

EXPLORING THE POTENTIAL USE OF WEB 2.0 FOR SUPPLY CHAIN MANAGEMENT

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Abstract

In today's global and dynamic environment, managing supply chain processes has been challenging for many organisations. Various information and communication technologies (ICT) have been adopted in the last few decades to improve communication, coordination of activities, cooperation, and collaboration across supply chain participants. The adoption of technologies for supply chain management (SCM), nevertheless, has always been difficult and complex because different parties are involved. More recently, with the emergence and popularity of web 2.0 as social technology, innovative companies have started to explore and adopt web 2.0 as an alternative method to achieve supply chain integration. Web 2.0 has many attractive features that are useful for dynamic communication and interaction across the globe, which can facilitate integration among supply chain parties. However, currently, there is still a lack of a holistic view of the potential use of web 2.0 for SCM. In this conceptual paper, we review the web 2.0 concepts and tools and then assess their potential use for SCM. A number of implications for managing supply chain with web 2.0 are also discussed.

Keywords: web 2.0, supply chain management, business-to-business integration, technology adoption

1. INTRODUCTION

Supply chain management (SCM) is concerned with planning, coordinating and the movement of products, services, finance/cash and/or information from the point of origin to the point of consumption in order to create customer value (Stadtler, 2004). In recent years, companies are facing a competitive and dynamic business environment due to globalization and heightened customer expectations. To maintain competitive advantage, companies should achieve greater coordination and collaboration among supply chain partners. Efficient transaction execution, flexible and dynamic interactions/communication and effective information sharing among supply chain participants are key requirements for managing supply chain activities (He et al., 2007).

Due to the complexity of managing supply chain operations, organisations have adopted information and communication technologies (ICT) to facilitate information sharing, cooperation and collaboration among supply chain parties. Nevertheless, because ICT-enabled SCM initiatives are inter-organisational in nature, their adoption has been difficult (Kurnia and Johnston, 2000). Various supply chain parties often have different and conflicting objectives which make it difficult to engage in close partnership to adopt certain technologies and initiatives (Arshinder et al., 2008, Simchi-Levi et al., 2008). The emergence of the Internet has played an important role in supporting supply chain integration and information sharing among supply chain members and has overcome some adoption barriers (Ghiassi and Spera, 2003, Giménez and Lourenço, 2008, Graham and Hardaker, 2000, Lancioni et al., 2000, Lankford, 2004). However, the traditional static connections among supply chain partners could not support sense-and-response capability and effective decision-making due to a slow response time for retrieving information (Goh et al., 2007, He et al., 2007)

In recent years, new generation software on the web, which is called 'web 2.0', has been developed. Web 2.0 has successfully applied in the social context by allowing end-users to be involved in collaborating and participating on the web. In addition, real-time information sharing and reusability of web sources and web applications could support crisis management capability, and enhance supply chain visibility. However, there is still a limited understanding of how web 2.0 can be used to support supply chain operations. Only limited number of studies has investigated this phenomenon focusing on different aspects. For example, Goh et al. (2007) and He et al. (2007) assess how web 2.0 concepts and technologies may create potential benefits through dynamic B2B integration, while Ooi et al. (2011) demonstrate how web 2.0 can be applied to SCM. However, Goh et al. (2007) and He et al. (2007) only focus on specific and limited SCM practices, and Ooi et al. (2011) do not thoroughly describe how web 2.0 can support the overall SCM practices.

Thus, the aim of this paper is to systematically explore the potential use of web 2.0 in supporting key practices of supply chain management based on literature analysis and synthesis. The research question addressed in this conceptual study is: *How can web 2.0 be used to support supply chain management practices?*

For the purpose of this study, we first review the literature on the concepts and tools of web 2.0. Based on this, we then synthesize the potential use and impacts of web 2.0 on SCM practices based on the existing studies. As a framework for our analysis and synthesis, we use Mentzer et al (2001)'s categorization of SCM key practices. The search for relevant literature was carried out using several databases including ScienceDirect, Emerald, ProQuest, EBSCO, IEEE, Elsevier and Google scholar. Typical keywords used in the search include web 2.0, supply chain management, web 2.0 and business-to-business integration. In addition, recent journals (2007 and beyond) including IT/IS-related and SCM/B2B-related journals (e.g. ISJ, JMT, JEB, SCMJ) were examined carefully to identify any relevant and useful articles to the topic of this paper.

The paper is structured as follow. Section 2 provides a literature review and synthesis of the key concepts and tools of web 2.0. Section 3 explores the potential use of web 2.0 for each of the SCM practices. Section 4 summarizes the key findings and introduces some possible challenges of web 2.0 for SCM briefly and concludes the study.

2. OVERVIEW OF WEB 2.0

Before the potential use of web 2.0 for SCM are explored, it is important to have a clear understanding of the key concepts and tools of web 2.0. These concepts and tools are later mapped to the SCM practices in order to identify the potential use. In this section, we synthesize various concepts and tools of web 2.0 identified from the literature. We then categorize them into four concepts and nine tools. The concepts include web as a platform, software-as-a-service (SaaS), rich Internet application (RIA), and collective intelligence. The supporting tools include really simple syndication (RSS), mashup, blog, wiki, micro-blog, social networking site, content community, podcast, and tagging and social bookmarking. Each of these is discussed below.

2.1. Concepts of Web 2.0

Web as a platform: For the generation before the emergence of web 2.0, operating system (OS) is a platform for any application systems. In other words, any application system is developed for a specific platform such as Windows, Mac, or Linux OS. In the web 2.0 generation, on the other hand, web plays the role as a platform. It means that it is possible to build web-based software applications that run on the web platform regardless user's actual computer OS (Ooi et al., 2011, Mathaba et al., 2011). Web 2.0 applications use the web as a platform because a wide range of interconnected devices offer a new level of rich and immersive experience for the users. Normally, application development involves an easy-to-use and lightweight programming model and a rapid and flexible deployment mechanism (Mathaba et al., 2011).

Service-as-a-Software (SaaS): SaaS supports on-demand access to web-based software applications, which are maintained centrally by a vendor or service provider. SaaS is a business model that provides software applications on the web as a service instead of packaged software that needs to be installed on the end user's computer (Hsu, 2011). SaaS is cost-effective since users only need to pay for use while not paying for extra hardware and other things related to the use of software including software installation and upgrades. With this concept, all users can use the same version of software, which offers an additional benefit.

Rich Internet Application (RIA): RIA is a web application that provides richer, more responsive and interactive user experience than a desktop application by using a thick client configuration (He et al., 2007). Thick client refers to moving the bulk of data processing operations to the client site to reduce server load. Consequently, RIAs offer advantages such as better interaction between users and system, a possibility of on/offline use of applications, a balance between client and server, and increased effectiveness of network connection (Chong et al., 2007).

Collective intelligence: Collective intelligence signifies the generation of intelligence based on knowledge from many people connected together (Goh et al., 2007). The interactive information sharing and effective support for continuous development and maintenance of information are recognized as an important process to deliver valuable and commonly acceptable information and insight.

2.2. Tools of Web 2.0

Really Simple Syndication (RSS): RSS is a service to distribute web content such as news headlines, blog entries or podcast easily and frequently to users who subscribe to the particular feed and use RSS reader. 'Feed', 'News feed', 'Web feed', or 'Channel' refers to a data format specified in XML format. The data format contains either a summary of the content of an associated web site or the full content to syndicate to users (Harris, 2008). RSS enables users to keep up with the rapidly changing updates of their preferred websites in an automated and efficient manner.

Mashup: Web mashup is a service that combines web service(s) and/or data via open Application Programming Interface (API). API refers to a programming interface offered by an application, provides the function to utilize information resources and to interact and communicate with other programs / applications, or web sites via the Internet (Fujii, 2010, Murugesan, 2007). In B2B context, mashup is defined as a lightweight tactical integration of the underlying applications and/or

information resources (e.g. contents and data accumulated in the database) from multiple sources inside and outside an organisation to create composite front-end applications, which can deal with situational and ad-hoc problems (Goh et al., 2007, Barnes et al., 2008).

Blog: Blog is a personal website where users can input their ideas, opinions, and comments. Blog posts (also called blog entries) are generally displayed in reverse chronological order. As blog has a feature that enables bloggers to post various types of content (e.g. message, picture, or video) in their blogs spontaneously, the content quality is higher than the traditional discussion board. Blogs serve as a new communication tool to enable effective interactions and communications among bloggers (Razmerita et al., 2009). For example, bloggers can create a link to other blog entries after reading them and reference them in their own blogs. Bloggers can also enter comments on each other's blog entries (Murugesan, 2007). In addition, blog readers can check the rapidly changing blog entries in their personalized web page or email if the readers subscribe to the interested blogs.

Wiki: Wiki is the simplest collaborative content management system for creating and editing content. Wiki is designed to allow any user to create a new web page or revise on existing page through a web browser (Burrus, 2010). The major difference between blog and wiki is that wiki allows users to change the original content while blog users can only add comments. Users can also view updates to the web page content based on the last visit. Thus, wiki is a powerful tool to harness the information/knowledge of diverse individuals for collaborative work, and it plays a role of centralized knowledge repository in organisations. Furthermore, a wiki markup language offers a short-cut mechanism for linking external documents and contents (Murugesan, 2007).

Micro-blog: Micro-blog is a type of social media that has some features of blog and social networking site (e.g. Facebook) (Kaplan and Haenlein, 2011). Twitter is one of the most popular examples of micro-blogs. Twitter is a micro-blogging service that allows all the participants to stay connected and communicate through the exchange of short messages using less than 140 characters per message, individual photos, or video links to a list of followers (Burrus, 2010). Users can get real-time information, deliver their opinions or thoughts to a large number of people at once and can easily share useful information obtained from other authors via re-tweet.

Social networking site: Social networking sites, such as Facebook and LinkedIn, support social networks or social relationships on the web among users. Using various types of information such as photos, audio, video and blog, users can establish and share their personal profiles. Furthermore, social networking sites such as Facebook support slow but continuous communication among users compared to micro-blog like Twitter because users make connections with others (e.g. friends, family and co-workers) who they may keep in touch with.

Content community: Content community refers to specific web sites where users can share multimedia content on the web. YouTube, Flickr, Digg, and Slideshare are good examples of content community. These websites allow users to upload multimedia files (e.g. texts, photos, videos, and presentations) that they want to share with others (Burrus, 2010). Furthermore, users can participate in voting to show a sign of agreement or disagreement on the web.

Podcast: Podcast refers to a collection of digital media files, which are distributed to users over the Internet using software that can handle RSS feeds (Harris, 2008, Harris and Rea, 2010). The file can be played back on a personal computer or mobile devices anywhere and at any time. Additionally, users can check and download the updated files according to users' preference on the basis of subscription.

Tagging and social bookmarking: Tagging is the process of creating keywords to online contents (Murugesan, 2007). Unlike the conventional category classification method, users can assign labels directly to the contents that they created. A computer automatically organizes the tags which users added because tag corresponds to a semantic category for the computer.

Social bookmarking refers to a process by which users bookmark useful or interesting web pages by tagging. Then, users are able to save, share, and access the tagged bookmarks on the web quickly (Burrus, 2010, Hsu, 2011).

3. THE POTENTIAL USE OF WEB 2.0 FOR SCM

To explore the potential use of web 2.0 for SCM, we first identify a number of key practices of SCM from the literatures and then explore the relevance of web 2.0 for each practice. Although the definition of SCM and the classification of SCM practices differ across studies, the underlying philosophy is similar, that is to seek synchronisation and convergence point of intra and inter-company capabilities into unified marketplace force, aiming at improving competitiveness of not only the company itself but also the supply chain as a whole (Li et al., 2004, Mentzer et al., 2001). We use Mentzer et al (2001)'s classification of SCM key practices as a framework for this study since their work is well recognized in the SCM literature with over 1400 google scholar citations by January 2013. The SCM key practices include: supply relationship management, integrated behavior, information sharing, risks and rewards sharing, collaboration, processes integration, and customer relationship management.

For each of the key SCM practices, below we analyze and synthesize how web 2.0 supports each practice. Table 1 provides a summary of our analysis.

SCM practices	Web 2.0 concepts	Web 2.0 tools	Potential Use	References
Supplier relationship management	Collective intelligence	Social networking site	- Helps find various and useful information about suppliers - Allows companies to promote themselves at no cost via business-oriented professional networking site such as LinkedIn	Burru (2010)
		Wiki	Facilitates business relationship based on enhanced mutual trust by effectively transferring information regarding the contract management	Ooi et al. (2011), Harris (2008)
		Content community	Allows to rate the performance for the vendors in a real-time	Lancioni et al. (2000)
	RIA	RSS	Provides market research information to buyers in a more efficient manner	Barlow (2011)
Integrated Behavior	Collective intelligence	Content community	Enhances education / training efficiency via social media website such as YouTube	Burru (2010), Barlow (2011)
		Wiki	Provides a collaborative education system created by a variety of experts in one place	Burru (2010)
		Tagging	Supports employees' cooperative ties with other supply chain members	Liu and Liu (2009)
	Web as a platform	Podcast	Provides informal education / training with less cost, less effort and higher effect	Liu and Liu (2009)
		Mashup	Offers new performance metrics to monitor the performance of the focal company itself and their suppliers can be established by mixing and transforming various information sources	Gohet al. (2007)
	RIA	RSS	Enables news or information to be pushed automatically to specific parties	Ooi et al. (2011)
Information sharing	RIA	Mashup	Enables supply chain visibility through mixing and integrating various sources of data from supply chain members easily	Koris et al. (2008)
		RSS	Enables information for order and inventory management to be pushed to supply chain partner automatically	Goh et al. (2007)
	Collective intelligence	Micro blog	Facilitates discussions to solve unexpected matters by spreading short message quickly	Burru (2010)

			and widely among supply chain members	
Collaboration	Collective intelligence	Social networking site	- Improves internal networking and collaboration among supply chain members - Disseminates news, announcement and knowledge easily	Burrus (2010), Ooi et al. (2011)
		Blog	- Enables a diversity of collaboration between individuals or between teams - Allows the expression of freedom of supply chain members at an acceptable level - Accumulates personal knowledge / opinion that can be accessed easily	Chen (2009)
		Wiki	Enables collaboration in making useful information / knowledge among a group of members	Goh et al. (2007)
		Content community	Enables all supply chain partners to offer opinions regarding any business development plan of a company that may affect supply chain activities	Ooi et al. (2011)
		Tagging and Social bookmarking	Helps up-to-date market information on the web collaboratively	Burrus (2010), Razmerita et al. (2009)
Risk / Benefit sharing	SaaS	-	- Lowers initial cost of technology implementation - Enables sharing of infrastructure and other costs among supply chain partners - Offer flexible and scalable SCM applications	Ooi et al. (2011), Fujii (2010), He et al. (2007)
Processes integration	Web as a platform	-	- Enhances level of integration and collaboration among upstream and downstream participants - Overcomes compatibility issue across different business partners	Ooi et al. (2011)
	SaaS	-	Enables supply chain members to access SaaS-based supply chain applications on the same platform	Goh et al. (2007)
Customer relationship management	RIA	Micro-blog	Offers a fast way to solve customer issues	Burrus (2010), Case and King (2011)
	Collective intelligence	Social networking site	Helps increase companies awareness, advertise products/services, get customer feedbacks, and build a customer loyalty	Social networking (2009)
		Content community	- Enables showcase the products / services - Facilitates friendly and personalised customer training	Barlow (2011), Liu and Liu (2009)
		Blog	- Facilitates marketing of products/services - Enables sharing opinions about products / services	Miller et al. (2010), Liu and Liu (2009)

Table 1. Possible use of Web 2.0 for SCM practices

3.1. Supplier Relationship Management

Supplier relationship management (SRM) refers to the process for building and managing relationships with suppliers (Johnson and Mena, 2008). One key activity is the selection of right partners, which basically requires widening market research (Li et al., 2004, Eltayeb et al., 2011). Another activity is the formation of strategic alliance with supply chain partners (Li et al., 2004,

Eltayeb et al., 2011). Theodorakioglou et al. (2006) argue that seeking close and long-term partnership with partner(s) who depend on each other for much of their business is important for effective SCM in the new competition because close relationship enables partners to share information more freely and leads to a higher level of participation of the partners to solve common issues and/or make joint plans for the future. However, long-term partnership itself may not always be the right approach in every occasion (Storey et al., 2006) as companies need to capitalize on short-term business opportunities in some cases such as when a main supplier is unable to meet particular orders. Hence, today strategic appliance requires not only mutual cooperation, open communication and the use of formal documents such as Service Level Agreement (SLA) or Product-Service Agreement (PSA) (Johnson and Mena, 2008, Theodorakioglou et al., 2006), but also dynamic B2B integration as well as agile and flexible commitment.

In terms of web 2.0 concepts and tools, social networking site, RSS and content community support SRM practice with the concepts of RIA and collective intelligence, while wiki and content community facilitate building strategic partnership based on the collective intelligence concept. For each explanation of the possible use of web 2.0 tool, we indicate the relevant web 2.0 concepts (Web as a platform, SaaS, RIA or Collective Intelligence) in square brackets.

Social networking sites: Suppliers' Facebook is a useful source of information in selecting partners because organisations may find information such as the level of communication with their customers, corporate culture, opinions of employees, the number of comments, the number of friends, and so on via Facebook [Collective Intelligence]. The information can then be used for assessing the reliability of suppliers. According to Burrus (2010), more than 35 million registered members spanning over 170 companies are actively networked with each other via LinkedIn, which is the world's largest business-oriented social networking site. From B2B perspective, LinkedIn can be an effective tool for B2B marketers. Marketing charts study shows that the largest number of survey respondents, which corresponds to 65 %, have used LinkedIn for acquiring buyers as of 2012.

RSS: The new content updated on the relevant websites can be delivered to buyers automatically through RSS subscription [RIA]. This is helpful for market search (Barlow, 2011) because RSS provides buyers with more efficient way to check new updates on several websites at a same time.

Content community: Based on contracts negotiated with the vendors, companies can rate the performance of its vendors in real time on the web (Lancioni et al., 2000). Companies can also make use the information about the potential supplier's performance or key characteristics that are rated or reviewed by past or current buyers on the web. Therefore, web rating or review system is helpful not only in monitoring the performance of the suppliers but also in sourcing new suppliers.

Wiki: Suppliers and buyers organisations can utilize wiki to help form strategic partnership. The website allows relevant supply chain partners to create, update and share information related to their deal management (e.g. contract term, regulation or policy) in one place [Collective Intelligence] (Ooi et al., 2011, Harris, 2008).

3.2. Integrated Behavior

Integrated behavior generally refers to coordinated efforts across the supply chain partners (suppliers, manufacturers, distributors, and/or retailers). Coordination indicates working together and complementarily for a shared or a common purpose and goal (Moharana et al., 2012). Cooperation is required at several management levels (e.g. strategic, tactic and operational management) to improve the supply chain network efficiency and the quality of products or services. In addition, Mentzer et al. (2001) suggest that integrated behavior between supply chain partners should be expanded in order to understand ever-changing end-customer needs in a more efficient manner and respond to market change quickly. Key activities to support integrated behavior across supply chain include management commitment to improve robustness and satisfaction level of supply chain members, co-developing and sharing of common policies and strategies, overall performance control, and so forth.

Content community, podcast, wiki, tagging, mashup and RSS support the practice of integrated behavior with the concept of collective intelligence, web as a platform and RIA.

Content community: Supply chain partners can establish a YouTube or SlideShare channel in order to share videos or pictures of best practice across the supply chain (Barlow, 2011, Burrus, 2010) as part of their effort to improve their own supply chain operations.

Wiki: Supply chain partners (especially retailers and suppliers) can collaboratively create a wiki site in order to educate and train internal and external employees (Burrus, 2010). The education information offered by multiple experts is highly possible to be informative and supportive.

Tagging: Organisation tagging tool enables search engine to correctly identify the required individuals regardless their position and location. Further, this tool can be helpful to develop employees' social networking which promotes close cooperative ties with other parties (Liu and Liu, 2009). Consequently, it enables quicker and better joint problem solving [Collective Intelligence].

Podcast: Podcast is useful for informal education and training. Podcast allows members to record directly their experiences in a form of audio or video content and broadcast them through the Internet [Web as a platform]. Thus, members can save time and effort in creating training documents (e.g. power-point presentations). Through RSS subscription, the system will send the updated content automatically to the participants, and the participants just need to download the necessary files and can access them on their mobile devices at any time and anywhere. Consequently, it improves learning effect, which can indirectly lead to enhanced processes and integrated behavior in fulfilling consumers' demand (Liu and Liu, 2009).

Mashup: Companies especially buyers can use mashup in order to monitor the performance of not only the company itself but also the suppliers. As mashup facilitates the ease of combining and transforming various performance measurements internally and externally from business partners, new performance metrics can be created easily according to specific situations and displayed for monitoring purpose [Web as a platform] (Goh et al., 2007)

RSS: It is important to regularly update news and information, which are necessary to particular supply chain partners in some of B2B websites. Through RSS, supply chain partners can gather different web sources automatically at one place. It ensures that supply chain partners have the latest news and information which help achieve integrated behavior (Ooi et al., 2011).

3.3. Information Sharing

Related to integrated behaviour, mutual information sharing among supply chain partners is an important practice to reduce uncertainty, especially for planning and monitoring processes in SCM (Mentzer et al., 2001). Yu et al. (2001) suggest that getting information about other supply chain participants helps reduce uncertainties. For example, timely sharing of information such as inventory level, sales volume, demand forecast, marketing strategy, and delivery strategy reduce the bullwhip effect between supply chain partners. This in turn leads to the reduction in inventory and backorders and increase in sales (Mentzer et al., 2001, Zhao et al., 2002, Yu et al., 2001).

Mashup, micro-blog and RSS have been identified as tools that can support information sharing practice with the concept of web as a platform, RIA and collective intelligence.

Mashup: To support order and/or inventory tracking activity and to streamline the process of manufacture and/or delivery, supply chain partners can set up a mashed up application that combines Google maps API and listings of supply chain participants. By enabling any changes in inventory level and/or sales volume of supply chain participants to be shared in the same domain, each role in supply chain can adjust their replenishment plan to meet customers' demands while keeping a relatively low stock level, which saves cost of inventory management. Also, transport cost can be reduced dramatically as suppliers can determine transport routes via Google map (Koris et al., 2008). Likewise, SCM operational activities-related information (e.g. inventory level and sales volume) can be shared in a rich form and in real time [RIA].

RSS: Companies can get the required news from specific supply chain partners timely through subscribing RSS feed (Goh et al., 2007). For example, if there is a delay in product delivery, a change

in price or service, or a new product, the news can be automatically delivered to the relevant partner(s) [RIA].

Micro-blog: Micro-blog like Twitter can provide the fastest way to spread pressing issues (e.g. unexpected situation or incident, or sudden change) to a large number of supply chain members (Burrus, 2010). Consequently, the companies can take more effective action for both expected and unexpected issues and changes.

3.4. Collaboration

Collaboration refers to joint implementation and operational efforts to produce mutual benefits across the supply chain members. Collaboration is important as it promotes new business value and creates opportunities. Key activities involve joint innovation, planning, forecasting and decisions.

Social networking sites, blog, wiki, content community and tagging and social bookmarking can support the collaboration practice with the concept of collective intelligence.

Social networking sites: Employees need to communicate and collaborate across the departments and companies in SCM. Through social networking sites (e.g. Facebook), supply chain members can be linked with each other easily (Burrus, 2010). Members can exchange and share their opinions, thoughts, videos and pictures via social networking channel regardless of time and place. In other words, social networking tool can create a new culture, which supports sharing opinions and ideas between members more easily [Collective intelligence]. It may increase employees' satisfaction, and thus support knowledge sharing internally and externally. Furthermore, news or announcements needed for specific member(s) can be delivered conventionally (Ooi et al., 2011).

Blog: Collaboration across departments and companies can be facilitated when supply chain members can share knowledge and express opinion conveniently using their own blogs [Collective intelligence] (Chen, 2009). A variety of collaboration vertically and horizontally within a company or across companies can play a key role to discover brilliant and fresh ideas for mutual business development with less research and development (R&D) cost. Thus, proper use of blogs among members may be greatly helpful for enhancing innovative capability of companies. Furthermore, with active participation of supply chain members, companies can secure a large amount of priceless intelligence asset that helps in making various decisions.

Wiki: In SCM, it is also important to harness and update creative thoughts and ideas of members in real time. For example, the collected suppliers' and customers' views on a product or a service in a wiki page would be informative for product/service development and innovation [Collective intelligence] (Goh et al., 2007). The wiki technology that allows tracking of changes made to the page(s) can be used to effectively manage in-progress project information within a business and across businesses. A wiki tool can play a role as a useful knowledge repository in SCM.

Content community: All supply chain partners can participate in voting on new product lines or product development ideas on the web [Collective intelligence]. Further, this collaborative work not only would lead to a higher level of end-customer satisfaction, but also help calculate and forecast initial demand (Ooi et al., 2011).

Tagging and Social bookmarking: Via tagging and social bookmarking tools, supply chain members can collect, classify and share web search results (Razmerita et al., 2009). This would be useful for amassing business intelligence and market information in a collective way which also facilitate collaboration among different parties [Collective intelligence] (Barlow, 2011)

3.5. Risk and Reward Sharing

Improving supply chain performance through partnerships requires a fair distribution of risks and benefits (Ha et al., 2011, Mentzer et al., 2001). Ha et al (2011) found that the mutual sharing of risks and benefits allows the suppliers to participate more actively in their purchasing, marketing, and product/service development processes. It also helps building trust between trading partners and strengthen relationship.

The concept of SaaS can support the risk and reward sharing practice. We do not identify any existing web 2.0 tools that are particularly relevant to facilitate this practice. Specific applications must be developed based on the concept of SaaS which can facilitate cost, benefit and risk sharing among supply chain partners.

SaaS: One of the limitations of EDI or other B2B platforms is the high cost of server, including hosting and maintenance fees (Ooi et al., 2011). With the concept of SaaS, supply chain partners can use their application through the Internet using a browser while only paying for the volume of services or fixed fee instead of software license because service provider support and maintain it, giving partners 24/7 access from any device anywhere. Furthermore, the cost of hardware, software and IT staff can be significantly reduced or eliminated, and thus the partners can share infrastructure and other related costs. Moreover, SaaS-based applications support supply chain partners with better flexibility, scalability and accessibility (He et al., 2007). It helps provide integrated and enhanced services to end-customers.

3.6. Processes Integration

Seamless integration of supply chain activities and processes from the point-of-origin to the point-of-consumption is necessary for improving the overall supply chain performance (Simchi-Levi et al., 2008, Schnetzler and Schönsleben, 2007). However, process integration has always been difficult, particularly in the context of supply chain management.

The concepts of web as a platform and SaaS support the processes integration practice. No existing web 2.0 tool is particularly relevant.

Web as a platform: The heterogeneous software applications and platforms often affect the complexity of integration within the supply chain. In web 1.0 era, some organisations cannot integrate their existing applications with their supply chain partners due to the compatibility issue (Ooi et al., 2011). With 'Web as a platform' concept, supply chain members can access the supply chain applications through any PC with Internet connection. Therefore, the complexity of processes integration between organisations can be reduced. Furthermore, with the growth of mobile devices (e.g. mobile phone, iPad, iPod), web 2.0 technologies support enhanced processes integration especially for supply chain organisations moving toward globalization in dynamically changing business environment.

SaaS: SaaS enables organizations to use supply chain applications offline. Data will then be synchronized with the server when the connection is re-established. As many organisations move toward globalization, the feature of 'offline SaaS' supports the idea of mobile offices (Goh et al., 2007).

3.7. Customer Relationship Management

Customer relationship management (CRM) refers to integrated approach to managing and developing relationships with customers (Johnson and Mena, 2008). Key activities include understanding and anticipating the needs of existing and potential customers' needs, capturing customers' hearts, and ensuring and managing customers' satisfaction. Linking CRM to SCM improves corporate performance especially in marketing, sales, and service operations (Johnson and Mena, 2008, Zeng et al., 2003).

Micro-blog, social networking sites, content community and blog can support CRM practice with concepts of RIA and collective intelligence.

Micro-blog: Twitter's real-time communication can be used as an obvious method to solve customer problems immediately (Burrus, 2010, Case and King, 2011). Companies can also use Twitter in order to promote perishable products/services rapidly and widely. Dell, for example, uses Twitter to deliver information about their corporate culture to their customers. This, in turn, enhances trust and satisfaction level of customers and attract more customers (Case and King, 2011).

Social networking sites: Social networking site helps gather customers' feedbacks on advertised products, build customer loyalty, and improve marketing ("Social networking", 2009). Supply chain

partners can use Facebook to introduce their products or services. Social networking site like Facebook allows existing and future customers to put comments and generate their own content around the products or companies [Collective Intelligence]. In addition, customers can click a 'Like' button on companies' Facebook page, which creates a direct communication between the enterprise and customers (Hopkins, 2012). What customers like can also be seen in all their friends' news feeds.

Content community: Companies can use content community like YouTube to introduce and show their products and services to customers (Barlow, 2011). As an example, Dell provides YouTube channel of their version, called 'StudioDell'. Through the channel, Dell offers customer educational contents about their products/services in an enjoyable and easy-to-understand manner (Liu and Liu, 2009). Therefore, content community such as YouTube can play key roles for educating customers and promoting their products/services.

Blog: Blogs allow customers to post their queries or issues, and employees and other customers can respond to requests to solve the queries or issues. As a real case, Direct2Dell blog of Dell is used as a marketing and promotional tool. It enables local employees to exchange the required information with their customers in their local language in order to enhance relationship with local customers (Liu and Liu, 2009). In SCM, close relationship with customers and active exchange of information between suppliers and customers would potentially improve demand forecasting and understanding of changing customers' needs. Besides, customers can share their opinions on the products/services and possible ways of improving better products/services (Gerow and Miller, 2010).

4. DISCUSSION AND CONCLUSION

To understand the potential use of web 2.0 on the overall SCM practices, we have reviewed the relevant literature and identified a number of web 2.0 concepts and tools which are relevant for SCM. We adopt Mentzer et al. (2000)'s classification of SCM practices and then synthesize the potential use of web 2.0 for each practice based on the existing studies. Based on our study findings, there are a number of key observations that we would like to highlight.

Firstly, our study finding indicates that 'collective intelligence' appears to be the most useful and relevant concept of web 2.0 in the context of supply chain management (see Appendix 1). A number of existing studies (Burrus, 2010, Ooi et al., 2011, Liu and Liu, 2009, Chen, 2009, Goh et al., 2007) have identified the relevance of collective intelligence in supporting supplier relationship management, integrated behavior, information sharing, collaboration and customer relationship management. Due to the social nature of web 2.0 and the fact that many challenges faced by organizations in managing the supply chain activities are related to human aspects such as collaboration, information sharing and trust (Kurnia and Johnston, 2000, Simchi-Levi et al., 2008), organizations may need to devise appropriate strategies to utilize the popular web 2.0 technologies to improve relationships with trading partners for mutual benefits. Although our study does not identify previous studies that show how the concept of collective intelligence supports risk/reward sharing and process integration, we argue that through the positive impacts of web 2.0 on other SCM practices, particularly through a higher level of transparency and partnership across supply chain participants, organizations can work more effectively towards risk/reward sharing and process integration. This concept is not mutually exclusive from the other three concepts since web as a platform, SaaS and RIA enable collective intelligence concept to be achieved.

In terms of the web 2.0 tools, our study indicates that different tools can be useful for particular SCM practices (see Appendix 2). For example, our literature synthesis shows integrated behavior of SCM can be supported by various web 2.0 tools such as RSS, mashup, wiki, content community, podcast and tagging. Thus, organizations need to carefully select appropriate tools to support some aspects of SCM practices that would fit their organizational culture and requirements since each tool has its own strengths and weaknesses. For risk/reward sharing and process integration, although our study does not identify any existing web 2.0 tools that are relevant, we have identified some studies (Goh et al., 2007, Fujii, 2010, He et al., 2007, Ooi et al., 2011) that show how the concept of SaaS can support these two practices. Thus, we can expect different tools and applications to emerge in near future that

are based on the concept of SaaS that facilitate risk/reward sharing and process integration among trading partners.

Despite of the potential of web 2.0 in SCM, there are some challenges identified in our study. Firstly, it is important to understand organizational culture and to select and adopt web 2.0 tools that fit the organizational culture. In doing collaboration work, for example, some inactive members may prefer to write content themselves and add comments on other's posting, and some other active or collaborative members may prefer to work together on the web. Thus, companies should figure out carefully about their cultural issue and consider about how to reduce the gap in order to maximize the benefits of using web 2.0 tools. Secondly, companies should understand possible risks such as data security, privacy and confidentiality and educate supply chain members (Rudman, 2010). Companies should also conduct cost-benefit analysis carefully before adopting any web 2.0 tools. SaaS payment models offer lower adoption costs, but it remains unclear whether the cost of leasing service is more beneficial than an in-house system for the long-term (He et al., 2007).

Our study has a number of limitations. Firstly, this is a conceptual study and our analysis is only based the existing literature focusing on the potential use of web 2.0 for managing supply chain. Future studies would be needed to explore the actual use of applying different web 2.0 tools and concepts for specific SCM practices through case studies. Secondly, our literature coverage may not cover all possible existing studies of web 2.0 and SCM, which are still rather fragmented. Finally, an in-depth exploration of the benefits and challenges of utilizing web 2.0 in SCM is required to complement the study. Nevertheless, since the use of web 2.0 technologies for managing supply chain is still emerging, this study offers a useful and initial guide regarding the potential use of web 2.0 for SCM, which is currently lacking in the literature.

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Appendices

Web 2.0 concept SCM practice	Web as a platform	SaaS	RIA	Collective Intelligence
SRM			Barlow (2011)	Burrus (2010), Ooi et al. (2011), Lancioni et al. (2000), Harris (2008)
Integrated behavior	Liu and Liu (2009), Goh et al. (2007)		Ooi et al. (2011)	Burrus (2010), Barlow (2011), Liu and Liu (2009)
Information sharing			Goh et al. (2007), Koris et al. (2008)	Burrus (2010)
Collaboration				Burrus (2010), Ooi et al. (2011), Goh et al. (2007), Chen (2009), Razmeria et al. (2009)
Risk / Reward sharing		Ooi et al. (2011), Fujii (2010), He et al. (2007)		
Processes integration	Ooi et al. (2011)	Goh et al. (2007)		
CRM			Burrus (2010), Case and King (2011)	Barlow (2011), Liu and Liu (2009), Social networking (2009), Miler et al. (2010)

Appendix 1. Web 2.0 concepts and its supporting SCM practices

Web 2.0 tool SCM practice	RSS	Mashup	Blog	Wiki	Micro-blog	Social network site	Content community	Podcast	Tagging / Social
SRM	Barlow (2011)			Ooi et al. (2011), Harris (2008)		Burrus (2010)	Lancioni et al. (2000)		
Integrated behavior	Ooi et al. (2011)	Goh et al. (2007)		Burrus (2010)			Burrus (2010), Barlow (2011)	Liu and Liu (2009)	Liu and Liu (2009)
Information sharing	Goh et al. (2007)	Koris et al. (2008)			Burrus (2010)				
Collaboration			Chen (2009)	Goh et al. (2007)		Burrus (2010), Ooi et al. (2011)	Ooi et al. (2011)		Burrus (2010), Raznerita et al. (2009)
Risk / Reward sharing									
Processes integration									
CRM			Liu and Liu (2009), Millet et al. (2010)		Burrus (2010), Case and King (2011)	Social networking (2009)	Barlow (2011), Liu and Liu (2009)		

Appendix 2. Web 2.0 tools and its supporting SCM practices