Can Social Media Do For Supply Chains?

As we analyze the use of social media in supply chains in this paper we will see multiple uses and effects of the generation and communication of additional information. First, social media
information can be integrated into supply chain transaction processing systems. For example, we will examine the integration of social media with other technologies, e.g., RFID and in order to capture a rich view of supply chain events. Social media provides another context to communicate and share that information. Second, social media will be examined as a way of building “relationships” between those in the supply chain. Supply chain firms might pursue strategies not unlike marketing organizations to get employees and partners to use social media to build and maintain relationships. Historically, communications in the supply chain have been “pointed” in one direction or another (unidirectional), e.g., “customer relationship management” is aimed at customers. However, social media ends up involving more than one direction in communication and involves a broader based of participants, ultimately making communications multidirectional. Third, information and knowledge gathered from the use of social media by supply chain participants can provide insight into issues such as evolving supply chain ontologies or gathering and shaping information or knowledge about participants, e.g., reputations. Fourth, social media, such as prediction markets can help generate information and insights from participants that are not normally accessible. For example, a prediction market that investigates supply chain events could begin to assess supply chain risk from the perspective of others in the supply chain, not just a specific company. In so doing, using social media gathers information from the crowd and mitigates the existence of potential asymmetries of information. Finally, social media appears to impact the velocity with which information is generated and processed. That velocity can be accelerated by embedding knowledge generated from social media into existing and overarching knowledge management systems.

Purpose and Contributions of this Paper

Accordingly, the purpose of this paper is to investigate current and potential uses of social media in supply chain systems. In so doing, this paper will examine how the capabilities of social media tools such as Facebook, Twitter, Delicious, Digg and others, or their emerging corporate versions can facilitate the supply chain. In addition, we also will integrate into some of the discussion, the impact of technology such as blogs, tags and wikis, and their emerging role in supply chains. Further, this paper is also concerned with how information generated in such settings could be investigated using approaches such as knowledge discovery to generate additional supply chain insights and uses.

Recently, there have been efforts to use social media for business applications. Perhaps the most frequently used purpose is advertising, but there have been other uses, including customer service, sales support, communications and others. However, the scope of this paper largely is limited to supply chain related applications. Finally, the purpose of this paper is not to try and provide a final evaluation of social media, but to see what is being done and what might be done using these emerging technologies.

This Paper

This paper proceeds in the following manner. Section 1 has provided a summary of the paper and a statement of the purpose of this paper. Section 2 provides a brief summary of social media, some business uses of social media and a case study to illustrate some of the more frequently discussed applications. Section 3 analyzes some supply chain applications that have been reported using social media, such as Twitter, Facebook and Delicious. Section 4 examines how social media might be used to capture and respond to supply chain events. Section 5 focuses on potential emerging applications using capabilities designed to facilitate development.
of relationships in the supply chain. Section 6 investigates user generated tags to evaluate and extend an existing supply chain ontology. Section 7 analyzes some uses of knowledge discovery using social media output as input data. Section 8 pursues the use of prediction markets in supply chain applications. Section 9 investigates the integration of social media and traditional knowledge management as a way of supporting supply chain processes and operations. Section 10 investigates some potential extensions to the research in this paper and some corresponding research questions. Section 11 examines some emerging potential limitations of using social media in a supply chain environment. Section 12 briefly summarizes the paper and its contributions.

2. Background: Social Media and Supply Chains

The term “social media” has been used in a number of contexts referring to a number of different technologies and what those technologies can accomplish. Social media typically refers to internet-based applications that allow for the development of user generated information and provide a forum for users to interact with each other. Social media also typically refers to technology-based media that allow development of extended sets of users to communicate with each other, beyond direct one-to-one relationships. Accordingly, in some cases, social media can refer to technologies that facilitate social interaction and development of virtual “relationships.” Typically, social media is cloud-based and often referred to as Web 2.0 (O’Reilly 2005) or Enterprise 2.0 (e.g., McAfee 2006). Social media have increasing allowed individuals to begin to use the Internet for communication and expression, breaking the Internet’s mold from the mid 1990’s that relied on companies, governments and universities for the majority of Internet content. As a result, increasingly, individuals now are responsible for large quantities of Internet content.

Social media may be seen as supplementing or replacing more traditional technologies (McAfee 2006), e.g., mail, email or telephone. Social media may take information from a one-to-one environment and disclose the information to larger numbers of people. Social media generally works to remove asymmetries of information, by making more information broadly public. Although social media typically refers to information generated by people, ultimately social media could refer to information generated by systems for people, people for systems or systems for systems.

According to one recent survey (eConsultancy 2010), Facebook (85%), Twitter (77%), LinkedIn (58%) and YouTube (49%) are the most frequently used social media by businesses. However, Twitter, Facebook, MySpace, and others are typically thought of as systems or places where high school and college students spend hours a day, posting information about their lives and reading information about others’ lives. LinkedIn may have more of a business flavor to it, providing potential business links between the participants. However, there are probably hundreds of companies that now provide what they call social media opportunities for users. For example, Yammer is a corporate version of Twitter designed with security and other concerns in mind.

**Twitter, Facebook, Delicious and Digg**

Twitter is a micro-blogging tool, where users can send messages of 140 characters or less. Users can also send pictures and videos through Twitpic and other sources. Facebook has a
broad base of capabilities. Facebook allows the user to define “friends” who are allowed to view materials that the user has posted. Friends can post comments on the user’s wall.

Social media often lets users supply tags to help describe material available in different knowledge repositories, including pictures or documents. For example, on Facebook, users can tag pictures, providing information such as who is in a particular picture. As another example, Delicious.com provides users with a forum where they can tag documents available on the web.

Digg is a social networking tool based on providing recommendations of stories or documents found on the web. People recommend stories and people follow other recommenders, so that there are people who we “follow,” but we also have “followers.” In addition, people can comment on the article.

**Case Study: Best Buy**

Best Buy has engaged the use of social media in a number of ways. Similar to other companies, Best Buy and Best Buy stores have a presence on Facebook which allows interaction with customers. In addition, Best Buy solicits information from their customers. For example, IdeaX (Exhibit 1) provides a way for customers and others to provide recommendations for improvements, etc. In so doing, Best Buy is reaching out to the “wisdom of the crowds” (Surowiecki 2004) for a broad base of recommendations and a different view. Twelpforce (Exhibit 2) provides a Twitter based outlet for customer inquiries. The Twitter account allows multiple employees to monitor and respond to customer inquiries using a single account (Neisser 2010). Meister (2009) notes that any Best Buy or Geek Squad employee can answer questions. According to Ashford (2010) this approach provides a proactive and transparent approach to customer interaction, as compared to a reactive traditional approach. Further, Best Buy’s Finance blog ([http://bestbuyfinanceblog.com/](http://bestbuyfinanceblog.com/)) is used to provide information for careers in finance at Best Buy.

However, as much as Best Buy has integrated social media into its interactions with customers and selected employees, their supply chain remains more traditional, with a focus on EDI and Web-based EDI, as seen at their supplier portal ([https://www.extendingthereach.com/wps/portal](https://www.extendingthereach.com/wps/portal)).

### 3. Supply Chain – Social Media Applications

Twitter and other micro-blogs, such as Yammer, can be used for a number of different purposes in the supply chain, such as communicating news about supply chain events. In addition, companies are using Facebook and other social media for applications that benefit the supply chain.

**Sample Supply Chain Twitter Event Messages**

Twitter messages can be used to provide information about a range of supply chain events. For example, Twitter messages have been used to indicate the arrival or departure of a shipment from a particular warehouse. In these cases, Twitter is being used to channel transaction information into different or multiple communication channels. Such uses may be important because of the need to coordinate the multiple parties in the supply chain that are interested in the information. For example, shipments may be “assembled in transit” and require coordination information throughout the supply chain (e.g., O’Leary 2000) or resources could be more easily coordinated and mobilized to handle large shipments if information is provided in more accessible formats.
Typical information generally includes the companies involved, shipment number, date and time, etc., as seen in exhibit 3. Twitter messages also are being used to establish transportation events that could influence delivery times and capabilities. For example, information about accidents and road closures as seen in exhibit 4 could be used to re-plan transportation routes. Further, Twitter messages are being used to distribute information about pricing changes, as seen in exhibit 5. In addition, Twitter messages have been used to communicate the need for shipments of a particular type, as seen in exhibit 6. Finally, Twitter messages regarding a supply chain discussion group are seen in figure 7.

Integration of RFID and Twitter

RFID (Radio Frequency Identification) can be used as a basis to generate Twitter messages to capture the movement of goods through the supply chain. O’Dell (2010) discusses a project from the University of Waterloo where Twitter messages about RFID-marked cows are generated after the cows are robotically milked. A variety of variables are captured and stored in a database, after which a Twitter message is sent summarizing the information. In a similar application, Murph (2009) describes a setting where a cat door is activated by cats wearing an RFID tag. The door opens as the cat approaches, a picture is taken and then message and the picture are sent using Twitter. This same approach can be used in the supply chain to facilitate supply chain transparency and speed of information flow, sending Twitter messages based on RFID events. In addition, using social media in parallel can generate a broader awareness of information that may be otherwise aggregated and buried in a transaction processing system.

Other Social Media Applications

Additional social media applications include, e.g., different supply chain related companies have a presence on Facebook, where they have “fans” and a “wall” to write on (http://www.facebook.com/cdcsupplychain). Further, a number of sources provide tags for supply chain information. For example, “Digital Supply Chain” (http://www.supplychaindigital.com/categories/supply-chain) provides documents that have been tagged. In addition, as seen below, Delicious.com users have generated a number of tags that ultimately relate to supply chain issues.

4. Using Social Media to Capture and Communicate Supply Chain Event Information

Architectures for autonomic systems in supply chains (e.g., O’Leary 2008) have stressed the importance of the ability of event managers to gather information that might influence events in the supply chain, e.g., weather or traffic. However, O’Leary (2008) and others have not accounted for information that would now be available from social media sources or that could be disseminated using social media. Accordingly, supply chain architectures need to account for the additional information flows that can result from the use of social media. In order to do that generally suggests that an understanding of the types of supply chain events that can occur should be investigated, and how the social media structure would overlay or integrate with existing architectures.

Supply Chain Events

In order to facilitate categorization of such messages and their unambiguous interpretation of social messages, and integration into the supply chain architecture and corresponding information systems, a common ontology or taxonomy could be used as part of event
communication processes. There are different supply chain ontologies available, including SCOR and others (Grubic and Fan 2010), each with differing levels of detail.

From an event set perspective, SCS (2010) provides a process reference model that suggests a “level 1” set of events that could be used to guide development of the use of social media in a supply chain setting. In that model there are five key events: Plan, Make, Source, Deliver and Return. Social media such as Twitter can be used to capture information associated with various supply chain events.

**Example Events: Deliver - Sending and Receiving Goods.** Social media can indicate events such as sending and receiving goods. As seen above, in exhibit 6, with respect to the availability of open shipments, Twitter can be used to coordinate supply chain shipments. Further, as seen in exhibit 3, when goods are being sent for delivery, a twitter message can be sent indicating the customer and the specific order to which the goods correspond. Similarly, as another example, when the goods actually are delivered, a twitter message could be sent indicating that a shipment that was ordered with a matching a purchase order was received.

**Example Events: Supply Chain Risk and Disruption.** Because of the nature of its short and quick bursts of information, Twitter can be particularly useful in generating risk alerts. Ultimately, those risks may result in supply chain disruption. As seen in the above example, transportation events, such as road closures or accidents, construed as potential risks to the supply chain can be sent to the entire supply chain. However, more than just traffic disruptions can be captured.

Social media also can facilitate response to supply chain disruption across multiple types of potential disruptions and across the life cycle of any potential disruption. Blackhurst et al. (2005, p. 4069) focused on three areas that were critical to supply chain disruptions: Disruption Discovery, Disruption Recovery and Supply Chain Redesign. Social media can facilitate adjustment in each area. For example, social media can help organizations discover the existence of a disruption. Consistent with the notions discussed above by Hayek (1945), with each contributor in the supply chain functioning as the eyes and ears of the supply chain, when a potential or actual disruption occurs, the rest of the chain can rapidly learn about it. Social media can also facilitate recovery and system redesign to mitigate future supply chain disruptions.

**Ontologies and Technology Environment**

It also is likely that social media will lead to an emerging ontology that matches the technology environment. For example, acronyms such as fyi (for your information) have emerged in some media likely because of the capabilities or limitations of the media. In the case of Twitter such abbreviations are frequently used because of the tight limit on characters. Such limits are relatively arbitrary, so it would not be unexpected to see a social media emerge that is designed for specific environments, such as supply chain, along with an ontology that allows for alternative numbers of characters, that relate to and meet supply chain needs.

**How Does Social Media Overlay or Integrate with Existing Architectures?**

One approach to integrating social media information is to generate intelligent systems that can parse the contents of Twitter or other types of message and convert them to inputs for existing systems. This approach would suggest that Twitter-like information sources may supplement or replace existing flows of information. Twitter-like supply chain messages likely would be good candidates for parsing because of their brevity and structure. For example, in exhibit 3, the term
“shipment” indicates a specific event and leads us to “know” that we need information about its shipment number (#OMS69696969), where it departed from (“shipper whse”), and when it departed (10/11/10 07:45 hrs) and that it was “on-time.” Other events could be analyzed for their expected content. Systems could then be developed to substantiate the set of expectations from the messages, using an approach developed by DeJong (1979), and others, and as exemplified in O’Leary and Kandelin (1992), and others.

Another approach is to leave the messaging in existing digital formats, e.g., electronic data interchange. Then the social media information would supplement the existing information, providing redundancy. In addition, social media information could function as providing relationship building, as discussed below.

5. Building Groups and Relationship Capabilities in Supply Chain Management

Although Facebook-like capabilities can be molded to help supply chain organizations in a number of settings, Facebook’s strength seems to be its potential for gathering information about opinions, building and maintaining relationships and ultimately developing trust among those in the network.

Understanding What Workers Think

Ashcroft (2010) has suggested that some distribution centers and warehouses have developed groups on Facebook that entertain criticisms of management outside the normal work environment and that have banded together. He also suggested that management may be interested in exploring those discussions. Historically, such information would generally have been transmitted orally, and generally unavailable to management. Accordingly, social media may be seen as a basis for understanding and generating information typically thought to be informal and generally not accessible to management.

Building Relationships with Customers

In one discussion about supply chain management, Gonzalez (2008) noted that a CEO had indicated that “This business used to be about relationships … I knew the people at my customers by name, and they knew me too. But now I’m just viewed as a supplier, just another company to include in the RFP process, and relationship is less important than being the lowest-cost provider.”

In this setting, it is possible that social networking applications could be used to begin to re-build the personal relationships that may have been de-emphasized over the years in favor of digital processes. Facebook-like applications could provide an environment through which suppliers provide communication that ultimately leads to building trust required in supply chains (e.g., King et al. 2010).

Customer relationship management (CRM) refers to a largely one-way flow of information and concern: from the seller to the customer. However, social media information, such as that in Facebook, goes in multiple directions.

Organizational Impact: Integration of Social Media into Business Units

Most firms that have engaged the use of social media like Twitter and Facebook, typically have done so through their marketing departments. However, some firms are beginning to integrate
social media into other aspects of the enterprise. For example, as noted by Slayter (2009) “While social media started as a way for Dell to distribute news and special offers, it has evolved into a critical relationship builder, integrated into all business units.” Social media and its multiple directional flows of information will impact those relationships. Thus, the role of social media is seen as a relationship tool, raising questions into what kind of relationships are associated with supply chains.

Trust and Communication Capabilities in the Supply Chain

In one discussion of supply chains (King et al. 2010, p. 10), it was noted that in spite of the existence of a range of technologies, including electronic data interchange and comprehensive databases, the members of the supply chain “… engage in continuous, near daily, communication.” They further note (p. 49) that “… efficient management … requires a high degree of coordination and communication” and that supply chain (p. 64) “… relationships (require) … high levels of trust and close communication.”

Accordingly, an emerging issue with social media is the extent to which social media provide the ability to generate communications that result in trust along the supply chain. eMarketer (2010) has published some results on this issue. Perhaps not surprisingly, friends are seen as more trustworthy than companies or independent third parties. However, blogs and posts on Facebook were seen as more trustworthy than Twitter. Such a difference in trust in media can be because of the abbreviated format associated with Twitter. However, such trust differences in media suggest that development of supply chain capabilities, designed to foster trust, leverage such differences. Additional research is necessary to further clarify these relationships and their persistence, particularly in a supply chain specific environment.

6. Generating and Evaluating Ontologies with User Generated Tags

An emerging source of knowledge in social media is the development of tags on Internet or Intranet content. A classic example of tagging documents is seen in the application “Delicious.com.” Tags on a document capture how a specific user would categorize the document. The number of tags on a document can range from one to any number that the user is patient enough to tag the document with. Ultimately, tag information could be developed by firm members, supply chain members or by those outside the supply chain, who are tagging documents that relate to the supply chain.

Supply Chain Ontology Example

Gruber (1993) defined an ontology as “a specification of a conceptualization.” Ontologies are valuable for a number of different reasons. Ontologies are useful in facilitating communication between different parties, providing a common language. For example, ontologies can capture and track abbreviations. In addition, ontologies can provide a basis for improving and facilitating search, providing pointers to documents, etc. that contain particular terms.

How can tags be used to facilitate development or evaluation of ontologies? One approach is to use the number of occurrences of a tag as an indicator of the importance of the tag in describing a concept. Thus, the number of appearances of a Delicious tag might be used to chose and evaluate the contemporary acceptability of different labels to capture different concepts.
As a case study, I used the existing supply chain ontology structure provided by Swaminathan et al. (1998) (Exhibit 8). Although limited to the “structure of the supply chain,” that ontology provides a basis to illustrate the potential use of Delicious tags in order to help evaluate and potentially generate an ontology. Using Delicious.com, the term “supplychain” was used as the root term as part of a process to examine a previously developed ontology and determine how the ontology might be updated to reflect the information captured in the tags. The notion was that terms that co-occurred with that “supplychain” could be used as the basis of substantiating and generating an ontology for supply chains.

Delicious.com was searched for co-occurrence of terms with the root tag “supplychain.” In each case, the search involved the root tag and one other tag, e.g., “retailer.” A list of some terms that co-occur at least one percent of the sets of tags with the term “supplychain” is given in table 1. Using that list, a revised ontology was generated and is provided in exhibit 9, also with the number of occurrences of each tag. The revised ontology has substantially more tag occurrences than the original.

In addition, the list of frequently co-appearing tags suggests some concepts not in the original ontology. First, the frequent co-occurrence of “green” and “ecology” likely reflect the increasing importance of those factors both in the supply chain and in other aspects of contemporary life that should be included in any supply chain ontology. Second, since the original ontology was generated, it appears that information technology has become more important. For example, tags for “software,” “RFID” (Radio Frequency Identification) “ERP” (Enterprise Resource Planning Systems) are frequently co-occurring. Thus, rather than a generic “information” perhaps information technology should be integrated into the ontology. Third, tags such as “finance,” “business,” “management,” and “strategy” suggest the integration of supply chain concepts with other business concepts. Accordingly, supply chain appears to be increasingly embedded in the “business” or at least with a “business view,” rather than a stand-alone concept.

7. Knowledge Discovery

Knowledge discovery can be used to analyze data available from social media sources. In particular, different “perspectives” on the content of social media used in a supply chain can be used to make a range of inferences for supply chain participants.

Sentiment Analysis

Social media messages may also include emotional or sentiment information. For example, the messages may reflect the happiness of completing a shipment or the frustration associated with a shipment being lost or slowed down. Such sentiment data could be investigated to try and understand if there are any trends in the information, e.g., “frustration” with a vendor or a specific company.

Sentiment can be ascertained using a number of approaches. One of the primary approaches is the use of “sentiment” dictionaries (e.g., Hoang et al. 2008 and Yang et al. 2006). Words like “sucks,” “hate,” “love,” and “dislike,” are used to analyze social media message content to determine the overall “sentiment” associated with the messages and content. Sentiment content that relates to different agents in the supply chain can be captured and analyzed with different objectives, such as monitoring a firm’s “reputation” or how well a supply chain is working.
Reputation and Partner Analysis

A range of social media can be used as a basis for reputation analysis of the specific firm and their supply chain partners. Twitter content, blogs, etc. can be monitored to gather information about how the supply chain views a specific company or its partners. For example, supply chain disruptions could be tied to reputation. Further, information gathered from social media information about supply chain partners can be compared to internal data or data gathered from other publicly available social media sources. Such data might help determine which supply chain partners should be used, and the advantages and disadvantages of different vendors.

In order to provide an example of the potential reputation analysis of three supply chain companies, I investigated the occurrence of the phrase “X Sucks” using Google Blog Search. For X = DHL, there were 299 results, for X = FedEx, there were 842 results, and for X=UPS, there were 1350 results. Typically a “result” is a blog that contains the expression of dissatisfaction with a particular shipper. This same approach can be used to investigate supply chains in general to gain an understanding of the evolving reputation of components of the supply chain, say over time.

Such results should not been seen independent of a business context. For example, it is likely that such findings are tied to number of packages shipped or number of packages of a particular type shipped, e.g., retail. Further, a broader base of “reputation” should be analyzed, including both positive and negative issues. Choosing a range of factors (such as timeliness of delivery, etc.) that affect reputation could result in “balanced score cards of reputations.”

Influence Analysis

Influence analysis is aimed at understanding who is talking about a company and who appears to be listening to them. One approach to begin understanding these issues is to examine social media information. For example, blogs or posts can be searched for information about a company to determine who is saying what about a specific company. Different criteria can be used to capture the concept of “influence.” Two key performance indicators are “number of publications” and the extent that a publication is “cited” or “commented on.” For example, the number of blogs or posts that a specific author generates about a given company provides a measure of the “number of publications.” Similarly, if a blog or posting is referenced by others that is a measure of cites, and influence. Finally, if others comment on a post or a blog that also provides another measure of that person’s “influence:” typically, the greater the number of comments on a posting, the greater the influence.

An alternative view of influence analysis can be traced through other social media like Digg. As part of Digg individuals suggest articles, videos etc., and in so doing they generate a “following.” Similarly, individuals follow the recommendations of others, becoming followers. In this type of a setting, the network of influence becomes clear through both “following” and “followers.” As an example, at the time of this paper in Digg, “All Things Digital” had 18 followers and was following two sources. Those 18 followers had 7906 followers, and those that “All Things Digital” was following had 86 followers. By analyzing networks of followers and following, we can determine who is directly or indirectly influencing who.

Supply Chain Network Structure

The network structure of Twitter, the friends associated with Facebook, the followers or following associated with a Digg recommender, or other social media messages provide a
network of interactions. Influence analysis networks can be studied for who is at the center of the networks and how fast that influence diffuses throughout the supply chain.

Such social media information could be used to compare the supply chain structure as it is designed to the supply chain structure as it actually emerges through agent interactions. In the same sense that social networks can be analyzed among informal groups (Freeman 1978/1979), supply chain groups also can be analyzed and extended (e.g., Lazzarini 2001). Further, that emergent structure could be analyzed for its evolution over time to determine the extent of stability or change and the corresponding impact on supply chain performance.

8. Prediction Markets in the Supply Chain

Prediction markets are another form of social media that can be used in the supply chain, but appear to have had only limited attention in supply chain research (Guo et al. (2006)). Prediction markets generally use pretend money (e.g., Google uses Gobbles) as a basis for pricing stocks that are of direct interest to the particular organization (e.g., “Project X will be on time” and “Project X will be late”). Prediction markets move to gather information from their participants that otherwise might not be accounted for, removing information asymmetries. As a result, prediction markets may facilitate gathering information from lower level employees or clients.

Prediction markets can be used to capture information about multiple types of organizational events. First, the likelihood of external events that might affect the supply chain could be addressed by the markets. For example, political issues, such as who would be elected president, might be addressed. Second, markets can pursue the likelihood of internal events or conditions occurring. For example, such markets might address the likelihood that a supply chain partner goes bankrupt. Third, once an event has occurred, internal or external, markets can pursue the impact of those events on particular entities, e.g., the company or its supply chain partners. For example, after the recent Japanese tsunami occurred, prediction markets might be used to address the impact on the supply chain.

Who would be in the Market?

One of the key concerns in the use of a prediction market is who would be in the market and should there be different markets for different groups? For example, consider a market that addressed questions related to timeliness of shipments, such as “Shipment X will be on-time” or “Shipment X will be 1 week late.” Although it might be helpful to remove asymmetries of information by finding out that the market thinks a shipment will be late, clearly that information might have an impact on future business done in the supply chain. If the market thinks that the shipment will be late, then those responsible could be affected, or the outcome could be a self-fulfilling prophesy. As a result, prediction markets may be limited to internal organization participants, rather than supply chain focused. Unfortunately, this would limit some of the potential contribution of the markets by eliminating some of the information sources.

9. Integrating Social Media and Traditional Knowledge Management

Recently, some consulting firms have begun to integrate social media and traditional knowledge management as part of their own knowledge management strategies for managing consulting
projects. For example, Cognizant has developed a knowledge management tool, referred to as Cognizant 2.0 that embeds social media in the context of a workflow system that is used to facilitate planning and implementation of relatively structured problems associated with knowledge management and knowledge transfer in outsourcing engagements (e.g., Rajagopal 2008).

Cognizant 2.0 illustrates two different approaches to providing and using knowledge as part of a knowledge management system: repository and router. The repository approach suggests that firms generate large repositories of documents, blogs, wikis, etc. and make that knowledge available to users to search at their discretion or build access to that knowledge into knowledge management applications. Alternatively, the router approach suggests that the firm find relevant knowledge and “route” that knowledge and information to their users when they need it, thus generating “just-in-time knowledge.”

Both approaches to knowledge are embedded in Cognizant 2.0, in the context of a workflow-based approach. For the process being modeled, at any step in the process, information and knowledge that is available about that step, e.g., checklists, documents, blogs, etc., are listed and made directly available to the user from the repository. In addition, if that information and knowledge is not sufficient, then the system will guide the user to make inquiries of others through the use of social media-like applications.

**Application to Supply Chains**

This same approach can be used in supply chains, particularly since many supply chain tasks are relatively structured, e.g., routing, loading, delivery, etc. Accordingly, for some task where the workflow can be structured, knowledge resources can be made available via the system. For example, checklists about contractor delivery trucks could be embedded in the system at each task so that users do not need to search for that knowledge. Further, social media, such as blogs or wikis, that contain relevant information or knowledge can also be captured and made available in workflow systems. In addition, social media can be used to generate and capture new knowledge, for users, just in time. For example, the system can be constructed to send out and manage the responses associated with the equivalent of Twitter messages in order to answer questions that were unanticipated during the development of the system or trying to take into account development of new knowledge. In so doing, questions could be directed to those in the supply chain that can answer the request or they could be open questions trying to draw on the wisdom of the crowds.

**10. Some Extensions and Emerging Research Questions**

There are a number of extensions to the research discussed in this paper. The scope of capabilities of specific tools that are examined could be extended beyond those of Twitter, Facebook, Delicious and Digg. For example, we could examine Youtube or LinkedIn or others for their potential contribution to the supply chain. In addition, there are a number of more extensive investigations that require additional research.

**Communication and Trust Building**

At the lowest level, social media provide another line of communication, supplementing other types of communication and providing redundancy. Not only do social media provide the opportunity for improved communication, but social media also provide the opportunity to
facilitate building trust among participants (eMarketer 2010). Accordingly, future research could further examine trust building, e.g., Porter and Donthu (2008)

**Provide a Context for Transaction Data**

Twitter, Facebook, Delicious and Digg all facilitate the development of context information. For example, Twitter provides a source from which the message is sent, and a time at which the information was sent. The time information also provides sequencing information to facilitate an understanding of how events are inter-related. In the case of the cows, RFID and Twitter messages discussed above, the date, the time, the sequence of the cows processed, and the amount of milk and the amount of time taken to milk the cow, could be captured and analyzed. In the case of shipments, the shipper, the amount of time taken to unload, etc. is all information that could be captured. Other information in the message also can provide additional context. As another example, Facebook provides a context based on who is part of the group that can access and post information for others to see. Delicious tags occur with other tags, and thus also providing a context. For example, a tag “SupplyChain” can co-occur with other tags such as “RFID” and “IT” suggesting a context of the analysis of “SupplyChain” in terms of information technology. Future research could investigate investigation of how the context can be structured and used.

**Accelerate Enterprise Information Speed**

As information is sent to others using social media, they in turn send it to others, providing the equivalent of an information supply chain. As information is sent to others, that speeds the awareness and increases the distribution base of the original information, potentially further accelerating the flow of information. Accordingly, news can find its way into and through the supply chain from multiple sources speeding overall awareness. Future research could investigate the extent to which information does accelerate in the supply chain through the use of social media.

**Ontology and Taxonomy Generation**

This paper used Delicious tags to generate an ontology for supply chain terms, e.g., to facilitate search. The approach used in this paper was to start with the root term, “supplychain,” and then find the more frequently co-occurring words. All analysis was done in pairs because of a relatively limited number of tags in the Delicious database. However, given a large database of tags, this analysis could be extended to longer chains of words, depending on the depth of the tree that we wish to construct. For example, based on exhibit 9, we might investigate the co-occurrence of word triplets, such as “supplychain,” “production,” and “retail”. Or alternatively, if there are only a small number of tags available, the terms “production” and “retail” could be used as root terms. Unfortunately, although this second approach would generate larger numbers of tags to examine, they would not be fully based in the context provided by “supplychain.” Finally, this same approach could be used to investigate related concerns, such as supply chain taxonomies, e.g., Capar et al. (2004), and how they might evolve over time.

**Capturing and Communicating Best Practices**

Best practice knowledge bases have been the source of previous research (e.g., O’Leary 2007). In addition, there has been some development of best practices for the supply chain at a practical, yet relatively high level (SCC 2010). Unfortunately, there is limited information available about individual supply chains generating best practice knowledge bases for internal usage.
However, social media could be used to capture best practice information specific to a particular supply chain or in general. For example, supply chain participants could generate best practice information in the same sense that Best Buy solicits “ideas.” Specifically, best practice information could be captured in a wiki. Ideas and best practices could be organized under user supplied tags that could be used to create an ontology or taxonomy to categorize and index the best practices. Future research could be done to investigate the use of other social media to study the capture of best practices.

**Supply Chain Mash-ups or Crowd Sourcing Supply Chains**

Mash-ups typically refer to integrating software from multiple sources. However, social media could be used to generate supply chains that “emerge,” rather than have an a priori structure, effectively building supply chain mash-ups. As an example, DHL apparently is interested in potentially crowd sourcing supply chains. Smith (2010) reported that DHL was planning on testing a program at the University of Potsdam that leveraged location knowledge provided by smartphones to allow them to determine who would be commuting using a particular route, as a basis of routing a package. ([http://www.livinglabs-global.com/showcase/showcase/392/bringbuddy.aspx](http://www.livinglabs-global.com/showcase/showcase/392/bringbuddy.aspx)) In a similar manner, social media, such as Twitter could be used to crowd source the movement of goods in the supply chain. Messages could be sent out, and virtual teams could be assembled.

**Shared Risk Identification and Management**

Recently, there has been substantial emphasis on Enterprise Risk Management (e.g., Deloitte 2010) and even supply chain risk management (e.g., IBM GBS 2008). However there has been limited attention directed to social media’s role in risk identification and management.

Social media can facilitate a shared risk identification and management by empowering members of the supply chain to identify and share identification of risks in the supply chain. For example, IBM GBS identified a number of risk factors, including

- Increased globalization through outsourcing, which elongates end-to-end supply chains
- Additional regulatory compliance
- Demanding customers
- Supply side capacity constraints
- Natural disasters

Each of these kinds of risk factors could benefit from the potential flow of information from social media. For example, with extensive regulatory compliance, some parts of the supply chain are most likely to be familiar with compliance than other parts, and they could use social media to alert each other. Those closest to the customer could alert others in the supply chain about issues that relate to demanding customers, etc. Prediction markets could be used to assess risk of different factors.

**Adaptive and Resilient Supply Chain Design**

Social media may help generate supply chains that are more adaptive and resilient than traditional supply chains. Social media ultimately develops multiple and redundant communication links. Accordingly, if one communication link is removed, other links are still available to provide communication capabilities. These redundant communication capabilities
suggest that the resulting organization along the supply chain can be resilient to disruption and adaptive to change. Further, empirical research could assess the extent to which social media could facilitate adaption and resiliency.

Theory X vs. Theory Y

Potentially, the type of managerial philosophy used in the supply chain may have an impact on the extent of use of social media. McGregor (1960 and 1966) analyzed two contrasting management philosophies, Theory X and Theory Y. Although there are a number of differences between those two philosophies, according to McGregor (1966), managers operating under the notions of Theory X assume that “Management is responsible for organizing the elements of productive enterprise—money, materials, equipment, people—in the interest of economic ends.” However, for managers operating under the notions of Theory Y, “the essential task for management is to arrange organizational conditions and methods of operation so that people can achieve their goals best by directing their own efforts toward organization objectives.” Under Theory X, managers push down information to employees, while under Theory Y, managers gather and use information from a wide range of employees.

Using social media as a basis to capture and communicate supply chain information clearly is consistent with the notions of Theory Y, but not with Theory X. Theory X managers would think that workers would not have a substantial contribution, whereas Theory Y would assume that workers would play an integral part in the necessary generation and communication of important information. As a result, we likely would more likely see adoption of social media by those supply chains with management more in line with Theory Y, as compared to Theory X. Future research could empirically examine this notion (e.g., O’Leary 2010) in the context of social media.

11. Potential Limitations of Use of Social Media in the Supply Chain

Although this paper has focused primarily on the benefits and opportunities associated with the use of social media in the supply chain, there are some potential limitations and threats.

Personal Use of Social Media

Management is likely to have some direct concerns arising from non-business or personal use of social media. First, a potential concern is that social media will be used for personal purposes, rather than organizational purposes. In so doing, time may be spent in non-productive efforts. Second, management may be concerned that the social media might be used to attack or undermine management efforts. Rather than simply being non-productive, the efforts may have a negative effect on productivity.

Privacy and Information Protection Issues

In many cases, corporate information flows would require protection or at least limitations as to who can access the information. Accordingly, the use of social media in corporate supply chain settings would require development to ensure information privacy and information protection.

Duplication of Information

One application of social media discussed above was to use social media to provide transaction information in additional channels, to accommodate the need for broader and alternative uses of
information. One potential problem of having information available through multiple channels is that the information quality may suffer from multiple channels of information. Ultimately, information delivered through different channels may differ, resulting in potentially different actions.

**Other Business Uses of Social Media**

Increasingly systems development corporations have developed social media-like systems for corporate consumption and resale, including Salesforce.com’s “Chatter” and Novell’s “Vibe”. The development of these systems suggests that there are limitations of current instantiations of social media software and that corporate social media-like systems will continue to evolve and be integrated into existing information systems. Future research could investigate the continuing evolution of social media, and the limitations that drive its development.

**12. Summary and Contributions**

Unfortunately, there has been limited research into the use of social media in the supply chain. As a result, the purpose of this paper has been to investigate the integration of social media into the supply chain by surveying some of the existing applications and examining some extensions. That analysis suggests that firms are beginning to employ social media in the supply chain; however, those applications are just beginning to emerge and are not fully developed or fleshed out.

Accordingly, this paper has a number of contributions. First, this paper summarizes some of the existing literature as it relates to supply chain and social media. Second, this paper extends that literature by investigating a number of potential applications of social media in the supply chain. Those applications included:

- Analyzing supply chain events and the role of social media in facilitating communication about a range of those events, including supply chain disruption.
- Beginning to understand the impact of social media on communications, trust and relationships in the supply chain.
- Investigating user supplied tags (e.g., from Delicious) to evaluate and extend a supply chain ontology.
- Using knowledge discovery of social meeting communications to access notions such as reputation, influence and networks of supply chain relationships.
- Analyze the potential use of prediction markets in a supply chain environment, including an investigation of potential market participants.
- Developing a number of potential extensions, such as supply chain mash-ups, ontology generation, capturing supply chain best practices and providing a basis for supply chain risk management.
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Exhibit 1 – Best Buy Twitter “Twelpforce”

Exhibit 2 – Best Buy “Ideas”
Exhibit 3 – Twitter Messages to Indicate Shipment

Four_Soft

Shipment #OMS69696999 departed from Shipper Whse #GLN12345678
10/11/10 07:45 hrs on-time
2:54 PM Oct 3rd, 2010 via web

Exhibit 4 – Road Closures and Accidents

ADSLOGISTICS Westbound 10 to Close Near Palm Springs for
Construction @NBCLA http://ow.ly/4ptLb #DOT
about 2 hours ago via HootSuite

511hamptonroads Event Cleared: Accident: WB On I-64W at MM 264
in Hampton. 2 lanes closed. 1:25PM
2 minutes ago via VA511DataApplication

511hamptonroads Update: Delay: WB On I-64 at the Hampton Roads
Bridge Tunnel West in Norfolk. 0 lanes closed. Delay 4 mi. 1:25PM
2 minutes ago via VA511DataApplication

Exhibit 5 – Pricing Changes

7LFreight Continental increased its FSC to $0.95/kg for all international
shipments, $0.38/lb on domestic, effective today.
about 4 hours ago via web
Exhibit 6 – Twitter Messages About Open Shipments

Exhibit 7 – Twitter Messages about Supply Chain Discussions
Exhibit 8 – Ontology: Structure of Supply Chain Library

Based on Swaminathan et al. (1998)

Exhibit 9 – Alternative Ontology Based on Tag Co-Occurrence