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## **Master's Thesis**

**Supply Digitalization: The Use of Web 2.0 Tools in Supply Chain Management.**

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## **Abstract**

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The world's globalization is increasing rapidly, and competition among companies increases at the same time. In order to survive the competition, companies are finding solutions to improve the efficiencies of their supply chain and purchasing processes. Rapidly improving technological solutions provide the tools to streamline operations and to collaborate more with other companies.

This study focuses on if companies use web 2.0 tools in their SCM and purchasing operations. Web 2.0 is already in use among consumers, and in some business functions such as marketing. This study consists of an extensive literature review about earlier IT solutions used in SCM and web 2.0 tools and their possible use in SCM. The study was conducted as a case study, and 5 representative of a global chemical company was interviewed. The main findings of this study was that web 2.0 tools are not extensively used in SCM and purchasing. The most tools used are Voice over IP and instant messaging. The benefits are more efficient communication, and time saving. It is identified that web 2.0 tools could improve buyer-supplier collaboration in many ways, but many barriers must first be resolved. The biggest barriers for implementation are fear of IT security, fear of leaking sensitive information, and organisational culture. The greatest potential of web 2.0 would be improved collaboration with other companies and suppliers, crowdsourcing and improved information sharing and information gathering with and from other companies.

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Maailma globalisoituu yhä enemmän, ja tämä kiristää yritysten välistä kilpailua. Pärijätäkseen kilpailussa, yritykset yrittävät löytää keinoja tehostaakseen toimitusketjuun ja ostamiseen liittyviä prosesseja. Nopeasti kehittyvä IT teknologia tarjoaa ratkaisuja prosessien virtaviivaistamiseen ja se mahdollistaa myös tehokkaamman yhteistyön eri yritysten kanssa.

Tämä tutkimus perehtyy siihen käyttävätkö yritykset web 2.0 työkaluja toimitusketjun hallinnassa. Web 2.0 työkaluja käytetään paljon tavallisten ihmisten keskuudessa, ja yritykset käyttävät niitä esim. markkinoinnissa. Tämä tutkimus koostuu kirjallisuuskatsauksesta, jossa perehdytään aiempiin teknologisiin ratkaisuihin toimitusketjun hallinnassa, sekä web 2.0 työkaluihin sekä niiden mahdolliseen käyttöön toimitusketjun hallinnassa. Tutkimus on tapaustutkimus, jossa case-yrityksenä toimii kansainvälinen kemikaaliyritys, ja haastateltavana oli 5 yrityksen hankintaosaston työntekijää. Tulokset osoittivat, että web 2.0 työkaluja käytetään varsin vähän hankinnoissa. Käytetyimmät työkalut ovat Voice over IP sekä instant messaging. Hyötyjä ovat tehokkaampi kommunikointi sekä ajansäästö. Tutkimus osoittaa, että web 2.0 voisi parantaa ostaja-toimittaja yhteistyötä monella eri tavalla, mutta suuria esteitä tulisi ensin poistetaan. Suurimmat käyttöönoton esteet ovat ongelmat tietoturvassa, tiedon leviämässä ja organisaatiokulttuurissa. Web 2.0 voi parantaa yhteistyötä, selkeyttää kommunikaatiota sekä parantaa tiedon jakamista ja sen etsimistä muiden yritysten kanssa.

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## **Definitions**

**Web 2.0:** *“Web 2.0 is a set of economic, social, and technology trends that collectively form the basis for the next generation of the internet - a more mature, distinctive medium characterized by user participation, openness, and network effects”* (Musser and O’Reilly 2006, p. 5).

**Electronic supply chain management (E-SCM):** The Council of Supply Chain Management Professionals define SCM as *“the planning and management of all activities involved in sourcing and procurement, conversion, and all logistics management activities. Importantly, it also includes coordination and collaboration with channel partners, which can be suppliers, intermediaries, third party service providers, and customers. In essence, supply chain management integrates supply and demand management within and across companies”*. (CSCMP 2016) And in addition, *“E-SCM must also integrate technology, especially the internet, in an effort to speed communication and information flow throughout the supply chain”* (Lancaster et al. 2006) and *“E-SCM focuses on the management of information flows and represents a philosophy of managing technology and processes in such a way that the enterprise optimises the delivery of goods, services and information from the supplier to the customer”* (de Búrca et al. 2005).

**Cloud computing:** can be defined as *“covering software applications delivered through the internet, and also the hardware and system software that is used within data centres to provide those services”*. For most companies this means that software and IT services are provided to corporations by a third party, and the software is delivered via internet. The hardware and other systems are outsourced to this service provider, which is responsible for the software updates, operating systems and technical issues. (Ojala and Tyrväinen. 2011)

**Electronic data interchange (EDI):** *A business software that “involves a communications standard that supports inter-organisational electronic exchange of common business documents and information”* (Monczka et al. 2009, p. 77).

**Enterprise resource planning (ERP):** *“A packaged business software system that lets an organisation automate and integrate the majority of its business processes, share common data and practices across the enterprise and produce and access information in a real-time environment. The ultimate goal of an ERP system is that information must only be entered once”* (Marnewick et al. 2005)

## 1. Introduction

*“The Internet/World Wide Web will be the backbone of electronic purchasing.”* stated Carter *et al.* (2000) in their article, as they forecasted what are the merging trends in supply chain management in the upcoming ten years. The internet is a permanent part of peoples’ lives, and corporations cannot conduct business without it anymore. Rapid development in information and communications technologies (ICT) and ever increasing interconnectedness of people and organisations has made the world practically dependent on internet and modern ICT devices, such as computers and smartphones.

Web 2.0 refers to set advanced internet technologies that have made social media and other similar functionalities possible. This has created a modern day phenomenon, as web 2.0 technologies have revolutionized peoples’ ways of interacting and communicating with each other over the internet (O’Leary 2011). Some of the most well-known web 2.0 technology enabled websites are Facebook, YouTube, Blogger and Twitter. All of these allow users to upload and share their own content on the website (such as pictures and videos), share information and to modify the content of the websites by commenting and reviewing. Social media and web 2.0 tools are becoming ever more important for organisations, as it is estimated that there will be almost 3 billion active social media users by 2020, as the number and availability of smartphones and mobile services will increase (Statista 2017).

So far, much of these web 2.0 tools are developed to be used among the common people, and social media has become a platform where people socialise, interact and share information with each other. Gradually this development has shifted to be used in business-to-consumer (B2C) context, as companies are using web 2.0 tools in various processes, such as customer relationship management (CRM), marketing and brand promotion. The main purpose is to communicate and interact with customers, but organisations are also progressively using web 2.0 tools in internal communications and even in the recruiting process of new employees. (Human Resource Management International Digest 2013) However, organisations are increasingly beginning to use web 2.0 tools in business-to-business (B2B) context, as they provide tools to communicate and collaborate with customers, suppliers and other stakeholders (Howells 2011).

As digitalization is developing rapidly, it is important to understand the potential benefits of new technologies on business performance. Web 2.0 tools are already being taken to use in organisations to some extent, but there is little evidence of using web 2.0 tools in supply

chain management. Web 2.0 has been studied much, and organisations are increasingly adopting it, but the use has mainly been limited to sales, marketing and public relations. (Almeida 2012) But organisations are starting to see the potential of web 2.0 services in other organisational functions. In the annual Deloitte Global Chief Procurement Officer survey 2016, it is reported that 16% of CPOs were investing in social media solutions to support procurement activities in 2015, compared to 6% in 2014. And especially 23% of CPOs in the EMEA regions are investing in social media compared to 8% globally. The survey was based on interviews with 324 CPOs in 33 countries. (Umbenhauer and Gregson 2016)

## 1.1 Background

Supply chain management (later referred as SCM) has changed dramatically from what it used to be in the beginning of the 21<sup>st</sup> century. Rapidly developing technology, and the world globalization that is a direct consequence of this, has leveraged the scope of business as competition has transformed from being local to global and the world continues to integrate further on. Development in information and communications technology, especially the internet, has made the markets more price sensitive as more information is available to buyers, and these buyers have the opportunity to source from a very large supplier base which practically covers the whole world (Lancaster *et al.* 2006). As competition increases, companies have to seek for excellence in SCM. This has awakened corporate managers to exploit new technologies in SCM as "*Firms with the most competitive supply chains are and will continue to be the big winners in contemporary business*". (Presutti, 2003)

Exploiting the internet in SCM as a phenomenon is not that new. As ICT improved and internet became available for the public, corporations have used the internet in various organisational functions, such as communications and resource planning. Internet-based SCM software, also known as e-procurement or e-supply chain management (E-SCM), are already widely adopted by companies and they are associated with several benefits, such as decreased costs, improved communications and tracking of inventory levels. (Lancaster *et al.* 2006) There are a variety of corporate E-SCM technologies to choose from, spanning from applications with a specific function to software that can perform multiple tasks and integrate processes within the firm.

In today's competitive and turbulent business environment, it is not necessarily a viable option for companies to invest in large-scale business software. Competition requires



companies to cut costs and supply chains need to integrate and share knowledge among partners to reduce outside threats and to respond rapidly to changes in the markets.

For companies, there are software and applications available that require heavy investments in licenced programs and new ICT infrastructure, such as new computers and data centres. Heavy investments as such are beginning to be out of date, as they can prove to be expensive when it comes to time and money. New applications arise as technology improves, and software that has been designed and implemented primarily among ordinary consumers and not in business-to-business context, are finding their way to SCM practises. Two emerging technologies are receiving more attention in literature when it comes to IT in SCM: cloud computing and web 2.0.

Cloud computing is a highly popular subject among organisations in these days. Moving to cloud computing means that software and IT services are provided to corporations by a third party, and the software is delivered via internet. The hardware and other systems are outsourced to this service provider, which is responsible for the software updates, operating systems and technical issues. (Ojala and Tyrväinen 2011) These kind of systems allow people and organisations to access the same data and software anywhere in the world with a device that has an internet-connection. (Bruque Cámara *et al.* 2015)

Web 2.0 is an example of cloud-based software, and as a term it is also used as a synonym for social media. Social media refers to applications that allow users to generate their own content and to interact with each other over the Internet. (O'Leary 2011) For example, blogs, mashups, wikis, collaborative websites, Voice over IP, podcasts, tagging, social networking and Really Simple Syndication (RSS) are some technologies that use web 2.0 technologies, and they are provided to users via cloud platform. Cloud computing enables users to access these web tools in any location as long as there is an internet connection and a web browser. (Almeida 2012, Bruque Cámara *et al.* 2015) "*Web 2.0 is a set of economic, social, and technology trends that collectively form the basis for the next generation of the internet - a more mature, distinctive medium characterized by user participation, openness, and network effects.*" (Musser and O'Reilly 2006, p. 5).

As e-procurement systems have been studied much in the recent years, and their effects on SCM are undeniable, cloud computing and web 2.0 are not yet fully implemented in SCM. Cloud computing has been implemented to some extent in corporate management and web 2.0 in other organisational functions, such as marketing and customer service. But as the competitive environment intensifies, there is need for more integration and

knowledge sharing among supply chain networks. “*Cloud and Web 2.0, which are designed to bind, share and connect the links in the firm’s value chain, can also have a major impact on the elements that comprise the supply chain*”. (Bruque Cámara et al. 2015)

## **1.2 Objectives, research questions and limitations of the research**

Internet has become a permanent part of corporations’ everyday business, and is evolving and shaping all the time. The main objective in this research is to study how new internet-based software, made possible by the development of technology, can be used in organisations’ supply chain management. Especially this study will focus on how web 2.0 systems can contribute to SCM. The main research question is:

- *Are organisations using web 2.0 tools in procurement/SCM and what are the benefits?*

The main research question will be supported with three sub-questions:

- *If a company uses web 2.0 tools in procurement/SCM, what tools are used and which are the most important?*
- *What are the advantages and disadvantages of using web 2.0 tools in procurement/SCM?*
- *What are the enablers and obstacles for using web 2.0 in procurement/SCM?*

The objective of this study is to examine whether or not organisations are using web 2.0 tools in SCM, and to truly understand the potential benefits of implementing web 2.0 tools in SCM, and what value is added to the supply chains compared to existing E-SCM systems. It is also important to understand what is needed to implement these technologies, and how does the implementation differ compared to conventional SCM technologies. Secondary objective of this study is to understand the potential usefulness of web 2.0 tools in SCM. If organisations do not use web 2.0 in their SCM activities, it is interesting to find out do the people in charge of these operations see any potential benefits in using these tools as a part of their daily activities, or are there too much disadvantages that make the adoption of these tools in SCM useless.

### **1.3 Limitations**

In this research the focus will be on how web 2.0 applications are used in procurement and SCM and what are the benefits of their implementation. There will be a short study on different forms of E-SCM and cloud computing, how these have developed in the past and how they are linked to web 2.0. However, the e-procurement and cloud computing systems will be left out of the empirical analysis. The empirical part focuses on whether or not companies are using web 2.0 tools in purchasing or SCM, and what are the benefits, potential and risks related to use. The empirical part will make a short review if there are other emerging systems that companies are pursuing in. The results of this study are based on a small number of interviews conducted in a single company, so the results cannot be fully generalised to any industry or business. Also the time of conducting this research may have an effect on the results, as technology and business environments are developing rapidly.

### **1.4 Research methodology**

This study is a qualitative research, and will be carried out as a case study. The empirical analysis of this research will be based on a set of semi-structured interviews. In a case study, a small group of participants is intensely examined, and conclusion can only be drawn regarding the participating group. The purpose may not always be the finding of generalizable truth, but more emphasis is placed on creating deeper understanding about the phenomena and to better describe it. (Colorado State University 2017) But although the purpose of case studies might not be the generalization of studied subjects, the case study results can be generalized to some extent through connections and similarities between research objects. Case study also enables readers to make own conclusion based on the results. (Metsämuuronen 2005, s. 206)

The case studies will be conducted through a set of semi-structured interviews. This is a suitable methodology for this research since the subject of research is a fairly new phenomenon, and there is only limited amount of literature available. In a semi-structured interview, the interviewees answer to predetermined set of questions, but not to predetermined set of answer alternatives. This allows the interviewee to answer more freely, compared to a fully structured interview, where the interviewees choose their answers among fixed set of alternatives. The ability to answer freely can generate more conversation, which allows more in-depth analysis of opinions and can bring up new

aspects on the research subject outside the survey. (Saaranen-Kauppinen and Puusniekka 2013)

### 1.5 Research Gap

E-procurement and the effect of internet on SCM have been widely studied over the years, increasing over time as we move towards present day. E-procurement and application of information systems is “*a phenomenon that continues to receive managerial attention and, consequently, academic interest*”. (Quesada *et al.* 2010)

New software and programs are created as the internet develops. The main difference in the old and new technologies are the amount of participants needed to be effective. For example, ERP systems are used to process information, create reports and to execute transactions, whereas “*Web 2.0 technologies are interactive and require users to generate new information and content or to edit the work of other participants*”. (Chui *et al.* 2009)

As stated earlier, organisations are already utilizing web 2.0 tools in several functions. Many scholars also see the potential of web 2.0 tools, and these could also benefit companies in other functions besides CRM and marketing. In figure 1 there is an illustration of how web 2.0 tools can have a bigger impact on businesses than earlier technologies (such as ERP), as web 2.0 tools are more collaborative, they allow better bottom-to-top approach when working and it can allow a broader set of employees to be engaged in projects. (Chui *et al.* 2009)

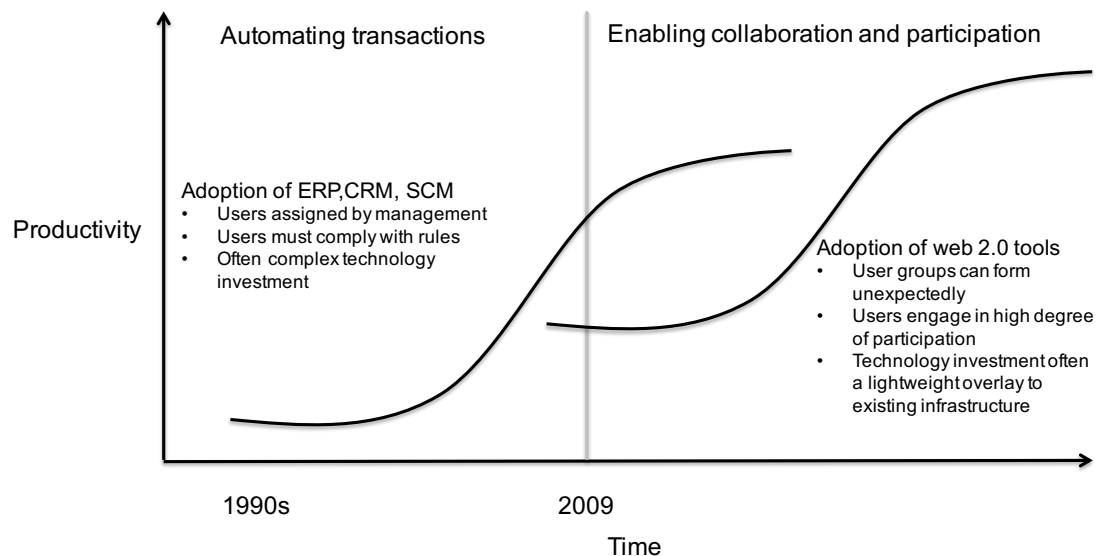


Figure 1. Adoption of corporate technologies (Chui *et al.* 2009)

The impact of web 2.0 tools on SCM has been studied in some researches, but no large-scale effort has been made to study the effects of web 2.0 in SCM. But the development of technology, and the improvement of ICT devices (such as smartphones) increase the potential impact of web 2.0 tools on SCM. (Bruque Cámara *et al.* 2015) O'leary (2011) examined how some social media tools could be used in SCM, but as it is also mentioned in the article, research on social media and its application to SCM is limited as corporations use these tools only little or not at all in SCM. The article provides some examples on how social media could be used in SCM (enhanced collaboration, sentiment analysis) and also some limitations that could impede the adaption of social media tools in SCM (information privacy and protection). The article itself lacks depth as it focuses only on few web 2.0 tools, but this could be due to the time period the article was written.

Bruque Cámara *et al.* (2015) studied the connection between cloud computing and web 2.0 tools on operational performance through supply chain integration. The findings supported theory about the importance of supply chain integration, and it is positively related to operational performance. Cloud computing can be used as a tool to improve integration, but relations between web 2.0 and supply chain integration was not found.

Baxter and Connolly (2014) conducted a literature review about implementing web 2.0 tools in organisations, and presented their own web 2.0 implementation framework. They go through some examples how companies use web 2.0 tools in their functions and conclude that the main feature of web 2.0 tools is to improve communications and knowledge sharing internally. It is also mentioned that research on web 2.0 tools in organisations is increasing, but it focuses on the use of the tools instead of the reasons why these were implemented in the first place.

Overall there is a lack of empirical evidence about the effects of web 2.0 tools on SCM. Web 2.0 tools are used in multiple organisational functions, but rarely in SCM. However, many studies indicate that web 2.0 tools can be useful and the effects should be studied more, as the impact on supply chain performance could be significant. Many scholars see much potential in web 2.0 tools in organisations and especially in SCM. As web 2.0 tools are becoming more common in organisations, it is important to study how these could be used in SCM.

## 1.6 Theoretical framework and structure of the research

E-SCM has a crucial role in modern SCM, as global competition is increasing. Different web technologies are proven to facilitate communications and enhancing operations efficiency, thus improving supply chain performance. (Tarofder *et al.* 2013) Also there can be severe obstacles when implementing new tools in SCM and within the supply chain network. Problems may arise from lack of commitment, lack of trust, lack of sharing knowledge among trade partners, and from unevenly distributed profits and costs. (Lancaster *et al.* 2006) Figure 2 illustrates the theoretical framework of this study.

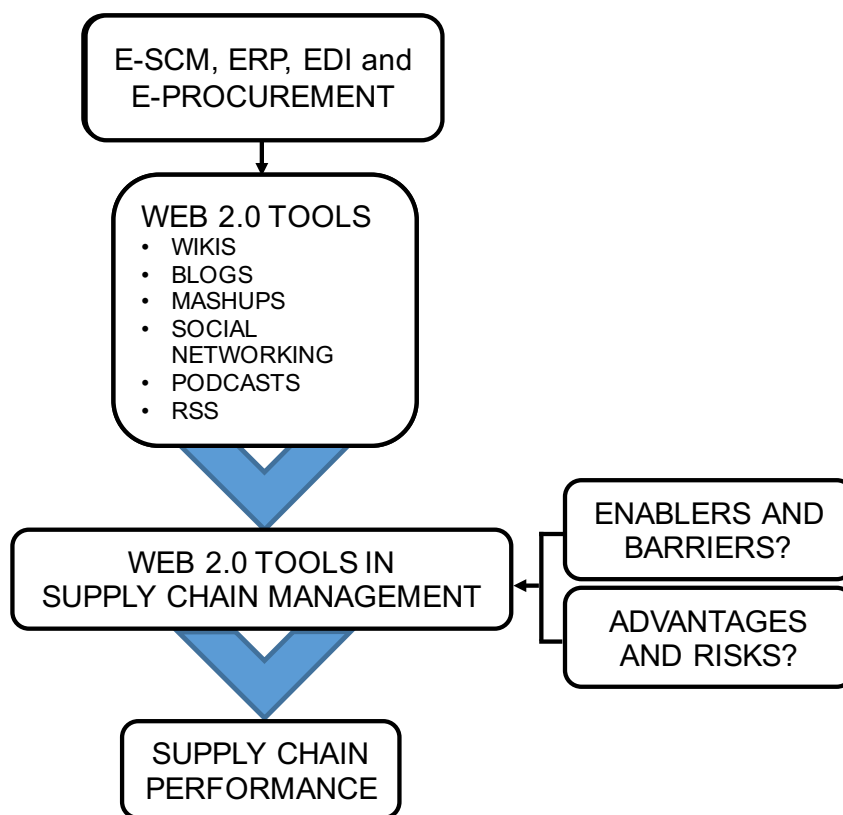


Figure 2. Theoretical framework of the research

When studying the effects of new technologies on SCM, one first has to understand the preceding technologies, and what different and new characteristics they have brought to SCM. The focus of the research lies on the effects of web 2.0 tools in purchasing and SCM. These tools are identified, and the possible advantages of implementing these tools and associated risks must also be identified. But most importantly, this research will try to find out what additional and new value web 2.0 tools can provide for purchasing and SCM. There is also a need for identification of the success factors that make the implementation

possible. All before mentioned aspects are studied in the light of how these contribute to improving supply chain performance.

The paper is constructed as follows. In section 2, there is a study about different electronic procurement tools, and how they have developed in the past. EDI, ERP and e-procurement tools are examined, and their advantages and disadvantages are reviewed. In section 3, cloud computing and web 2.0 tools are examined, and a review is made on how web 2.0 could be used in SCM. The potential advantages and risks are examined. In section 4, some possible alternative solutions, IoT and Big Data, are introduced and examined how they could be used in SCM. Section 5 will focus on the research methods of this study. In section 6, an empirical study and analysis is made whether or not organisations are using web 2.0 tools in SCM, and do professionals see any potential or risk in using them. The future trends of SCM and purchasing will also be discussed. The empirical part is based on set of 5 interviews with procurement professionals in a global chemical company. In section 7, conclusions and recommendations based on theory and empirical results are provided.

## 2. Electronic supply management

In this section there will be a view about e-procurement systems, how they have developed and how the internet can be utilized in supply management. **E-procurement** can be defined as “*any technology designed to facilitate the acquisition of goods by a commercial or a government organisation over the internet*” (Davila et al. 2003).

### 2.1 Beginning of E-SCM & EDI

Since the end of the 20<sup>th</sup> century, there has been more focus on the performance of supply chain management. As almost 70% of corporate revenues are spent on supply chain activities, such as procurement of materials and logistics, there is pressure to drive for excellence. As global competition increases, organisations have to gain competitive advantages through “*product innovation, higher quality, and faster response times, all of which must be delivered, in most cases simultaneously and always at the lowest costs attainable*”, because in a competitive environment, the capability to raise prices does not result in profitability. (Presutti 2003)

Before modern times, purchasing and supply management activities were not very reciprocal and collaborative, because supplier relationships were adversarial in nature. This resulted from the view that the main function of procurement was to act as efficient as possible, and this efficiency was measured in lowest purchasing costs as possible. This led to buying organisations to use multiple suppliers and competitive bidding to push down purchasing costs, and arm’s length relationships were maintained as it would be easier to change suppliers when needed. But as global competition increased quickly since the late 1970s, organisations realized that they could survive competition by collaborating with suppliers. Intense competition forced buyers to see supplier as source of added value, and to truly harness the potential benefits sourcing from suppliers, the buyers had to deepen collaboration with suppliers and to share information throughout the value network. (Monczka et al. 2009, pp. 24-25)

In today’s competitive environment, it is not all about who can provide goods to consumers with the lowest price possible, but more who can provide the most added value. Off course the ability to cut costs is valuable, but today buyers and consumers appreciate other factors as well. The “four Ps’; product, price, promotion and place can be replaced with “the four R’s: reliability, responsiveness, resilience and relationships”. Reliability in SCM means reducing performance variability and ensuring deliveries to be



on time, since many organisations are relying in small inventories to save costs. Responsiveness is associated with ability to shorten lead times and increasing flexibility by eliminating non-value adding activities. And as modern supply chains are ever more complex, they need to be resilient to stand up for sudden events and interruptions. This has to be done by improving risk management and collaboration across the supply chain. The final R, relationships, stands for creating strategic partnerships across the supply network to gain mutual benefits by deepening collaboration, sharing information and thus achieving cost reduction and improved quality. All these four R's might be costlier to implement than strategies in the past, but they often result in better cost effectiveness and other benefits. (Waters 2010, pp. 8-10)

Even though that it was widely known that supply chain integration and collaboration has several benefits, such as cost minimization and more flexible processes, companies did not proceed with supply chain integration because companies were worried about possible risks that could arise from knowledge sharing. But as competition increased and technology developed, companies realized that information sharing is a key element in decreasing external threats, and benefits would overcome the disadvantages as it would lead to the ability to implement cost-saving strategies, such as just in time delivery and inventory reduction. (Rahman 2004)

After the development of Just-in-time (JIT) inventory and production methods in Japan, companies elsewhere had to develop systems to boost communication and collaboration between supply chain partners to increase efficiency, as the JIT methods enhance efficiency and lower inventory costs, resulting in decreased total costs. (Chou *et al.* 2004) In the 1980s, Electronic data interchange (EDI) was a solution for companies to exchange customer and supplier information. EDI uses standardized format in messaging, and EDI links organisations from computer-to-computer and the implementation needs investments from both the buyer and supplier. (Rahman 2004)

EDI was really the first electronic SCM software for external use and to strengthen collaboration in the supply chain network. EDI had many benefits, as it simplified communication processes, shortened transaction time and decreased possibilities of humane errors, as before modern IT systems all documents had to be processed manually and they had to go through multiple steps. (Monczka *et al.* 2009, pp. 668-685) In SCM, the benefits of EDI rely on communication and information sharing between the buyer and supplier. Purchase orders, invoices, delivery instructions and other documents can be sent electronically. This enabled fast and reliable messaging between transaction

partners as there was less need for posting, mails and manual handling. This enhanced communication led to better abilities to react to market changes, exploit market opportunities, decrease in administrative costs and also enabled inventory reduction as there is better exchange of manufacturing and demand forecasts. EDI also enabled organisations to involve in JIT programs through increased information sharing, better accuracy and timeliness of data and decrease errors (Iacovou *et al.* 1995, Quayle 2006, pp. 320-324)

## **2.2 Internet based procurement and tools**

Internet-based supply management and procurement began as soon as the technology was suitable to be implemented in corporate systems. And from early on, the main benefit of applying electronic procurement systems has been the ability for buyers and suppliers to interconnect and share information and knowledge. Since the 1980s, large corporations exploited telecommunications technology to connect with suppliers, as telecommunications was seen as a way to enhance efficiency of processes and to reduce transaction cost. (Croom 2000)

Since the increasing development of e-commerce in the late 1990s affecting the B2B markets, procurement and supply chain activities were significantly affected by these new trends. Procurement was started to be seen as a strategic function to support organisations' goals by reducing purchasing costs and by that increasing profits. Electronic tools used in procurement are called e-procurement applications, and they are "*designed to automate the buying cycle, optimise spend, improve process and workflow, support bidding and tendering and facilitate more effective search for products and services via the internet*". (Smart 2010)

There are many e-procurement applications available for organisations to increase their procurement and operational performance. To start with, e-procurement software (sometimes buying software) are applications in a buying organisation to enable employees to source for products and other goods from catalogues provided by the organisation's suppliers. The software collects purchasing data and enables automation of the purchasing process. (Smart 2010, Davila *et al.* 2003)

Internet market exchange (also electronic marketplaces or eMarkets) is a virtual market place where buyers and suppliers can perform transactions. Buyers have the possibility to source from a large supplier base and to access multiple catalogues, and buyers can also

request for quotations (RFQ's). Suppliers have the possibility to prospect for suitable buyers. (Smart 2010, Davila *et al.* 2003, Puschmann *et al.* 2005)

B2B auctions and reverse auctions are events where the suppliers and buyers place bids to obtain goods via internet. In normal auctions, the supplier places the minimum price for the subject of sales, and the buyers place bids (raise the price) to purchase objects or services. Whereas in reverse auctions, the buyer is offering a contract for set of suppliers, and the suppliers compete against each others on who can fulfil the contract with the lowest price, so they are bidding the price downwards. The winner is usually the supplier who can perform the task at the lowest price, but other criteria and condition besides money have to be also fulfilled to earn the contract. Auctions are good for buying organisations as the bidding process reduces costs and usually reveals the true price of doing business, and allows to compare suppliers. The suppliers benefit by being able to access new and ready markets and by being able to sell excess inventory. (Smart 2010, Davila *et al.* 2003, Puschmann *et al.* 2005) Electronic auctions reduce purchasing cycle time as all processes are computer managed, which allows real-time bidding processes and reduced paperwork. Electronic auction also increases supply transparency, as every participant can see the buyers and supplier prices and bids. (Yu *et al.* 2008)

Supplier catalogues are websites that the suppliers use to display their offerings. The buyers can easily view the available selection and to place orders. In some cases, this can also be done through a buying organisations own e-procurement software, and in this situation the purchasing process is recorded on the buyer's systems automatically. (Smart 2010, Puschmann *et al.* 2005)

Overall the main purpose of e-procurement tools is to decrease spend in companies and to gain control over the purchasing process. There is less paperwork and less mistakes in processes. With e-procurement, the purchasing process becomes more simple, faster and there is more discipline over the sourcing and from whom the goods are purchased. Maverick buying, a situation where procurers buy from suppliers who don't have contracts and negotiated prices with the company, is decreased as e-procurement tools enable buying from suppliers who have relationships with the organisation. (Davila *et al.* 2003)

But although individual e-procurement tools provide organisations with multiple benefits, such as possibilities for cost savings and process streamlining, these tools do not generate large-scale collaboration among the whole supply network. Some tools, such as the catalogues, are useful in sharing product information and prices, but lack depth in

reciprocal approaches and does not create any incentives to deepen relationships and collaboration further. *“Overall, technology will move from standalone, serially connected application to integrated, collaboration-based, flexible systems emphasizing collaboration, user-defined analysis, and knowledge management”* (Monczka *et al.* 2009, p.756).

### **2.3 Enterprise resource planning (ERP)**

After their first appearance in the 1990s, Enterprise Resource Planning (ERP) systems have been the backbone of organisational data processing and integration of business functions within corporations. (Monczka *et al.* 2009, p. 668) ERP is considered to be as *“one of the major breakthrough information technologies that can re-shape the manufacturing industry”*. The ERP markets and spending through ERP systems continue to grow, as ERP systems can increase supply chain visibility and supply chain efficiency. (Hwang *et al.* 2013)

A ERP system is defined as *“A packaged business software system that lets an organisation automate and integrate the majority of its business processes, share common data and practices across the enterprise and produce and access information in a real-time environment. The ultimate goal of an ERP system is that information must only be entered once”*. (Marnewick *et al.* 2005)

ERP systems have had a great impact on businesses. The underlying objective of ERP systems is to integrate business processes and planning through a shared database, and organisation’s employees and management has an access to this database and everyone in the organisation works with the same data. This can enhance better decision making and possibilities to pursue efficiency across the organisation as there is less data errors and more communication between business functions. (Monczka *et al.* 2009, p. 668) One of the greatest single benefit of ERP systems is the possibility to unite all organisational processes, data and other elements under one set of software, instead of having multiple different software at the same time (Gupta *et al.* 2006).

Besides integrating all organisation’s databases into one master database, the ERP systems can be built upon modules. Organisations can purchase different ERP modules that are focused in different business functions (such as finance, manufacturing, human resources and CRM) from different ERP solution providers, or they can purchase the entire software from a single supplier. But importantly, organisations can only purchase modules that they need, instead of investing in a single software that covers all

organisational functions. (Kakouris *et al.* 2005) And although ERP can be built up from different modules, it is vital to ensure that the modules are integrated to each other properly in order to allow smooth information flow throughout the organisation. For example, in SCM context this means that purchase orders and other related SCM information are transmitted directly to finance (and also to other relevant functions) in order to create invoices and to adjust changed inventory levels. And vice versa, as finance adjusts inventory levels, this triggers purchase orders in inventory management to obtain stock levels determined in demand planning. (Marnewick *et al.* 2005)

ERP systems have reshaped SCM. Although ERP systems were first developed to improve decision making and processes internally by enabling better information flows within organisations through central databases, the ERP systems were able to be extended to connect customers and suppliers with the help of the internet. "*With respect to supply chain integration, internet technologies have opened enormous possibilities for organisations to share data*". (de Búrca *et al.* 2005)

In general, many studies about ERP's have recognized that the appearance of ERP systems have revolutionized SCM, and many studies also agree them to be beneficial for organisations, especially for manufacturing companies (Shatat *et al.* 2012). After it became possible for organisations to connect their ERP systems with external partner's ERP systems, organisations have been able to harness multiple benefits and to increase supply chain performance significantly. In their study of Taiwanese IT companies that adopted ERP systems, Yang *et al.* (2009) reported that adopting an ERP system resulted in many benefits. ERP systems that were linked to external partners and suppliers, streamlined information flows that resulted in better response time and improved inventory management across the supply chain. Increased communication performance led to better possibilities to order tailored solutions via the ERP systems and improved quality management. The ERP systems enabled networking with partners that supported synchronization of processes with supply chain members. In sum, benefits of ERP systems include decreased costs, better communication and coordination of processes, increased ability to react to fluctuations in demand and abolishment of duplicate processes within organisations and networks. (Yang *et al.* 2009)

Shatat *et al.* (2012) investigated the relationship between ERP systems and SCM performance among Malaysian manufacturing companies that were using ERP systems. Because ERP systems use shared databases and are able to communicate with external parties, ERP is able to collect and transmit data on real time basis, thus improving

information movement and availability along the supply network. This improves supply chain flexibility as decisions can be made faster, rapid reaction time to environmental changes is increased and uncertainty is reduced. With ERP systems, inventory management and replenishments can be automated. This means that stock units and raw materials can be ordered automatically according to current inventory levels and as company receives orders from customers. As this inventory information and also manufacturing information are shared with suppliers, it is possible to enhance synchronization of processes, thus reducing cycle times, operating costs and inventory costs by both the buyer and supplier. (Shatat *et al.* 2012).

Sharing of the inventory and sales data can decrease the risk of the bullwhip effect, a phenomenon where inventory levels and difficulties in forecasting increase when moving upstream along the supply chain due to inefficiencies in information sharing. This forces suppliers to prepare to demand fluctuations with large inventories that result in huge costs. (Lee *et al.* 1997) With the ERP, such information can be shared automatically with the whole supply network, thus decreasing demand fluctuations and uncertainty, and improving forecasting and inventory management in upstream supply chain. Overall information is more transparent while using ERP systems, which enables savings in above mentioned issues and improves organisations abilities to respond to customer needs. (O'Leary 2004)

Bendoly *et al.* (2005) reported that a clear benefit in the use of ERP compared to EDI systems is that EDI systems require users or partnering organisations to adopt similar systems in order to communicate with each other, while internet supported ERP's remove such boundaries as they are able to communicate with other different ERP systems. This enables more members to join a network as their current ERP systems are sufficient enough to communicate with other ERP systems, and there is no need for investments in a separate EDI to communicate with. And the longer a company has used an ERP system, the greater were the capabilities for cost savings as they have probably obtained more knowledge on using the ERP. (Bendoly *et al.* 2005) Hunton *et al.* (2003) show that companies that have adopted an ERP system have significantly better return on assets, return on investment and asset turnover than companies that had not adopted ERP systems. "*ERP operation time is a critical attribute for SCM performance, usually it takes more than three years to have a positive effect on SCM*" (Yang *et al.* 2009).

ERP systems are also beneficial in procurement processes. Organisations that have adopted ERP systems have better capabilities in strategic sourcing, category

management and supplier relationship management than those organisations that don't use ERP. This results from ERP systems' ability to monitor and measure costs, thus revealing maverick buying habits and increasing control over procurement procedures. By processing transaction data and creating spend analyses, more accurate sourcing decisions can be made. And by analysing third party spending, more tactical approaches can be taken to improve processes. Teams can be formed with suppliers to improve costs structures and drive innovations for further supply chain improvement, thus developing supplier relationships. (Huang *et al.* 2015)

A key benefit for ERP systems is the ability to integrate different e-procurement tools (such as catalogues) and other functionalities, for example planning and information sharing with suppliers, into its operating systems. This contributes to the implementation of E-SCM across the supply network if ERP is integrated with both upstream and downstream partners. This can create competitive advantage through improved visibility and process optimization. (de Búrca *et al.* 2005) When examining existing literature about ERP systems and SCM, there is a strong coherent opinion about the importance of ERP systems and their major beneficial contributions to SCM. According to Yang *et al.* (2009) ERP systems improve the performance of an organisation through improved SCM and *"it is not solely a myth"*. *"Through the tactical benefits of ERP, a firm has the ability to access correct and consistent data in a timely manner. Managers can easily get the integrated information to make decisions, and have efficient resource management and production control to meet customer needs"*. (Yang *et al.* 2009)

#### **2.4 Disadvantages of E-SCM: Effects of internet and e-procurement on the business scene**

It is clear that E-SCM has several benefits. Compared to the past, electronic software reduces paperwork and manual labour, decreasing possibilities for human errors. Processes can be automated and moved on-line, thus reducing work load and related costs. As communications becomes real-timed, this increases procurement process efficiency and reduces cycle times.

The most predominant feature of internet based procurement is the increasing possibilities for global sourcing. Internet allows companies to source beyond their native countries and nearby geographical areas, thus promoting global competition. (Rahman 2004, Chou *et al.* 2004)

E-procurement also affects list pricing. Purpose of e-auctions is to bring down prices and reveal the “real price” of goods. And if suppliers want to compete and win auctions, they have to abandon pre-determined pricing to some extent. (Rahman 2004) This shifts power towards the buyers, as they can force suppliers to compete against each other in pricing to some extent. As the buyer has the power in supply chain relationships, this enables the buyers to make shorter contracts with the suppliers, instead of locking themselves in a relationship. (Rahman 2004, Chou *et al.* 2004, Yu *et al.* 2008)

The internet enhances inter-organisational communication, collaboration and supply chain transparency. EDI and ERP systems have been the forerunners of sharing business information across supply networks. Increased communication and transparency have reduced organisational boundaries, and technology is promoting organisations to form “*extended enterprises*”. (Chou *et al.* 2004) Real-time communications, visibility and response time help reducing risks and increase agility within the whole supply network (Smart 2008). But although information sharing and collaboration may increase both the buyer’s and supplier’s performance, information sharing can still be problematic if there is lack of trust and one party is expecting opportunistic behaviour from the other. (Nyaga *et al.* 2010)

Information sharing is risky, but it is the basis for efficient collaboration and increased performance. In the internet era, systems such as ERP require extensive information sharing among partners to function properly and to live up to expectations, but at the same time supply chain partners become more interdependent on each other. As organisations share confidential data, that can be of competitive advantage, they lose some of their independence and become dependent on the performance of the supply network. “*Business management has entered the era of networking competition which moves the competition from local to global business environment and from company against company to that of supply chain against another supply chain*” (Shatat *et al.* 2012).

But these effects are not always beneficial for everyone. There are several disadvantages linked to E-SCM that create barriers for adopting electronic systems in SCM and prevent organisation from integrating supply chain partners in their systems.



### **2.4.1 Disadvantages of EDI**

Although EDI provided companies with multiple benefits and new innovative communications systems, EDI systems were very expensive and this fact prevented EDI from becoming popular among organisations, and the use was limited only to large companies. (Presutti 2003) EDI also needed standardized systems, in other words organisations had to have similar EDI systems to be able to communicate with the EDI. This reduces willingness to invest in such software in smaller organisations because it does not provide a comprehensive solution to solve all deficiencies in communication. (Bendoly *et al.* 2005) Investments in EDI systems can cause problems as these investments can be specific to certain relationships, as organisations may use different EDIs that cannot communicate with each other. And because the high investment and other related costs of EDI implementation, this can cause the organisation to be locked to a specific relationship, and opportunities to create new relationships becomes more difficult. (Williams *et al.* 2002)

Despite from being promising changer of supply chain communications, EDI remained the tool of the of few. As EDI required application-specific investments, the EDI tools could not be used in any other tasks than communicating which is troublesome for smaller organisations. Heavy investments and high maintenance costs made SMEs' reluctant to adopt EDI, but sometimes larger trading partners insisted other organisations to adopt EDI systems. Sometimes these systems were differentiating from what they possibly had (if they had an EDI already). (Monczka *et al.* 2009, p. 685)

### **2.4.2 Disadvantages in e-procurement**

E-procurement related risks can be divided into four categories: internal business risks, external business risks, technology risks and e-procurement process risks. (Davila *et al.* 2003)

In internal business risks, organisations fail to integrate the new e-procurement software with already existing software. Implementation should be as smooth as possible, and failure to do so results in duplicate processes and the information provided by the systems can become unreliable. (Davila *et al.* 2003) Extensive training of employees is also needed. Change resistance and old purchasing behaviour is hard to change, and can lead to the existence of maverick buying even after e-procurement implementation (Angeles *et al.* 2007).

In external business risks, the e-procurement software needs to support supplier accessibility to the system for them to make needed updates, for example in their catalogues. But smaller suppliers may lack technical capabilities to enter a certain system and may be reluctant to adopt new systems without guaranteed future revenues. If the technology is unreachable by suppliers, it limits the effects of the e-procurement system across the supply network as the amount of suppliers will remain small and new suppliers won't join the network. (Davila *et al.* 2003)

External risks are also associated with new suppliers and buyers. Some e-procurement tools promote new partners, with whom the organisations have not done any transactions, to join the network (such as e-marketplace). But still the focus remains mostly on pricing. This exposes the company to face unforeseen costs, as there may be issues in quality, delivery times and high switching costs. There needs to be mechanisms that guarantee that the new buyer/supplier meets required criteria to be a part of the network. (Davila *et al.* 2003, Yu *et al.* 2008)

There may be lack of e-procurement system vendors who are able to provide a comprehensive service package, and consultancy may prove to be less of a help than expected. The buying firm's suppliers can also be immature in e-procurement adoption, and may need monetary support and other incentives to develop their e-procurement competencies. (Angeles *et al.* 2007) External risks also arise from the fact that e-procurement software does not guarantee lower costs and other efficiencies. Disappointing results may be due to improper use of the system or there is lack of understanding of the use and logic behind the system. For example, if reverse auctions are implemented in markets with only a few suppliers attending, the suppliers can try and push the prices up when they see the opportunity. (Pearcy *et al.* 2008)

Technology risks are associated with lack of e-procurement software standards. Without standards, incompatible software is incapable of communicating with each other, and hinders the adoption and integration of e-procurement. (Davila *et al.* 2003) Angeles *et al.* (2007) also confirm that e-procurement systems lack integration possibilities to other software as there is need for more standardization, and information sharing between software can be challenging. There can also be issues in software capabilities and tailoring, and many small e-procurement software vendors' programs lack essential features, such as invoices, authentication and security. (Angeles *et al.* 2007) Internet as a trading platform is vulnerable for outside attacks and interferences. Internet technologies

are based on open standards, which makes web-pages exposed for outside infiltration by hackers or viruses. So focus is needed on security measures. (Chou *et al.* 2004)

E-procurement process risks include fears about security and control of processes. E-procurement tools must be secure so that unauthorized use will not cause disruption in other supply chain activities. Organisation might avoid adopting e-procurement due to unwillingness to share information and can also see such software a potential leaking point of intellectual property. (Davila *et al.* 2003, Percy *et al.* 2008)

The most negative effect of e-procurement tools is that the focus in buyer-supplier relationships become more price-centric. Especially auctions push down prices, and quality of goods decrease as suppliers are unable to add value in their offerings. Supplier profits are reduced, which affects the supplier's ability to invest in new technology and production facilities. (Davila *et al.* 2003) Sometimes the main purpose of e-procurement adoption is to "squeeze" out costs in the supply chain (Croom 2005). *"Some suppliers refuse to participate in e-procurement bidding, believing it will result in less profit and more work"* (Yu *et al.* 2008).

Although the buyers and end-customers benefit from this development, the power in supply chain relationships shifts to the buyer. And as one party tries to benefit over the other, this can result in poor supplier relationships. Many suppliers are doubting e-procurement system benefits for the supplier side, as mainly the purpose of such systems is to drive down costs. There is little collaboration involved, and mechanisms such as auctions make changing suppliers easy. When the supplier fears over its profits, may this lead to lack of commitment and issues in trust and loyalty. (Chou *et al.* 2004, Percy *et al.* 2008, Smart 2008, Yu *et al.* 2008)

### **2.4.3 Disadvantages of ERP**

Although ERP systems have proven to be highly beneficial for modern businesses, they don't come without problems either. According to literature, biggest problems in ERP systems lie in the implementation phase and in usage after the implementation. *"In order to obtain benefits and avoid serious difficulties, companies need to solve the ERP implementation problems"* (Gupta *et al.* 2006). Many ERP projects prove to be costly and goes over the budget and fails to reach project goals. IT systems can cost millions, but this does not ensure smooth implementation. But as a difference to other IT systems, problems in ERP systems are usually not related to technology, but issues are more

related to the organisation itself and people (organisation culture and change resistance), rather than in complexity of technology and usage. (Helo *et al.* 2008)

For ERP to be successful for the company, it has to be implemented properly, a lot of training is needed for employees and top management has to be committed to the project. ERP systems are designed to be used across the organisation, so it affects the whole company. Organisations rely on consultants and other outside people to implement the systems, but they might not have proper knowledge of the company's business processes. Major problems occur after implementation as users don't know how to use the system and how to interpret the data that the ERP is providing. So company's own people have to be involved in the implementation process and they need to learn how to use it. (Wallace *et al.* 2001, pp. 23-28, de Búrca *et al.* 2005)

One of the main problems with ERP systems is that organisations find it difficult to understand the logic behind ERP systems. People find the software complex, and need extensive training to be able to use the system. Some ERP packages do not fill business requirements, and the system needs to be tailored according to business processes. In some cases, software packages for SMEs' lack flexibility in these matters. This could result from both the lack of understanding of ERP systems requirements in the buying organisations, and the lack of knowledge about organisation's problems and preferences by ERP system vendors. "*Business processes are driving ERP systems, and not vice versa*". (Helo *et al.* 2008)

*"Installing an ERP system is an expensive and risky venture. IT managers must decide how to use their limited resources and invest in the right product"*. (Yang *et al.* 2009) A problem with ERP systems is that there might be a lack of proficient providers of large, global ERP solutions that the company could implement in several different countries with different languages, measurement systems, regulations and currencies. Many ERP providers lack abilities to create solution that could be implemented globally and configured to adapt to local cultures. This forces multinational companies to choose from only a few ERP vendors. (Huang *et al.* 2015)

There is a similar problem in the adoption of ERP as there is in EDI. To harness the full benefits of ERP systems, they need to be connected with partnering organisations ERP systems. But some organisations, especially SMEs', might be reluctant to extend their ERP systems with others, but they might be forced to do so by larger partners who dictate the relationship. Unwillingness to integrate can derive from fears related to sharing of

confidential information and high costs related to technical expertise required to integrate the ERP systems, especially if the company lacks technical competencies. (de Búrca *et al.* 2005)

## 2.5 Summary

The evolution of technology and internet have provided multiple benefits to SCM and supply network performance. The evolution from EDI to ERP have irreversibly changed how organisations manage their supply chains. The main advantages and disadvantages of E-SCM tools according to literature are listed in table 1.

	Advantages	Disadvantages
EDI	<ul style="list-style-type: none"> <li>• Sharing of knowledge</li> <li>• Enhanced communication</li> <li>• Linking of organisations</li> <li>• Decreased errors</li> </ul>	<ul style="list-style-type: none"> <li>• Expensive</li> <li>• Weak possibilities to communicate with other devices</li> <li>• High maintenance costs</li> </ul>
E-Procurement	<ul style="list-style-type: none"> <li>• Faster transaction and processing of information</li> <li>• Automated buying cycle</li> <li>• Spend optimisation</li> <li>• Catalogues</li> <li>• Auctions</li> <li>• Cost cutting</li> </ul>	<ul style="list-style-type: none"> <li>• Main focus in cost cutting, may result in: <ul style="list-style-type: none"> <li>- lack of trust and commitment from supplier</li> <li>- lower quality</li> </ul> </li> <li>• Variety of software</li> <li>• Supplier accessibility?</li> </ul>
ERP	<ul style="list-style-type: none"> <li>• Integration of business processes</li> <li>• Sharing of one database</li> <li>• Modularity</li> <li>• Integration with suppliers</li> <li>• Streamlined information</li> <li>• Monitoring</li> </ul>	<ul style="list-style-type: none"> <li>• Expensive</li> <li>• Implementation</li> <li>• Extensive training of employees needed</li> <li>• Number of vendors</li> </ul>

Table 1: EDI, E-procurement and ERP advantages and disadvantages

Overall, E-SCM provides multiple benefits to all supply chain members, such as decreased inventory levels, improved delivery performance and decreased buying costs. And although E-SCM is not risk free and also has its own disadvantages, literature mainly agrees that the advantages overcome the disadvantages as long as preceding factors of trust and commitment are present between the supply chain partners (Nyaga *et al.* 2010).

But it seems that most of E-SCM literature focuses on managing material flows and other tangible subjects, so there is lack of discussion about how E-SCM can provide intangible benefit to supply networks. E-SCM mainly focuses on sharing information related to inventory levels and production. With the help of new tools, it is possible to make deeper collaboration with suppliers and increase performance in many levels, for example in coordination of activities and project management (Chui *et al.* 2009). As mentioned earlier by Monczka *et al.* (2009 p. 756) the trend in e-procurement is moving towards more collaborative technologies, and single stand-alone solutions will be replaced with software that promote mutual benefits through cooperation and knowledge sharing.

### 3. Cloud computing and web 2.0 in SCM

In SCM literature, E-SCM has positioned itself as a key enabler of supply chain integration. Different electronic business applications designed for interaction and coordination increase buyer-supplier collaboration, and increased collaboration leads to improved cost, quality, flexibility and innovation performance. (Wiengarten *et al.* 2013) SCM integration (or collaboration) means that two or more independent organisations work together and implement joint strategies to perform better than working alone. This means generating trust and commitment among trading partners through information sharing, joint efforts (mutual planning, decision making, inter-firm teams) and specific investments on supply chain relationships between supply chain parties. Information sharing is seen vital for building lasting relationships, as it helps the supplier to improve performance and increase efficiency, thus promoting buyer success. Mutual sharing of important information (such as demand forecasts and cost information) enhances both the buyer's and supplier's performance, and generates trust and commitment. (Simatupang and Sridharan 2002, Nyaga *et al.* 2010, Wiengarten *et al.* 2013) "The literature provides overwhelming support for the notion that effective SCM relies heavily upon integration and coordination across functions and enterprises" (Pearcy *et al.* 2008)

As the older technologies rely on clerical functions running of the daily business and executing of single functions, new technologies are more interactive, promote user collaboration and focus more on creating and sharing of information (Monczka *et al.* 2009, p.756). These technologies probably don't have anything to do with purchasing per se, but they provide powerful tools for project management, messaging and collaboration beyond company borders (Chui *et al.* 2009).

In this research we are particularly interested in the opportunities that come with web 2.0 tools. But before examining what web 2.0 tools are and how they can benefit SCM, we first have to understand the preceding technology, cloud computing.

#### 3.1 Cloud computing

*"Cloud computing is defined here as covering software applications delivered through the internet, and also the hardware and system software that is used within data centres to provide those services"*. This means that a third party (the vendor) provides the software to the customer over the internet, and the customer does not own the operating systems, data centres and or any other related technology. The customer outsources its IT

infrastructure, and the vendor is responsible for installation, updates and maintenance. (Ojala and Tyrväinen 2011)

Cloud computing creates value by implementing a “*multi-tenant architecture*”, where the vendor provides the IT infrastructure and serves multiple clients simultaneously. This reduces costs by the client as the same infrastructure, management, monitoring and maintenance are concentrated to the vendor. This way hardware and computing capacity usage is optimized, as the clients pay for what they use. This reduces resource shortage and under-utilization. (Dhar 2012)

There are three different cloud service models: Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Software as a Service (SaaS) (Chandrasekaran 2015, p. 67).

In IaaS, a third party service provider provides the organisations all the IT infrastructure needed to run their software. The designers of the software are liberated from maintaining data centres and other physical infrastructure, but the designers are still responsible for the software itself (operating systems, data, updates, configurations and running of the software). In PaaS, software developers are provided a development platform online to program and deploy their application. This makes software and application development process more efficient as developers don't have to invest in their own IT infrastructure, and deployment becomes instant through the same platform. In PaaS, the users are only responsible for the running and management of the application, and other issues are managed by the cloud service provider. Development can be done in cooperation with the service provider. (Chandrasekaran 2015, p. 67-83).

Providing software services to end users over the internet is called Software as a Service (SaaS). Traditionally, software needed to be installed to a certain computer, and licensing fees had to be paid. In SaaS, the software itself is not installed in the user's computer, instead it is provided on-demand and the software is accessible by any device which has an internet connection and a web browser. In SaaS, users are not responsible for anything except for paying for the service, and the service provider is responsible for the physical IT infrastructure, running and functionality of the software. (Joint *et al.* 2009, Chandrasekaran 2015, p. 83-90)

Cloud computing has multiple benefits compared to conventional IT practices. By moving IT infrastructures to cloud, organisations can receive overall savings on capital and operational costs, as there is no need to invest in hard drives, servers and physical data storage equipment on site. There is also no need for infrastructure maintenance and



monitoring. This leads to savings in total cost of ownership. (Joint *et al.* 2009) Cloud computing enables faster implementation of new IT software in organisations, as the cloud IT infrastructure is less complex and is pre-integrated to some point as the infrastructure already exists by the cloud provider. (Dhar 2012) Cloud computing free users from being bound to a certain geographical place and time. *“Data is no longer stored on one’s personal computer, but are hosted elsewhere to be made accessible in any location and at any time”*. (Scale 2009)

Cloud computing uses a revolutionary business model in IT services. Services are delivered on-demand, so the customers pay only for what they use. This is linked to a fundamental benefit of cloud computing, scalability. In cloud computing, computing capacity can be suited to meet the changes in demand very quickly. This enables quick expansion in computing capacity if demand increases (more people using the software) and vice versa. So scalability in cloud computing removes the need for further investments in own data centres, and at the same time organisations don’t face situations where own computing capacity is under-utilized. This increases IT systems agility and efficiency, and promotes asset-free environment. (Durowoju *et al.* 2011, (Dhar 2012). *“For the first time, organisations can realistically consider IT as less of an asset and more as an expense”* (Dermirkan *et al.* 2010)

Cloud computing can be beneficial for SCM in many ways. Cloud computing can lead to increased integration between supply chain members as cloud computing enables data to be integrated internally and externally, and suppliers and customers can access reliable data sources about inventories, production and ordering processes on a real-time basis. (Bruque Cámara *et al.* 2015)

Cloud computing can be seen as a solution to reduce environmental and inter-organisational uncertainties. Environmental uncertainty arises from many sources, for example from shortage of resources (e.g. disruptions in raw-materials production), political tensions between countries and competition against other organisations. Inter-organisational uncertainty is associated with relationships with other organisations and trading partners. Problems in communications, trust and collaboration increase this uncertainty. Both uncertainties are reduced with effective information sharing. Cloud computing supports many E-SCM tools that are used for communication and information sharing, and possibilities for scaling, rapid deployment and cost savings, makes cloud computing a suitable solution for organisations to base their supply chain IT infrastructure on. (Cegielski *et al.* 2012)

Improved accuracy and timeliness of data and promoting supply chain partner accessibility to the data can improve supply chain reaction times to market changes and enable better planning i.e. supply chain agility is improved (DeGroot and Marx 2013). As cloud computing can be implemented quickly and scaled to meet user demands, supply chains using cloud computing would be able to respond and adapt to environmental changes faster as *“cloud computing help organisations to maintain alignment between ever-evolving supply chain initiatives”*, thus contributing to supply chain agility. (Wu *et al.* 2013) When IT infrastructure is moved to a cloud, this enables the users to access and use a common resource base. Cloud also enables these resources to be utilized not only by the internal users, but external as well. *“Thanks to the use of cloud computing, people and organisations are now able to leverage the use of knowledge-generation-related applications both within an organisation’s boundaries and outside them”*. (Bruque Cámara *et al.* 2015)

From all the three different cloud service models, SaaS is the most used model and most studied in overall literature and when it comes to SCM, and *“compared with IaaS and PaaS, SaaS might be the only “visible” cloud computing contact for the end user”* (Jede *et al.* 2015). Organisations prefer SaaS because it allows to access multiple applications on a global scale without having to use own resources in IT infrastructure development and management. So deployment is faster and therefore is the payback time. (Dhar 2012) As cloud computing allows better integration of data across the supply chain, SaaS has become the major model for providing E-SCM applications for organisations. (Bruque Cámara *et al.* 2015)

But still E-SCM software remains to be production and inventory management focused, sharing data only accordance to production schedules and demand planning. Although software is now easier to deploy with lower implementation costs, they lack properties in coordination and communications on the individual level, and in managing “the big picture”, such as projects and strategy formation. A solution for this could be web 2.0.

### 3.2 Web 2.0

Web 2.0 is a bundle of different internet technologies and software that use the internet as a platform and that are designed to facilitate connectivity, information sharing and generating of new content. A very distinguish feature of web 2.0 tools is the participative nature of these applications, where users interact and share content directly to each other. (Musser and O'Reilly 2006, pp. 5-12) Some of the best known examples of web 2.0 are social and interactive web-sites, such as Twitter, Facebook and Wikipedia, which all have millions of users. Web 2.0 has enabled the creation of social networking and many other social applications, thus social media applications are used as a synonym for web 2.0 tools (O'Leary 2011). Popularity and interest in web 2.0 is growing among people and business entities: "*Web 2.0 technologies, also known as collaborative Internet tools, are a highly topical subject area in business and academic communities*" (Adebanjo and Michaelides 2010). Social media applications have been highly popular among common people for years (nearly 3 billion users by 2020 according to Statista, 2017), and organisations have adopted web 2.0 tools in internal communications, B2C communications and marketing in the recent years, and organisations are also starting to implement web 2.0 in external communications in the B2B environment. (O'Leary 2011)

Web 2.0 is the next generation set of internet technologies that are built upon web 1.0 technologies. Web 2.0 moves away from static and on-sided web pages to more collaborative usage, enabling end-user activity and knowledge sharing and creation, leading to a "*an open, trusting, service-based online society, which provides a unique platform for developing new ways of working*" (Adebanjo and Michaelides 2010) Whereas web 1.0 allow only the creator of the website to modify the content, web 2.0 gives everyone visiting the website the ability to alter the content of the website. Visitors may add information or articles to the websites, start conversations, and create reviews and comments about the content or a subject. This increases interactivity and reciprocal behaviour of the internet. (Baxter and Connolly 2014, Bruque Cámara *et al.* 2015). A key feature of web 2.0 tools is that they are entirely web-based and use cloud computing technologies and business models when they are delivered to users. (Bruque Cámara *et al.* 2015)

Attribute	Web 1.0	Web 2.0
Computer Configuration	Client-server	Peer-to-Peer
Primary access device	Computer	Smartphone or mobile device
Primary Participants	Individuals	Communities
Nature of activities	Reading	Interacting (reading and writing)
Primary tools	Web pages	Social media (wikis, blogs, feedback)
Communication	One-way	Network
Interaction	Download	Connect
Access	On demand	Continuous
Primary product focus	Real goods	Value-added information

Table 2. Characteristics of web 1.0 and web 2.0 (Tingling *et al.* 2011)

Table 2 illustrates the differences between web 1.0 and web 2.0. In web 1.0, the content is mainly read-only, and lack interactivity. It is mostly used for advertising and broadcasting of information for the others. Web 2.0 on the other hand is used as a mean to socialize and to connect and assemble people with shared interests on a global basis. (Shaikh *et al.* 2014) So the key difference is that people are turned from consumers of content, to creators of content (Cornmode and Krishnamurthy 2008). Although in web 2.0 can be created and published easier than in web 1.0, web 2.0 is more of an extension to web 1.0 rather than a replacement (Kamel Boulos and Wheelert 2007).

### 3.3 Web 2.0 tools

*“Web 2.0 is a network platform on which peers contribute to the development of tools, content, and communities on the Internet”* (Shang *et al.* 2011). Web 2.0 consists of websites that aim to increase cooperation and information sharing among users. These websites may be called collaborative websites. In these websites a group of people create new content from information originating from different sources to benefit larger user groups. Although these websites may contain inaccuracies and errors, the success lies in

attracting a wide base of users from different backgrounds to contribute in information creation and validating new and already existing information. (Helquist et al. 2014) Web 2.0 consists multiple different web technologies which all have different functions. Blogs, mashups, wikis, social networking, voice over IP, podcasts, tagging, and Really Simple Syndication (RSS) are just some technologies that use web 2.0 technologies, but all contribute to sharing of information and content to other users. (Almeida 2012, Bruque Cámara *et al.* 2015) And as it is implied in the study made by O'Leary (2011), there is increasing interest in implementing web 2.0 in B2B interactions. There are a lot of web 2.0 tools available, and next there is a short study of some of the web 2.0 tools that are commonly known and used by enterprises.

Blogs are “*web pages that incorporate regular posts about a particular topic, current events or the expression of personal thoughts*” (Kosonen *et al.* 2007) The basis of blogs is the ability of the blog owner to create discussion and to spread information about certain topics. Readers of the blogs are able to comment on the writing and bring up their own opinions and knowledge about the topic at hands, thus promoting discussion. (Lytras *et al.* 2008, p. 3)

Mashups are websites that combine the content of two or more different websites. For example, a website can have a map from a mapping website, and on the map real-time traffic situation can be shown, based on data presented on an other website. (Lytras *et al.* 2008, p. 5) An example can be Google Maps ([www.google.com/maps](http://www.google.com/maps)), which is a mapping service that combines normal maps with traffic information, public transportation options and photographs of different locations that users have uploaded to the service.

Wikis are structured websites that promote users to participate in content creation. Wikis are simple and flexible to use, and anyone can create new content or modify/updated existing content. Thus wikis are powerful tools in sharing knowledge almost about anything and linking different and related websites together. (Levy 2009, Lytras *et al.* 2008, p. 4) For example, Wikipedia ([www.wikipedia.org](http://www.wikipedia.org)) is an online encyclopaedia, where anyone can create an article, and others can edit this article to improve its accuracy and quality.

Social networking sites (SNS) are websites that allow users to create a profile to a service, and to connect and interact with other people who have made profiles to the same service. Contents of public profiles are visible for everyone, whereas the content of private profiles are only visible for profiles the person has chosen to connect with. Through these profiles

people are able to share personal information about themselves, such as areas of interests, hobbies, work and photos. The idea is for people to connect with other people that have similar interests, and the connection would otherwise not have been made, for example due to geographical distance. (Boyd *et al.* 2008)

A key feature of SNSs' is the network of connections. A person can create a network of people who share the same interests or opinions on certain matters and build relationships with these people. And in this network, people can be total strangers to each other. SNSs enable people to form smaller groups within these networks. SNS supports communication with connections and the network with the ability to send messages and sharing of information. SNSs can be seen to replace other means of communication, such as e-mails and telephone calls. (Boyd *et al.* 2008, O'Leary 2011) Social networking sites "*not only facilitate the rapid diffusion of information; but, because the source of the information may be known to the recipient, the information may be given a higher level of credence and credibility than unattributed, public information*". (Tingling *et al.* 2011) Examples of SNSs are LinkedIn, Facebook and Twitter, which all allow users to connect with other users and follow the posts of certain users, and to create networks and share information and multimedia content with each other, and to collaborate within these networks.

Voice over IP (VoIP) are communication technologies that allow land or mobile phone calls to be converted into digital form and then delivered over the internet instead of using telephone network. VoIP also enables computer-to-computer calls to be made. (Cisco Systems Inc. 2016) Skype, a software that enables real-time video calls over the internet, is the most known example of VoIP (Adebanjo and Michaelides 2010).

Podcasts and multimedia sharing services. In the beginning, podcasts were digital recordings of audio programs, that could be distributed and listened through the internet or other device. Today, podcasts also include videos and they are a way of distributing multimedia content over the internet. Usually podcasts are shared through multimedia sharing services, such as YouTube. (Lytras *et al.* 2008, p. 242) Podcasting allows anyone to make their own audio or video content to targeted audiences. Podcasts are widely used for educational purposes, and people can access these audio/video files anytime and anywhere. (Liu *et al.* 2009) Multimedia sharing services are used to share audio, photos, videos and documents to others. Businesses use these kind of services to promote and present their products. (Barlow 2011, p. 467)

Tagging and social bookmarking. Tagging in the web 2.0 world means individuals creating own keywords or bookmarks for categorizing objects. This helps items to be classified and organized on a personal basis, enabling faster searching and recalling later on as these tags can be used in search engines. Social tagging allows others in the community to tag items. (Lytras *et al.* 2008, p. 5, Musser and O'Reilly 2006, p 17)

Really Simple Syndication (RSS) is a technology used to send out notifications about updates made in webpages. Before RSS, people needed to visit the actual websites to see if there are any updates or new content available. With the RSS, the user receives automatic notifications about updates and other news about the websites the users are following. As an example, a blogger makes a new post in his/her blog, and the readers receive a notification that a new publication has been made. RSS feeds can be applied to various types of websites (news, blogs, SNS). This enables information to be found more quickly and save time as users do not have to constantly visit webpages to see if they are modified. (Levy 2009, Lytras *et al.* 2008, p. 4)

### **3.4 potential usage of web 2.0 in SCM**

*"The essence of web 2.0 lies in the sharing of information through the interconnectedness of people"* (Milovanovic *et al.* 2016). As the nature of web 2.0 tools are collaborative, the most apparent use for such tools in SCM would be enhancing of dynamic and open communication, furthering supply chain integration and building of stronger relationships with customers and suppliers. (Barlow 2011, p. 466, Im and Kurnia 2013, Milovanovic *et al.* 2016)

Im and Kurnia (2013) conducted a literature review of web 2.0 tools and provide some implications about how these tools could be used in SCM and what are their benefits. They divide the benefits according to different set of SCM practices: supplier relationship management, integrated behaviour, information sharing, collaboration, risk and benefit sharing, and process integration. (Im and Kurnia 2013) Tingling *et al.* (2011) use the Supply Chain Operations Reference (SCOR) model to examine how web 2.0 effect SCM and what are possible future implications. The SCOR-model divides supply chain activities into five processes: plan (operating the supply chain), source (ordering, scheduling and receiving of goods), make (converting inputs into outputs), deliver (fulfilling customer orders) and return (services from the customer). (Tingling *et al.* 2011, APICS 2017) Bruque Cámara *et al.* (2015) list out many possible implications of web 2.0 in SCM. Web

2.0 can enhance supply chain integration directly or indirectly, as many of the web 2.0 promote knowledge sharing.

In supplier relationship management (SRM), web 2.0 tools could be used to build and manage relationships and in searching for new suppliers. In the era of web 2.0, and especially with the introduction of smartphones and tablets, common people have become producers of content, and news about current events and changes spread across the internet on real-time basis. Different tools, such as blogs, SNS and discussion forums provide a platform for people to discuss about current topics and certain subjects. (Tingling *et al.* 2011, Im and Kurnia 2013) The information created on these websites are a source of collective intelligent: knowledge generated by a group of people i.e. wisdom of crowds (Goh *et al.* 2007). In the planning and sourcing phase of the SCOR-model, buyers could use this crowdsourcing to gather timely, qualitative information about suppliers from professional networking sites. People share opinions and ratings of companies and their products online, so buyers could use this available information when assessing new suppliers. (Tingling *et al.* 2011, Im and Kurnia 2013) Other potential tools in SRM could be RSS (updated information from relevant websites) and wikis could be used to create and share relationship specific documentation. (Im and Kurnia 2013)

SNS could also be used to detect new trends and changes in the business environment (Bruque Cámara *et al.* 2015). Organisations can use SNS and blogs for promoting and advertising to balance demand and sales. As people are more active in sharing information about experiences and opinions publicly via social network sites and discussion forums, these sites can be used to conduct a sentiment analysis. Sentiment analysis (or opinion mining) is the “*computational treatment of opinions, feelings and subjectivity in texts*” (Pang and Lee 2008) where the purpose is to discover positive, negative or neutral posts regarding a certain subject. Higher amount of positive discussion may lead to increased sales, and negative discussion may cause the opposite. The identification of the polarity (amount of positive vs. amount negative posts) of discussions in social networks may be critical for companies, as this information is crucial for product development, operations planning and forecasting to synchronize supply capabilities. (Asur and Huberman 2010, Chae 2015)

Related to different products, web 2.0 has changed the business scene in many industries, as more and more services and products are delivered digitally. For example, Netflix has shifted from delivering physical products (rental videos and DVDs) to delivering services through the internet (online streaming). Moving from physical products to online services



transforms supply chains as some parts become obsolete (in this case some parts of logistics in deliveries) and enables more efficient collection of customer data and activity. (Tingling *et al.* 2011)

Integrated behaviour means that supply chain partners try to coordinate their efforts across the whole supply chain in order to respond to changing end-customer needs and to improve flexibility. This needs efficient information sharing and understanding of goals and customers. SNS and multimedia channels could be used to share information and best practises to improve performance. Organisations could use wikis and podcasts to share information and experiences related to training of staff internally and externally. (Im and Kurnia 2013) SNS can be used to form relationships within an organisation, and enable employees to connect with each other and to share information and experiences to improve integration internally (Baxter and Connolly 2014). Communication between organisations could be improved with instant messaging and VoIP, leading to operational flexibility (Bruque Cámara *et al.* 2015).

According to Im and Kurnia (2013) information sharing among supply chain partners is to reduce uncertainties in planning and monitoring of processes. Mashups and GPS can be used to track, monitor and streamline manufacturing and delivery processes. For example, with a similar software as Google Maps, the locations of transportations and inventory levels in different physical production sites could be shown. SNS and blogs (such as Twitter) can be used to spread information about possible issues in production and logistics quickly. (Tingling *et al.* 2011, Im and Kurnia 2013) Wikis could be used to collect information collectively, and decrease information asymmetries, as organisations are dependent on managing and sharing knowledge (Baxter and Connolly 2014). Musser and O'Reilly (2006, p. 13) call this "*harnessing collective intelligence*". In the internet era, competitive advantage is derived from how efficiently users can share data. Integration therefore can be achieved through creating a platform for users to add own data relating to product and design information.

Collaboration in a supply chain is the joint implementation of efforts for the benefit of all the members in the network. Through SNS, organisations can link internally and externally, efficiently share opinions and to vote/decide on certain matters online. This could also be seen as a tool to create new culture within a network to promote opinion and information sharing behaviour. Blogs could be used to share knowledge and express opinions, very much like SNSs. Wikis can be used to gather supplier and consumer views about a product/service in one place to improve development and innovation processes. Tagging

would allow this information to be found faster. (Im and Kurnia 2013) Blogs can be used as a platform for a supply chain member to present its ideas for product design, quality or other relevant supply chain performance improvements, and initiate discussion around this topic together along with suppliers and customers (Bruque Cámara *et al.* 2015). Web 2.0 can reduce the costs of communication and collaboration, as web 2.0 tools can improve ways of communication and lower travelling costs as meetings can be hosted via VoIP. (Bughin *et al.* 2009)

Adebanjo and Michaelides (2010) analysed the opportunities that web 2.0 could provide for business clustering and how these so called “*e-clusters*” could provide value for their participants. This is done through e-communities and SNS. The authors state that web 2.0 increases company connectivity and interaction as web 2.0 encourages community building with subjects who share common interests without geographical constraints (compared to traditional clusters). Web 2.0 enabled networking sites allow people-information-interest matching and searching, thus increases the possibilities of “*collision rate*” with other companies that could be identified as potential suppliers or customers. In addition, Adebanjo and Michaelides found that through these networks, participants can push down purchasing costs through aggregated demand.

Risk and benefit sharing relates to improving of SCM processes so that risks and benefits are fairly distributed in a supply chain, as unequal distribution of both hinders collaboration between companies. Former B2B technologies, such as EDI, were relatively expensive and required high maintenance fees. Former systems required lots of resources to be build (infrastructure) and operated (training of staff). As Web 2.0 uses SaaS, it is easier and faster to implement than earlier B2B systems, and it has low operating costs as companies only pay for what they use. SaaS is also easy to scale up or down and enables smoother integration between organisations as the software is web-based, which also enables global accessibility. (Im and Kurnia 2013)

Web 2.0 can contribute to risk management as timely information can be distributed to a world-wide audience instantly. Popular SNS (such as Twitter) can be used to detect and alert about supply chain disruptions (such as natural disasters) and other relevant events (Chae 2015) SNS could enable revelation of problems that need fast responses from various supply chain members. (Bruque Cámara *et al.* 2015)

Integration of processes is important for smooth SCM performance. In the past, system integration was more difficult as organisations were using a variety of systems, and these

systems were sometimes incompatible with each other and could not be integrated. Web 2.0 can improve system and process integration, as they are delivered as SaaS, and these applications are accessible through the internet and a web browser. This reduces integration problems and improves interconnectedness of platforms. (Im and Kurnia 2013)

Customer relationship management is the management and development of relationships with customers. In the past, CRM communications have been one-sided as organisations have promoted their products to customers. Web 2.0 provides tools to enhance reciprocal activities with customers through SNS and blogs (Facebook, Twitter). As this information would be visible to all, supply chains partners have the access to this information and they can proactively react to customer feedback and harvest other information about customers to further understand them. (Im and Kurnia 2013) SNS can be used to conveniently engage with a large number of stakeholders to communicate about positive news and new supply chain initiatives. Especially spreading of positive news is considered to be strategic use of web 2.0, as word-of-mouth (WOM) is recognised to be very powerful among consumers. (Chae 2015). In the SCOR-model, the **return** phase is affected by the development of SNS and discussion forums, as customers can post and share information about their levels of satisfaction about a product/service, thus enhancing WOM which can either have a positive or negative effect on organisation's demand. (Tingling *et al.* 2011)

### **3.5 Possible risks and how to manage them**

Although web 2.0 tools are increasingly popular, and have proven to be useful in the business world and the tools have lots of potential if implemented in SCM, web 2.0 does have some problems and risks.

Most of the risks are related to the openness of the tools and trustworthiness of content. As web 2.0 tools promote user interactivity and openness/transparency of usage, they are subject to security risks and hacking. This is due to the ability of users to upload and modify content. This can cause a situation where a social network user posts a seemingly legitimate link to an other website, but instead this link contains a harmful code or other malicious content, such as viruses. As other users click the link, they accidentally download this virus to their own computers and pollute all the computers in an organisation. (Lawton 2007) As web 2.0 is based on sharing and creating content, the information may be unreliable as information creation is less hierarchically controlled than before and peers may have a chance to modify the content (van Zyl 2009). Main risks in web 2.0 is related to letting users outside of own organisation to access the network or conducting business

over the internet, which increase the risks of unauthorized access to information systems (Rudman 2010).

According to Almeida (2012), increased information sharing and fears of employee misuse have caused some organisations to restrict the use of web 2.0 due to perceived security risks and fear of leaking of sensitive information. Improper use of web 2.0 tools exposes the organisation to malware, viruses and spam. (Almeida 2012) Organisational reputation may be affected through inappropriate use of web 2.0 tools, especially social media. Web 2.0 tools may contain misleading or wrong information. People may criticize the company in social media, or company employees may themselves spread negative information about the company accidentally or intentionally. (van Zyl 2009)

The power of web 2.0 relies on collaboration and knowledge sharing. But according to Liu and Liu (2008), willingness to share knowledge is somewhat against human nature. As organisations share knowledge, they might lose the uniqueness of the knowledge that is the cornerstone of their competitive advantage. So a key problem in web 2.0 is trusting other parties in a network. As trust is a fundamental principle in positive interaction with other organisations, it can be expected that organisations are unlikely to share any type of knowledge with other parties if there is no trust among the business partners. (Liu and Liu 2008)

Adebanjo and Michaelides (2010) state that a key enabler of social networks is obtaining critical mass. "*The success of social networks is based on the ability to attract a wide base of users and attain critical mass*". This indicates that a network cannot provide any benefits if there are no participants, so in the case of web 2.0, a corporate social network would be useless if there is no interest among other organisations to join the network. Bruque Cámara *et al.* (2015) mention that web 2.0 is not likely to produce any value to organisations just by itself, but as web 2.0 is a set of collaborative tools, it needs to be linked to agents along the supply chain, which can improve integration and thus increase performance. According to Adebanjo and Michaelides (2010), the size of the network is critical, since the more there are members in a network, the more information can be attained and, for example, more demand could be aggregated. Another challenge is to create a unified culture within this network, as relationships in an organisational network are very different than relationships within people. Organisational networks are characterized by that every organisation has to contribute to the network, so the web 2.0 tool used for networking has to provide the conditions to identify and make contacts with other companies and to generate trust.

Tingling *et al.* (2011) conclude that web 2.0 is likely to have a great impact on traditional SCM. Web 2.0 is likely to redistribute the power relations in a supply chain, as information that previously has been restricted to transactional basis, could now be gathered from other sources. As information is more transparent, and more information is available through the internet, the situation is simultaneously beneficial and a threat for different actors in the supply chain. Web 2.0 enables information to bypass traditional routes, and this is likely to increase end-customer power, as they can access larger amount of information and spread either positive or negative WOM. (Tingling *et al.* 2011)

In buyer-supplier relationships, “*suppliers might seize the opportunity to move down the value chain*” and new actors may enter the industry. Information can be sourced directly from the internet or from IT companies that gather information about users’ activities and preferences as a part of their daily operations. For example, software companies, such as Google and Apple, are likely to increase their power due to the abilities to collect user data, and develop their businesses to bypass other supply chain members and place themselves closer to end customer in the supply chain. The challenge for companies in the web 2.0 era would be to show the value they can produce for a supply chain, and make this also visible for the end-customer. Organisations which fail to show their value for the supply chain and directly to the end-customer will lose to those which can. (Tingling *et al.* 2011)

To prevent risks related to viruses, malware and improper usage from happening, appropriate security measures have to be in place. Organisations should have up-to-date anti-malware software on their computers, and web-browsers should have content filters to prevent the users from accessing harmful websites. The employees must also be trained to use web 2.0 tools properly and to understand the risks associated with these tools. Organisations should have clear and unambiguous policies about the use of web 2.0, and complying with these policies must be monitored. (Almeida 2012, Baxter and Connolly 2014)

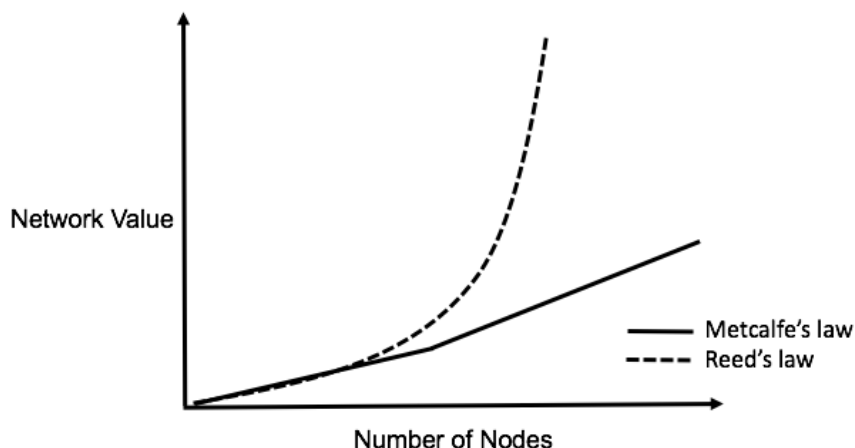


Figure 3: Network effect (Musser and O'Reilly 2006, p. 13)

Related to the aspect of obtaining critical mass, Musser and O'Reilly (2006, p. 13) discuss about how web 2.0 networks create value for organisations which participate in electronic networks.

Musser and O'Reilly (2006, p. 13) state that the increased amount of active users add value increasingly to the processes as they chat, collect, search and filter data. The added value can be illustrated as in figure 3, where the value of a network increases as the number of nodes increases. Figure 3 illustrates the difference between Metcalfe's law and Reed's law. In Metcalfe's law, value of the network grows proportionally to the square of number of devices in the network ( $N^2$ ). This is associated with traditional methods of communicating, such as phones, computers and etc. Whereas according to Reed's law, the network value grows exponentially ( $2^N$ ). This can be achieved with web 2.0, as it facilitates the formation of groups and sub-groups, thus enabling faster growth of networks. (Musser and O'Reilly 2006, p. 13) Therefore companies who decide to engage in implementing web 2.0 tools with their stakeholders, should make clear to all that the more members there are in a network, the more value it can produce to the members!

### 3.6 Linking the old and new

*"One of the primary benefits of EDI is the sharing of information between companies. This information sharing could come in the form of sending documents, raw data, money, etc. The difference is that newer interactive technologies have increased the size and scale of such interactions. For example, newer technologies utilize a networked framework, and are therefore capable of bypassing direct one on one links, allowing the possibility of simultaneous interactions between firms of a supply chain". (Plank and Hooker 2014)*

van Zyl conducted a literature review about electronic social networking in companies, and identifies several benefits and disadvantages (table 3). These can be used as arguments for or against implementation of web 2.0 tools in organisations. The study shows that social networking can increase productivity and innovations through more effective communication and identification of experts and opportunities outside own organisation. But at the same time perceived benefits of hierarchical knowledge transfer and fears of knowledge leakage and acts of vandalism may be the barriers to web 2.0 implementation.

New software and programs are created as the internet develops. The main difference in the old and new technologies are the amount of participants needed to be effective. For example, ERP systems are used to process information, create reports and to execute transactions, whereas “*web 2.0 technologies are interactive and require users to generate new information and content or to edit the work of other participants*”. (Chui et al. 2009)

Benefits	Disadvantages
<ul style="list-style-type: none"> <li>Up to date contact information linked to user maintained profiles</li> </ul>	<ul style="list-style-type: none"> <li>Potential source of information which can be used in social engineering attacks</li> </ul>
<ul style="list-style-type: none"> <li>Identification of experts, opportunities and potential business partners</li> </ul>	<ul style="list-style-type: none"> <li>Spammers and virus-writers can set up false profiles</li> </ul>
<ul style="list-style-type: none"> <li>Increased productivity and workflow efficiency</li> </ul>	<ul style="list-style-type: none"> <li>Decreased productivity caused by employees spending too much time networking and posting entries on blogs and Wikis</li> </ul>
<ul style="list-style-type: none"> <li>Increased staff motivation and sense of community through the accumulation of a digital reputation</li> </ul>	<ul style="list-style-type: none"> <li>User generated content can be unreliable, potential loss of confidential or sensitive information</li> </ul>
<ul style="list-style-type: none"> <li>Retention of cumulative organisational knowledge and experience in a fully searchable format</li> </ul>	<ul style="list-style-type: none"> <li>Resource waste with regard to bandwidth, server and network utilisation</li> </ul>
<ul style="list-style-type: none"> <li>More effective, appropriate and efficient use of computer-mediated communication technologies</li> </ul>	<ul style="list-style-type: none"> <li>Damage to organisational reputation either through intentional acts of vandalism and misinformation or through negligent acts or omissions</li> </ul>
<ul style="list-style-type: none"> <li>The ability to influence the perception of the organisation and/or brands through improved customer relations, viral marketing and innovation</li> </ul>	

Table 3: Impact of social networking/web 2.0 on organisations (van Zyl 2009)

Based on the extensive literature review about past SCM software and web 2.0 tools, some main differences can be pointed out and the potential added value web 2.0 can provide to buying organisations can be discussed.

The most profound difference between EDI, ERP, e-procurement tools and web 2.0 is the nature of working and doing business. Purpose of EDI and ERP is to create and share data about processes, such as costs and inventory levels, which are then used to support decision making processes. One can presume that the data is mainly quantitative. E-procurement is used to streamline purchasing processes, and make the whole process more efficient.

Web 2.0 is used to collaborate and share information with network members. The data can be the same as in EDI or ERP, but the purpose of web 2.0 is to deepen collaboration and create value through allowing members to share information on a larger and wider scale. More qualitative information can be passed through these tools. Web 2.0 may not be a direct buying channel, but the value is created in other functionalities and supporting activities. Web 2.0 can be used to negotiate, execute operations and projects and to source for information and customers and/or suppliers. Web 2.0 tools enable formation of networks, virtual groups and subgroups, sharing of documents, expression of opinions, chatting, online video meetings, notification of new updates and events, and a new way to illustrate data.

The weakness of web 2.0 is that as it is a set of collaborative tools, the value is dependent on the amount of users (Adebanjo and Michaelides 2010). But at the same time, competition is forcing companies to collaborate increasingly, and competition has shifted from company vs. company to supply chain vs. supply chain (Shatat *et al.* 2012). Existing SCM software, ERP and e-procurement, are mainly implemented to improve own processes and identify bottlenecks in own organisational processes, and the risks and benefits are not equally distributed among the supply chain. But web 2.0 on the other hand can be implemented to benefit the whole supply network. Web 2.0 can be used to improve SCM capabilities internally, but the value is really maximized when used together with external partners. The value is created through bidirectional and reciprocal activities and information sharing and from deeper supply chain integration. To succeed in the global competition, supply chain members need to find ways to exploit internal and external knowledge more efficiently. Web 2.0 tool enable smoother flow of information from organisation to another and from employee to employee, as users may directly link with each other and knowledge is no more hierarchically managed. Web 2.0 tools are cloud-based programs, which means that they do not require investments in hardware and infrastructure, and the tools are available on smartphones and can be used anywhere with an internet connection. In theory this would mean easier adoption and more agility as the tools are not location-specific.



#### **4. Other possible tools for supplier collaboration and communication**

According to the literature review, web 2.0 tools appear promising, and could be very beneficial in SCM and purchasing, especially in supplier communication, collaboration and data sharing. But web 2.0 and its usage in SCM has still not been studied that much in the academic field. As a limitation to this research, this can be due to that technology develops rapidly these days. Many new technologies have emerged, and these can be implemented in SCM and purchasing. These new technologies and solutions can currently appeal more interesting than web 2.0 tools. In this section, there will be a short overview of IoT and Big Data, as they could improve supplier communication and collaboration and they are also relevant for web 2.0.

##### **4.1 IoT in SCM**

Internet of Things (IoT) can be defined as “*devices or sensors connected world’ where objects are connected, monitored, and optimised through either wired, wireless, or hybrid systems*” (Zhou *et al.* 2015) This means that various devices (things) are connected to each other and to a controlling device (such as computer or smartphone) wirelessly over the internet, which enables the management of these “things”. These “things” are able to communicate with each other and exchange data. For example, a car can provide information about traffic and engine functionality, and a user can interpret this information through a smartphone and send this information forward. (Li and Li 2017)

IoT can be beneficial for SCM and purchasing in various ways. By adding sensors to devices and other things, this can enable the production of huge amounts of data (linked to Big Data, which will be discussed later). IoT can improve in-transit visibility, if items are provided with Radio Frequency Identification (RFID) chips. RFID chips produce various information about the items they are attached to, such as identity, location, temperature, transportation speed, and many other types of information on a real time basis. Technologies as such can improve company logistics monitoring and enable more proactive approach on reacting and mitigating possible threats, e.g. route optimization through traffic intelligence and surveillance of shipping conditions (humidity, temperature etc.). (Shankar 2017)

In addition to logistics visibility, IoT can improve warehousing, manufacturing and customer service. As the idea of IoT is that everything can be connected to the internet, this enables more visibility on consumer usage and enhances the possibilities of collecting

customer data. As an item is connected to the internet and to the manufacture/producer, data about the customer's behaviour, preferences and the way he/she uses the item can be collected, stored and analysed for future product/service design in order to produce more value for the customers. In the past, customer data has been collected through interviews and surveys which produces time lags and might not produce accurate image of the present as the results of surveys might not be reliable. IoT provides more tools to support fact-based decision making, as it provides real-time information. (Parry *et al.* 2016, Li and Li 2017)

Overall IoT is a tool for smart and reactive decision making. With IoT, any item or device can produce information related to production, logistics and usage. With the ability to produce vast amounts of information, the users are able to monitor different stages of production and delivery processes in different manufacturing and warehousing sites across the world, also including post-sales usage. With this "smart manufacturing", organisations receive more visibility in their production performance and enable them to be more reactive to events and disruptions, and to optimize their supply and production. (O'Marah and Manenti 2015)

IoT also affects procurement. As IoT produces large amounts of data and reports, it may improve spend through reduced amount of manual monitoring. Direct spend, such as inventories, can be improved through better monitoring and automated order placing. Indirect spend can also be improved through automated orders and better monitoring of the lifecycles of real-estates and machines, and malfunctions can be predicted more accurately. (York 2015a) But as the components needed for IoT supported manufacturing and warehousing are more complex, deeper supplier collaboration is needed and supplier's capabilities needs to be confirmed in order to mitigate supply risks related to parts enabling IoT, as these might be the cornerstone of manufacturing (York 2015b). In supplier collaboration and communication, IoT enables the exchange of real-time information. As information moves fast, deliverable materials can be traced and material flows can be adjusted quickly, thus IoT can increase supply chain agility. Related to purchasing, IoT can present the actual condition of the product that are about to be purchased. Overall IoT can provide multiple benefits to SCM by enabling the efficient sharing of various data, increasing visibility, and improving customer-buyer-supplier collaboration related to manufacturing, design and process optimization. (Lou *et al.* 2011, Bi *et al.* 2014)

But although IoT might present many possibilities for purchasing and SCM, IoT itself is not enough to provide any value. IoT produces masses of data, and it needs to be analysed. (Li and Li 2017) The data generated can be called Big Data. Big Data is usually defined with the three V's: *Volume, Variety and Velocity*, which refers to the large amount of data that is generated, different types of data (structured and unstructured), and the speed in which data is generated. Big Data analytics on the other hand is about using analytic techniques on Big Data, such as data mining and statistical analysis. (Russom 2011) Big Data analytics is needed to sort and make sense of this data, to find the most relevant information, causalities and trends in order to make data from IoT the basis for decision making, forecasting and process optimisation. (Li and Li 2017)

#### **4.2 Big Data Analytics and Predictive Analytics in SCM**

There is more and more data generated in the world than ever before. This is because data is generated and collected in more detail. An example is that instead of just gathering data about number of units sold, other data such as time, type of consumer and location is also collected. Although there is more data that could be conventionally managed, Big Data is usually associated with better decision making and profitability as companies are more data driven. (Waller and Fawcett 2013)

The challenge with IoT and related methods is that large amount of data that they produce is unstructured, which makes it difficult to analyse with conventional IT tools. (Rozados and Tjahjono 2014) "Big Data Analytics" or "Predictive Analysis" in SCM are a set of techniques and "*both quantitative and qualitative methods to improve supply chain design and competitiveness by estimating past and future levels of integration of business processes among functions or companies, as well as the associated costs and service levels*". (Waller and Fawcett 2013) This means that if data is unstructured, it needs sophisticated methods for one to interpret the data and make decisions based on it. Techniques, such as statistics, data mining, simulations and mathematic modelling are used to find patterns and trends in the past and in the present to better understand situations and consumer behaviour. The data can be used to forecast future events and optimize processes accordingly. (Waller and Fawcett 2013, Kache and Seuring 2015)

Academics have found many implications for Big Data and Predictive Analytics in SCM, and many of them are related to IoT. In the internet era, data can be sourced from almost everything. With Big Data and Predictive Analysis, companies can have better understanding of their customers and improve their demand planning and warehousing

according to customer information. Customers leave a trace of their buying behaviour when using loyalty programs or when purchasing from web shops or through applications. This data can be analysed to discover demand peaks, buying behaviour and to improve material flows and create customer profiles. Customers also publish information about their opinions regarding products/services in social media and other social platforms. This is very much related to web 2.0 and sentiment analysis, which is a tool to identify opinions of the crowd and to recognize the positive or negative “buzz” around a product or service. Firms may use this data to further improve product/service design to better meet customer demands, and thus create positive word-of-mouth. (Asur and Huberman 2010, Rozados and Tjahjono 2014, Schoenherr and Speier-Pero 2015)

In procurement, Big Data can be used to process transactional data, as big companies have thousands of transactions every year. This could improve spend visibility and cost management, as procurement patterns of a single buyer and the department as a whole can be identified and mapped. Big Data can also be useful in monitoring and estimating purchase prices, as firms could try to forecast and identify in what kind of situations buying prices are the lowest based on historical data. Procurement can also benefit from applying Big Data to warehousing and logistics and improve visibility on both, and better monitor conditions and lead times as with IoT. Procurement could also benefit from analysing suppliers through external and publicly available data, such as social media and other web 2.0 platforms. These could reveal important performance indicators of the supplier. Increased data and knowledge about the business environment and suppliers’ conditions can improve the buyers negotiating positions. (Rozados and Tjahjono 2014, Schoenherr and Speier-Pero 2015)

Overall Big Data and Predictive Analytics in SCM are associated with more informed decision making (more available data), improved demand planning (demand patterns and forecasting) and cost management (visibility) and Big Data can also improve process efficiency and help in detecting bottlenecks (optimization). Big Data can also be a key enabler of supply chain integration, as it increases visibility and more data can be exchanged and used as a basis of supply chain coordination (Schoenherr and Speier-Pero 2015). But there are some barriers which might be potentially harmful for companies implementing Big Data. To ensure visibility across the whole supply chain, data centres must be accessible and interconnected, otherwise if data is stored in silos, it could be incomplete and the decision makers might not see “the big picture” (Rozados and Tjahjono 2014). Creating masses of data, sharing it and connecting it to several interfaces can develop security concerns as some may get access to sensitive data. Some of the

biggest concerns with Big Data is the lack of data and how to identify the most relevant data. If there is no data or lack of data, one cannot perform analysis or the analysis is insufficient to be the basis of decision making. Companies must also identify what is the most relevant data for their purpose in order to make accurate decisions (Schoenherr and Speier-Pero 2015). Many may say that the more data, the more accurate predictions can be made. But this is only true when the quality of the data is ensured. If the data used is of poor quality, inaccurate results and even false results may be produced. This is why the quality of data is more important the quantity of data. (Schiff 2015)

## 5. Research methods

The research method chosen for this research is case study and the study was carried out through a set of five interviews. Case study is an appropriate research method for this subject, as there is little research on using web 2.0 tools in purchasing and SCM, and there is little public information available that would confirm that organisations are using web 2.0 in their procurement processes. The semi-structured interview method also makes it possible for the interviewees to talk more freely, bring insights outside the survey to the interview, and they can also reflect more on their experience and knowledge outside the case company. The research method is explained in more detail in chapter 1.4.

The interview (appendix 1) consisted of 13 questions, which focused on the current status of stakeholder communication and collaboration, whether or not the interviewed people use web 2.0 tools in their work, would they see them as potential tools for improvement and lastly they were asked about some future insights about what would be big themes in buyer-supplier communication and collaboration. The interview questions were sent to the interviewees beforehand for them to prepare themselves for the interview.

The case company is held secret by the request of the interviewees, and the interviewees also requested to stay anonymous. The case company is a multinational chemical company, which has operations in Europe and Asia. The company focuses on the production and marketing of chemical products on a global scale. The company has over 5,000 employees, and the company's turnover in 2016 was over 10 billion euros and profit was almost 1 billion euros. The industry is characterized by the use of large supplier base, and there are lots of small suppliers. The purchasing department is responsible for indirect purchasing, which consists of the purchasing of materials, maintenance, spare parts and construction work. As indirect purchasing is usually not considered as "strategic", collaboration with suppliers is usually not very close, as the price is the dominant criteria when choosing suppliers for these kind of products and services.

The interviewed people were all in managerial positions in the company's procurement department. The interviewees, presented in table 4, represent the company's managers and team leaders in various purchasing categories, such as materials and maintenance, services and procurement analytics. Their work experience in purchasing varied between 5 to 22 years. One interviewee is the project manager of process improvement in the procurement department. Different kind of purchasing needs different levels of supplier collaboration, so a variety of people with different roles in the company were interviewed.

The interviews were conducted between 29 May and 6 June 2017. All were held individually face-to-face and the interviews were recorded except for interviewee C, who did not want to be recorded. The duration of the interviews varied between 30 and 60 minutes.

Interview	Position	Experience (years)	Area of responsibility	Will be later referred as:
1	Team leader	6	Equipment, materials and spare parts	A
2	Purchasing specialist	5	Equipment, materials and spare parts	B
3	Team leader & lead purchaser	15	Services, maintenance and construction services	C
4	Category leader	22	Equipment, materials and spare parts	D
5	Team leader	5	Procurement and sourcing analytics, metrics and support	E

Table 4: The interviewees: their work experience and role in the company

## **6. Web 2.0 tools in supply chain management**

In this section the results of the interviews are analysed. The results are divided into 6 sections: first the current situation of the company is reviewed. Second part will discuss the usage of web 2.0 tools in the procurement department and the identified benefits. Third part focuses on the perceived potential of web 2.0, and fourth on what are the perceived disadvantages and barriers for implementation. Part five discusses about what could be the enablers for increasing the usage in the SCM scene. The sixth section will focus on what other tools can be used and how the future will change buyer-supplier collaboration.

### **6.1 Current situation of supplier communication and collaboration**

The first objective of the interviews was to analyse the current tools and methods used in buyer-stakeholder collaboration and communication. One has to first understand the preceding conditions in order to find out what improvements can be made. The current situation of stakeholder communication and data sharing can be described to be "traditional". The company relies on the use of mobile phones, e-mails and face-to-face meetings. Then there are various different tools for specialised purposes, such as software for asking quotations and bids. As person A said "*The current tools and systems are good enough. They get the job done and the content of data and messages are more important than the tools used*". All others also stated that the current ways are working, but they also identified a lot of problems. The most problematic things in current tools are the way they are used and the amount of data. People use e-mails even for very small things, which causes people to receive tens of e-mails a day. As interviewee B said: "*The problem with e-mails is that there is too much messages. There is no time to process them all and the data gets easily lost*". Employees might not have time to process all mails and sometimes mails just get lost in the masses. Problem with phone calls are that although they are very efficient way of communicating, nothing cannot be agreed on the phone. Everything needs to be written down, which again causes more e-mails. C mentioned; "*There are too many systems, and usually for one purpose only*". This refers to the situation that there are a lot of different systems used in the company, and usually these systems serve a single function. This leads to a situation where data is stored behind different systems, so it is time consuming for an employee to learn how to use multiple different systems and try to search specific data.



The internet itself is not utilized very much in searching for information about suppliers. Usually buyers check the suppliers web pages and its profile to get a first impression about the company. Internet is also used to check contact persons and references, but basically internet itself is not utilized in decision making. The interviewees explained that most of the suppliers are small companies, and there is not that much public data available about the companies. As mentioned by person A, the company works in B2B markets and mainly buys industrial products, thus there is less “buzz” going on in the internet and crowdsourcing is hard to implement. Other explanation can be that using the internet as a tool is not a part of working methods or there is simply no time to browse the internet.

## **6.2 Web 2.0 in purchasing and SCM and its benefits**

The second part of the interview was about finding out whether or not people in the procurement department are using different web 2.0 tools in their daily work. The results varied among the interviewees, but some similarities in the perceived benefits and disadvantages could be found. Parts 6.2 and 6.3 will focus on the benefits and potential of web 2.0, and part 6.4 will examine the disadvantages and barriers for implementation.

The interview revealed that the company is currently using some web 2.0 tools as a part of daily work. Despite this information, the interviewees told that the use varies a lot, depending on the tool. One finding was also that most of the interviewees were unfamiliar with the concept of web 2.0, although everyone knew what were meant by things such as social networking, wikis and blogs. But after a short introduction of web 2.0 tools and concepts, the interviewees were able to name some tools that are used in the company.

All interviewees mentioned the use of VoIP and a chatting software. VoIP enables rapid communication without having to move to different physical location, and meetings can be held for larger audiences. This saves time and costs as people don't need to travel to meetings within the company, as the company has many production sites. Chatting enables fast communication and a fairly easy way to solve small matters. Interviewee C also points out, that the chatting software leaves a trace of the conversation, which makes it easy for the users to catch up with what was discussed and agreed in the past. These views were widely shared by all interviewees. As the current situation in the company still relies heavily on e-mails and phone calls, the interviewees were grateful that the tools are

able to save them time, and people may be more comfortable in using them instead of e-mails and phone calls.

The company has blogs and social networking sites that are available for internal information sharing and publication of topical news. The blogs are more for “official” use, as company newsletters and information about current events are published through a blogging tool. The SNS is more for “informal” use, where every employee can post publications about e.g. what is new and what is going on in their department. All interviewees mention the existence of these tools, but no one uses the SNS due to lack of time and/or interest. The use of the SNS was seen as a bit “pointless” when it comes to work, and the information available on the site was more or less “nice to know” -stuff. On the other hand, the blogging tool was seen more important because it contains more information regarding the whole corporation. Most of the interviewees mention that they use the blogging tool to keep updated about company matters. As Tingling *et al.* (2011) and Im and Kurnia (2013) mention, SNS and blogs can be used to spread information and create discussion. The basic idea in the company’s own tools are the same, but the way they are used might be the reason why they are perceived differently. It is important for everyone working for the company to know what is going on, but information that concerns the whole company is perceived more important than information regarding a single department or even a team. But none of these tools are used with external partners, due to reasons which will be discussed later in part 6.4.

### **6.3 Potential of web 2.0 in procurement**

The interviewees saw very much potential in how web 2.0 could improve procurement and collaboration with external partners. All interviewees stated that if the right tools were to be implemented, in addition to current ones, the impact could be positive. The interviewees had slightly different views and opinion about how web 2.0 could be beneficial.

Interviewee A saw much potential in web 2.0, as the current communication systems are seen “*challenging*”, although the tools “*get the job done*”. The interviewee emphasized that web 2.0 could be used to increase information and experience sharing between companies. Information could be shared not only with suppliers, but also with similar companies that use same suppliers or have similar processes. Interviewee A also stated that sharing good and bad experiences about suppliers with other companies could also be useful in supporting sourcing processes. Web 2.0 could help in making right decisions

when choosing suppliers. If there is little information about a supplier available, the chances of making a bad decision increases. When the buyer notices that the supplier is not suitable, a lot of time and money has already been invested.

Interviewee A's opinion was that using web 2.0 more as a part of daily work could increase visibility on the business field. This would help the employees to be more acknowledged about what is going on in the industry. The employees wouldn't necessarily have to connect with other companies, but they could follow more what is going on in other places e.g. crowdsourcing could be utilized more by reading blogs and following SNSs more frequently. This idea was enforced by an example, where a supplier went bankrupt. This came as a surprise for the case company, and could have probably been avoided if people would follow more what is going on in the industry.

Interviewed person B saw most potential in improving SRM, and making the most of it. Currently most conversations are done over the phone or email, web 2.0 could enable more efficient collection and recording of supplier ideas and conversation, so they could be more deeply analysed and utilized. *"So much information is lost with the current tools. If better tools are already available, why not use them?"*. The interviewee also said that implementation of mashups and podcasts could add more depth and systematic approaches in SRM, as they could be used to collect and spread information. Interviewee C had pretty much the same ideas about the potential of web 2.0 as B. Person C saw that web 2.0 could be used to have broader communication with stakeholders. According to C, e-mails are too separate, so web 2.0 could make communication more traceable and linked to other conversations. Web 2.0 could also help to make external communication more participative and improve problem solving, brainstorming and solution finding through crowdsourcing and social web tools.

Interviewee D had similar opinions as A. D saw most potential in collaboration with other companies, even with competitors. The interviewee said that companies could create their own *"social groups"* where they could e.g. share experiences and information about suppliers. According to the interviewee, this is already being done in some industries. *"Sharing information with competitors shouldn't be seen necessarily as a bad thing, because the conversation could only be about suppliers and their products and not about processes and confidential matters"*. Web 2.0 would also make it easier to create interest groups that would combine people from different departments, from suppliers and other partners to discuss about certain process/product related matters. Information sharing within a company could also improve, especially if a company has many production sites.

D said that web 2.0 could be used to break the “silo effect” as many sites are like “*their own islands*”; they may have their own way of doing things, so the barrier to communicate and share experiences could be lowered with web 2.0 applications.

Interviewee E implied that web 2.0 could be fairly easily implemented, as the technology is already available and some tools already in use. Compared to complex ERP implementation, web 2.0 tools could be implemented much more easily. This is based on the SaaS service model where services are provided via internet (Im and Kurnia 2013). More difficult would be getting employees familiar with the systems and getting them to use the new tools on a daily basis. As every tool has its own purpose and function, the most promising and interesting tool according to this interviewee was mashups. As stated by Lytras *et al.* (2008, p. 5), mashups are websites that combine the content of two or more different websites. E saw that mashups could be used to source various information about suppliers. As much of information is already publically available (news, financial figures, public opinions), but scattered around different sources, there is need for a tool to combine all this information. E said that this would improve availability of information, and support decision making as you could base your decision on multiple sources. Mashups could also gather more qualitative information about suppliers. All in all, the interviewee saw that these kind of solutions would improve information collecting, and thus improve fact-based communication and could even improve negotiation power.

#### **6.4 Disadvantages and barriers for implementation**

Although the interview revealed that web 2.0 could be very useful, especially in improving stakeholder and supplier communication and improving information gathering and sharing, the interviewees also identified many risks and disadvantages that create barriers for the implementation of web 2.0 tools. VoIP is used very rarely with outsiders, other tools not at all.

The biggest disadvantages that every interviewee mentioned was security and privacy issues, and that web 2.0 could be prone to hacking. This was also considered as a major barrier for the implementation of web 2.0. The interviewees said that if the systems are based on sharing of information, it could be somewhat easy to make mistakes and spread wrong and sensitive information. Interviewee C said: “*If the basis is that people collaborate more, does it mean more humane errors?*”.

The interviewees were also concerned about confidentiality, and this raised many questions. Although web 2.0 is based on sharing information, where is the limit? Do people understand what can and cannot be shared and published on different platforms? And how can system users be sure that the system provider does not leak information forward? Interviewee B said that *“companies fear of leaking sensitive information to others”*. Interviewee A mentioned that every relationship is confidential; it is not easy to start changing experiences with others without causing some kind of problems, as business relationships are mostly based on mutual trust. These were the most severe disadvantages and threats that the interviewees identified. *“People tend to speak more freely over the phone than in e-mails or other platforms”*, this was said by D when asked about the disadvantages of web 2.0 and was later complemented by; *“People tend not to participate in conversations, if they see more threats than benefits”*.

Other issues were related to data and its amount and quality. Interviewee C was worried that as there are already vast amount of data coming from various sources, would the total amount of data be overwhelming after the implementation of more web 2.0 tools? E, who is already highly involved with supplier analytics, was concerned about the quality of data. For mashups to be reliable, the data sources must be trustworthy. Public sources may be problematic if the data cannot be verified, and in some sources information may be made up without any connections to reality.

Interestingly, the interviewees did not come up with any other direct disadvantages that could be related to web 2.0. The Interviewees had more views about barriers why the company or other companies don't use web 2.0 tools in their purchasing (disadvantages can also be considered as barriers). The barriers where related to users, stakeholders and the company's processes and culture.

Interviewees A, B, D and E all said that the company has many internal barriers that impede the company from adopting more collaborative tools. They all state that the organisation culture is rather bureaucratic. This makes adopting new tools a slow and long process. Another internal barrier is change resistance. Although the culture might be bureaucratic, the company has made many changes in the recent past. But some feel that the changes were not managed well. Managers who make the decisions, don't have a clear vision on how changes will affect different functions. Some feel that employees were not informed properly about the changes, which has caused confusion and frustration. Employees find it hard to keep up with the changes, which has made them sceptical towards new changes and software, and their argued benefits. Person C said that there

are already a lot of systems in use, so would new web 2.0 tools be too much? People would need time to adapt and learn how to use new systems, and time is something that is a rare resource in many modern companies that drive for more efficiency. B also said that *"If people don't know about these tools, they also don't understand their potential"*. This comment was probably targeted towards people higher in the company's hierarchy, who make the decisions about what systems are in use. This was an interesting finding, as the company has already implemented some web 2.0 tools. But this also confirms that on a general level, people don't have that much knowledge about what web 2.0 is, and what can be done with it. This finding was already mentioned in part 6.2.

Other barriers are related to use with external parties. One prerequisite that C said was that *"All suppliers and other stakeholders would have to have similar systems, otherwise they would be useless"*. This was enforced by the words of A: *"We are not the biggest company in our industry, so do our suppliers think we are attractive enough to implement these systems with us?"*. The problem is that if you're the only one using such tools, there is little value in the system. And company's suppliers also has to realize the value of new tools. If the buyer is not an interesting and promising customer, the suppliers see little point in investing such tools. A and D also saw the way of doing business as a barrier for implementation. It was said that purchasing is very much project oriented, and suppliers may change between projects. This decreases suppliers' interest in investing in such systems, as the buyer cannot guarantee that the business relationship would continue after a certain project. So there is a risk that the investment would go to waste. Most of the suppliers are small companies, so it would require relatively large investments for them to implement new systems.

### **6.5 Enablers for implementation of web 2.0 in SCM?**

The interviewees saw much potential in web 2.0, but they also identified multiple disadvantages and barriers for implementation. But with the right enablers, web 2.0 could be considered to be implemented in companies to increase collaboration and communication. The interviewees were more focused on the barriers for implementation, so these enablers are derived from the literature.

Probably the greatest enabler would be trust. Many disadvantages and barriers were related to fear of misuse of the systems and leaking information. Trust is essential in every business relation, and employees and managers also have to trust in the systems and in what they are doing. Many barriers, such as fear of information leakage, employee

prejudice and change resistance could mostly be handled through increasing trust. As mentioned by Nyaga *et al.* (2010), increasing collaboration and information sharing could improve both buyer's and supplier's performance, but the business relationship is problematic if there is no trust and one expects the other one to be opportunistic.

The interviewees mentioned that there would be need for change in organisational culture in order to implement collaborative tools with external partners. People in managing positions should overcome their fears of risks, and to examine what could be achieved with new tools. One could ask that what is preventing from people doing mistakes and leaking sensitive information with the current systems? If the current way of thinking is that current tools are "good enough", that is non-productive thinking. As competition increases, companies need ways to improve processes, and focus also on other things than just product development. With more open environment, and people changing their attitudes, a lot could be achieved. As Im and Kurnia (2013) mention, web 2.0 tools could be used to change and promote new culture within companies, as the tools are designed to increase interaction with other people.

As mentioned by Musser and O'Reilly (2006, p. 13), the network effect is based on the increased amount of users, and the network's value increases when the number of nodes increase. The key is to get partners to understand the potential of these tools, and to get them adopt similar systems or allowing them to have access into company's own systems. There has to be mutual benefits, and these benefits have to be visible for all parties in the network. Implementation of web 2.0 should be fairly easy, as they are based on cloud technologies and some tools are probably already in use by some companies. The business partners would need to be convinced that relationship-specific communication channels would be in use, and business continuity should be ensured. Web 2.0 would probably be a bad investment if the business relationship would last only for one or couple of transaction. So the key would be to generate mutual trust and commitment to the cause, which would further deepen supply chain integration (Simatupang and Sridharan 2002, Nyaga *et al.* 2010, Wiengarten *et al.* 2013).

As Angeles *et al.* (2007) say with e-procurement systems, extensive training is needed to overcome change resistance and for employees to become efficient users. This can be applied to every system, old or new. When implementing new systems in an organisation, employees need proper training and guidance on how to use the systems and what information is allowed to be shared with stakeholders and suppliers. This would increase their familiarity and confidence with the systems, and would decrease the threat of

mistakes and leaking of sensitive information. It could also be good to agree with counter parties about proper guidelines and rules on how to use the systems and how to behave in collaborative sites.

## **6.6 Future of supply digitalization**

Even though the interviewees said that there is much potential in web 2.0, and it could really improve supplier and stakeholder communication and collaboration, there are many problems that would have to be solved first. But in the meantime, other new technologies are emerging and affecting purchasing. Web 2.0 is not a set of very new technologies, and first tools appeared before 2010. In this section, interviewees were asked how they see the future of SCM, and how do they see that systems and processes are going to change.

A's vision about future SCM included deeper collaboration and partnership type relationships. Currently systems are merely tools to get things done, and at the end it all comes to profits and savings. New systems would need more mutual benefits and motivators in order to be more popular among buyers and suppliers. When asked about how the internet will affect purchasing in the future, the answer was that the internet has already affected purchasing greatly. A's opinion was that the use IoT/Big Data would increase in the future. But for them to become useful and working tools, the basics must be in order. More data is always more data, and the interviewee did not see any disadvantages in that. But the quality of data must first be ensured. Interviewee A shared the view of Schiff (2015), that if data quality is poor, IoT and Big Data is useless. Big Data would also need skilled workers to handle the data and provide sufficient support for decision making.

According to B, future SCM would include more cloud-based services. B thinks that SRM would be moved to systems which would allow the services to be used as data banks, and information could be distributed more efficiently and allow more reciprocal approaches. B's vision was that internet will transform purchasing to be more automated and manual labour will decrease. As a result of this, work would require more cognitive and problem solving skills. When discussed about future systems, B said that the possibilities of IoT is being studied. These could bring lots of possibilities, but the interviewee was worried about the technical issues, such as are the devices reliable? If the systems are too much dependent of computers, technical issues could cause major problems.



C had very much the same visions as B. The main opinion about future systems included cloud services and making data exchange easier. Suppliers would also be encouraged to share more data. C saw that Big Data could enable more efficient analysis of purchasing data, which could improve of processes further. When discussed about possible advantages and disadvantages, the opinion was that more data is always good up to a certain point, but could this lead to the same situation what is currently happening, that there is too much data and not enough time to process it all?

D did not have much visions about emerging tools and systems, but more visions about procurement and SCM as a whole. The vision about the future was that buyer-supplier relationships would be more partnership like; buyers would have less suppliers, but the relationships would be closer. Suppliers would participate in planning and designing processes, so there would be more integration. When asked about the effects of internet on purchasing, D's answer was that the company should exploit more internet-based software in different phases of the purchasing process, such as e-auctions and e-sourcing. This gave the image that the company has not adopted that many e-procurement tools, that could help in streamlining processes and making purchasing more efficient.

D's opinion about IoT in SCM was that it can enable condition monitoring for equipment and machines, which can enable more proactive purchasing to avoid production standstills. This would mean that machine send data about its functioning, and repairs and spare parts purchasing could be done in advance before any disruptions in production. Big Data could enable simulation of different scenarios and production processes. But according to the interviewee, in the end it is a human who makes the decision, which can be based on past experience rather than computational data. Also some purchasing processes cannot be fully automated, as some purchases may only be done by humans. This is because a major part of the procured products are tailor made for the company, and suppliers have to meet strict standards. Purchasing such products always need human interventions and negotiation. But overall the interviewee saw that internet will be a big part of future purchasing, and with IoT will enable better collection of supplier performance and quality, which is essential for negotiations and supplier improvement. Especially quality needs to be measured more, and this data needs to be shared with the supplier.

E's vision was that supply digitalization will develop further on. The opinion was that internet itself won't change purchasing that much any more, as the benefits and disadvantages are mostly already acknowledged. Instead, internet would be more of an enabler, and the focus would move more to "full suit"-systems that would include all necessary processes related to purchasing. When asked more about possible new solutions in buyer-supplier collaboration, E had the same vision as D, that the use of IoT would increase in some processes, especially in preventive maintenance. New systems would improve the speed of data exchange, but E wondered would there be too much confidential data transmitted to partners?

## 7. Discussion and Conclusions

The modern world is digitalizing ever more rapidly. Technical and digital innovations will play a crucial role in the business scene of today and near future. Digitalization will not only affect business communications, but it will affect the whole company, from production to sales. Increasing globalization, and increased competition will force companies to increasingly collaborate with each other. Technological improvements can enable the digitalization and automation of the whole supply chain. But as for now, full automation is still a dream, but digitalization provides the means to collaborate more efficiently. But what are the means of digital collaboration, there are many possibilities, and web 2.0 tools could be one potential solution. In this research, web 2.0 tools and their applicability in purchasing and SCM was studied. In part 1, the background and motives for this research are introduced. In part 2, earlier electronic purchasing systems were reviewed, and the advantages and disadvantages were examined. In part 3, cloud computing and web 2.0 tools were introduced, and web 2.0 tools were examined more closely about how the tools could be applied in modern purchasing and SCM. In part 4, new emerging applications, IoT and Big Data, and their use in purchasing and SCM were studied. In part 6, an empirical study about the use of web 2.0 was conducted. This study was carried out as a case study, and it contained 5 interviews in a global chemical company. The interviewees were from the company's purchasing department, and all have different responsibilities in the company. The main results of this research are summarized in table 5. The purpose of the study is to answer the main research question:

- *Are organisations using web 2.0 tools in purchasing/SCM and what are the benefits?*

The main research question was supported by three sub-questions:

- *If a company uses web 2.0 tools in purchasing/SCM, what tools are used and which are the most important?*
- *What are the advantages and disadvantages of using web 2.0 tools in purchasing/SCM?*
- *What are the enablers and obstacles for using web 2.0 in purchasing/SCM?*

Advantages	Disadvantages
Efficient communication Saves time and improves efficiency No need for travelling Increased information sharing Collaboration with other companies Easy to implement	IT security Humane errors Too much data Competence of users Data quality issues Publicity of information? Confidentiality of data?
Enablers	Barriers
Innovative organization culture Change management Trust among trading partners Trust on both management and employee level Similar systems among buyers and suppliers	Bureaucratic Organization culture Change resistance No understanding of the tools Lack of trust among trading partners Others don't have similar systems Characteristics of the industry

Table 5: Main findings; advantages, disadvantages, barriers and enablers of web 2.0 tools

### 7.1 Current situation in the case company

Before examining whether or not the case company was using web 2.0 tools in its purchasing and SCM processes, the current systems and methods were studied. The interview showed that the company's main methods of communication and collaboration were e-mails, phone calls and face-to-face meetings. It was also told, that these methods are not very efficient, and they are associated with many disadvantages, such as too much mails, no recordings of discussions and that the current tools are time consuming. The company does not utilize internet itself that much for it to be an important tool for the company. As mentioned by Tingling *et al.* (2011) and Im and Kurnia (2013), the internet, especially blogs and SNS, could be used to collect various information created by other people through crowdsourcing, but this can be challenging if there is no discussion about certain suppliers. As interviewees mentioned, this can be due to the fact that many suppliers are small companies operating in B2B-industries, so they don't receive much public attention.

The interviews showed that there is need for tools that could improve communication, internally and externally, and the data which the communication produces needs to be accessible by other people. For example, personal e-mails cannot be accessed by others, so problems arise in situations where an employee is absent. ERP can show transactional data (Hwang *et al.* 2013), but communication related to them can be hidden behind different systems. As mentioned by Davila *et al.* (2003) and Angeles *et al.* (2007), the inability of different systems to communicate with each other can produce problems.

Information might be stored in different places, and not all have access to it. This creates interruptions in information flows, and can cause the company to look bad in the eyes of the supplier as people may have mixed information about what is going on with different transactions. But there is also the aspect of trust, which is especially important in business relationships. Not all information is intended to be shared with other people although it may contain information which could concern other people in the procurement department. As Chae (2015) mention, web 2.0 is associated with possible strategic use of WOM, so the current situation may be counter productive and produce negative image towards the suppliers and other stakeholders. So taking these points to account, web 2.0 tools could improve communication and enable smoother information flows from the buyer to suppliers. Communication would be more precise, when the buyer would have more information available about what is going on with different suppliers.

## **7.2 Are organisations using web 2.0 tools in purchasing/SCM and what are the benefits?**

Many companies are still using e-mails and phone calls as their primary tools when collaborating with other companies. Both have been the backbones of organisational communication for decades, so moving away from them will not happen fast. According to this research and to answer main research question, companies' purchasing departments are using web 2.0 tools in their internal communications. SNS and blogs are used for company's internal network building and notification distribution. Employees use VoIP and instant messaging for faster communication and collaboration internally.

According to the interviews, the mentioned web 2.0 tools create operational efficiency, as people can work mostly from their own desks, and communication is clearer. The benefits originate from people not having to travel to meetings as they can participate in meetings from their own desks, thus time and money is saved when unnecessary travelling is reduced. A benefit of the instant messaging is that conversations are traceable, and it shows the whole conversation history that has been discussed with other people. These same benefits were also identified by Bughin *et al.* (2009) and Bruque Cámara *et al.* (2015), who mention in their studies that VoIP and instant messaging increase operational flexibility as meetings and communication can happen almost anywhere. The SNS and blogs enable organisational information and news to be easily available. Tingling *et al.* (2011) and Im and Kurnia (2013) also mention, that SNS and blogs can be used for efficient distribution of information and create discussion over topical subjects. Although

this is a benefit, it is not very crucial for the functionality of the purchasing department, as news can be distributed in other ways.

But although the web 2.0 tools are only in internal use, this is still beneficial for the efficiency of the purchasing department. A large part of communication and collaboration is done with internal stakeholders and people who make purchase requests. Improving internal communications should be seen as a key enabler of efficiency, as purchasing needs to collaborate with many different departments as part of daily work, and their purpose is to serve internal clients and stakeholders. But one could think that VoIP would have the same problems as regular phone calls. The biggest benefit is that people don't need to move to different places, but the problem of not recording the calls and not being able to make agreements is still evident. But overall current web 2.0 tools are the first step in improving buyer-stakeholder/supplier collaboration. The collaboration systems must work internally, in order to be implemented with external parties. The company should study on how it could exploit more its already existing web 2.0 tools. One could also think that SNS and other communication tools would have same problems as e-mails, but SNS enables formation of groups and sub-groups, so conversation can be more organized and SNS is less likely to be "messy" as an e-mail inbox. As Boyd *et al.* (2008) and O'Leary (2011) say, SNS can be used to connect people and support social interactions, so SNS could be used to replace or complement e-mails and phone calls. SNS could also be used to build e-communities to improve collaboration (Adebanjo and Michaelides 2010).

As the interview showed, web 2.0 can really improve communication and efficiency. The tools are designed to enhance communication and enable smoother information flow across networks (Bruque Cámara *et al.* 2015). This is something that companies should consider. ERP systems focus mainly on the company's own processes and transactions, so qualitative data is easily bypassed. Web 2.0 tools could enable the formation of a broader perspective on different matters, and information could be retrieved from sources that were earlier not thought of. This way ERP and web 2.0 systems could support each other.

### **7.3 If a company uses web 2.0 tools in SCM, what tools are used, which are the most important tools and what are their potential?**

To answer the first sub-research question, out of the 4 mentioned web 2.0 tools VoIP and instant messaging are seen as most important. The purpose of the SNS and blogging tools are to bring company people together, and inform employees about important news

and events in the company. Due to these reasons, they are seen not as important as the VoIP and instant messaging. The purpose SNS and blogging tools makes them not critical for work, and people might ignore them for that reason, especially if there is a lot of work and little excess time. The purpose of the SNS tool is to create a sense of “togetherness” through networking (Boyd *et al.* 2008), but people don’t necessarily have time to use the tool, and the information may be irrelevant for individual employee. VoIP and instant messaging are more important, as they are directly linked to work, and used to collaborate and solve problems with other people in the company.

In addition to the current tools and their advantages, the interviewees identified much potential in web 2.0 tools and how they could improve buyer-supplier relationships. Interviewee A pointed out that web 2.0 could enable better information sharing with partners and sharing experiences about suppliers to support decision making through SNS or similar platforms. It could be advantageous for similar companies to increase collaboration in sharing experiences and good practices (Im and Kurnia 2013). This could lead to better results when competing against bigger competitors and performing better locally. The idea of sharing information is in line with Tingling *et al.* (2011), which presents the idea that networking tools can reduce uncertainties in planning and sourcing processes through gathering of qualitative information produced by other users. Interviewee A also brought up the utilization of discussion forums and social media to bring more insights about the business environment, which would mean the use of crowdsourcing. This implies that the company relies more on information given by the supplier, and secondary sources are not used that much although they could be a valuable source of qualitative knowledge (Tingling *et al.* 2011, Im and Kurnia 2013).

Other potential is related to sharing of information and collaborating with suppliers. Information could be shared and collected in one place, and thus improve problem solving and make relationships more participative. This view is in line with Musser and O’Reilly (2006, pp. 5-12), who state that web 2.0 has a very participative nature, and data can be shared directly to each other, through SNS or wikis. Other ideas were that web 2.0 tools can enable companies to create social groups internally and externally, and decrease the negative consequences of the silo effect. Companies could improve in building similar processes with different production sites. As Adebajo and Michaelides (2010) mention, it is crucial to create a unified culture in a network for it to succeed. Interviewee E was excited about the potential of mashups, which can be used to source information from multiple sources. Better information availability strengthens fact-based decision making, and more information can be linked to increased power in relationships. This is very much

linked to Tingling *et al.* (2011), which state that knowledge accumulation from various sources increase negotiation power as knowledge bypasses traditional routes.

Overall the potential of web 2.0 relied very much on the improvement of communication and collaboration internally and externally according to the interviewees. Other potential was related to information gathering from various sources and the recording of conversations with different stakeholders. This could be seen as a cry-out for better communication tools, as part 6.1 revealed, the interviewees were not very satisfied with current tools (phone calls and e-mails). But as some of the interviewees mentioned, web 2.0 could make a lot of things easier and possible, but at the end of the day, people should adapt to these tools and actively use them to make the most out of them.

Increasing the use of web 2.0 in daily work could provide employees better insights what is going on in the industry on an overall level. But if the users don't have past experience, it could be difficult to get all employees to use web 2.0 so that it would be beneficial for the company. But the tools are already available, so implementation should be fairly easy. The company would not have to invest in social tools itself, as employees could be encouraged to join public SNS sites and to follow discussions about the industry and purchasing for free. Joining such networks is easy, but the employees should have the motivation to do so, and they should be advised what they can and cannot do on public web sites. Crowdsourcing can be thought to be more relevant in the consumer markets, where people are more active to discuss about products, services and companies. B2B markets and industrial markets remain more "hidden", as companies might be more interested and careful about what their employees write about other companies on public sites.

As most businesses are still human-centred, it is clear that the web 2.0 tools have to be implemented in external communication to bring out their maximum potential. As competition increases, it is not enough to only improve internal communication, but this can be seen as a stepping board for wider implementation. What can also be interpreted from the interviews that in addition to clearer communication, there is need for tools that enable more efficient way of sourcing for information and gathering it in one place, so it can be utilized later. As mentioned by some interviewees, the use of mashups could really help companies to collect information from different sources to create a broad view on what is going on, in addition to financial information (Lytras *et al.* 2008, p. 5). SNS, blogs, multimedia and podcasts could all be used to source for information, and especially be



used for crowdsources, which can contain information that is disregarded in more traditional news and information channels (Goh *et al.* 2007).

#### **7.4 What are the disadvantages of using web 2.0 tools in purchasing?**

In this section, the second part of the second sub-research question is answered: What are the advantages and disadvantages of using web 2.0 tools in procurement/SCM? The disadvantages of web 2.0 are related to the usage of the systems, and cyber security. The biggest fears are that using web 2.0 would make data leaking easier, and that the tools would be more prone to hacking and malware. This study brought up some complementary additions to the literature review, which focuses mainly on outside security threats (Lawton 2007, Almeida 2012). A disadvantage of web 2.0 is also people deliberately distributing information outside the company, and not through accidental actions. Confidentiality is also a problem, as not all information is meant to be shared. As web 2.0 tools are to increase collaboration and communication, a disadvantage is that confidential matter is shared to other people, and people might not know what can and what is allowed to do. According to Liu and Liu (2008), sharing knowledge is against human nature, as they might lose parts of their competitive advantage. Business relations are based on trust, and partners are unlikely to share knowledge if they do not trust the transaction partner (Nyaga *et al.* 2010). Some interviewees were worried about that the systems could provide too much data that cannot be processed properly, and data quality was seen as an issue if the data is produced by other people, and the trustworthiness cannot be verified. These disadvantages are related to the nature of web 2.0 tools; anyone can create and add information and content to websites (van Zyl 2009, Baxter and Connolly 2014, Bruque Cámara *et al.* 2015).

These are somewhat similar disadvantages that one could associate with other internet-using devices and tools. What is preventing people from sharing information to unwanted entities through e-mails and phone calls? If people appeal to such reasons as security risks, it is not a very valid reason. Most systems are already connected through the internet, and transactions and such are conducted via e-mails, so they possess the same data security issues as any other computer software. Companies should trust their employees that they are working for the best interests of the company, and also to trust their partners that they are working towards mutual benefits. Companies should also have up-to-date anti-virus software even without new internet tools due to increasing international internet hacking (Almeida 2012). So by trusting in employees, and proper

education of the usage of new tools can reduce possible threats. Businesses already have to rely on outside information, and that the information is correct. So crowdsourcing should also be seen as a complementary process to current processes. If reflecting to the current situation, the benefits of web 2.0 could overcome the disadvantages.

### **7.5 What are the enablers and obstacles for using web 2.0 in purchasing?**

This part is to answer the final sub-research question; What are the enablers and obstacles for using web 2.0 in procurement/SCM? The biggest barriers for web 2.0 implementation are internal. The interview showed, that the case company itself is bureaucratic and not very agile, which makes adoption of new tools challenging. Holtzblatt *et al.* (2010, pp. 4666-4671) say, that the main barriers for the implementation of web 2.0 tools are cultural and societal. The company's management and organisational structure does not promote the right attitude that would make implementation of new technologies easier, although there is a clear need for more sophisticated tools. Due to this, employees are said to be change resistance, and do not receive changes positively. Challenges in organisational culture, fear of leaking information and change resistance in both management and employee level makes it hard to adopt new systems.

The implementation of web 2.0 tools would need a profound change in a company's way of thinking. Company's atmosphere should promote innovative thinking, and attitude should be more open for new tools, both on the management and employee level. Baxter and Connolly (2014) say that managements role is to support and guide change processes to enable smooth change of processes and overcoming obstacles. Especially when global competition is increasing, there should be more adaptive thinking towards collaborative tools that promote discussion and innovating. Although many companies advertise themselves to be innovative and agile, the reality can be something different. The importance of change management cannot be stressed enough. The change has to come from within the company, and the success of adopting new tools depends on the company's ability to implement changes. People on the management level should be aware of the possibilities that new tools could provide, as they are already in use to some extent. If web 2.0 tools are already in use, and the effects are positive, why not examine the potential of other new tools?

External barriers are related to the usage of web 2.0 tools on a wider perspective. Interviewees identified that for collaborative tools to produce value, critical mass has to be achieved and suppliers and buyers should have the same systems. This was mentioned

by Adebajo and Michaelides (2010) and Bruque Cámara *et al.* (2015): the success of web 2.0 and other collaborative tools relies on attaining critical mass, and needs to be linked to stakeholders along the supply chain to produce any value. This can prove to be challenging, if partners don't have mutual motivation to do so. The industry itself can produce its own barriers. The case company's purchasing is heavily project oriented, which does not promote continuous business relationships. If there are no continuous transactions, investing in collaborative and relationship-specific tools would not be reasonable. A network should see that web 2.0 could take communication and collaboration to a next level, and provide value for all the participants, as illustrated by Musser and O'Reilly in figure 3 (2006, p. 13). Otherwise it could be hard to get others to adopt systems, especially in this case where the buyer cannot provide promises that business relationships would continue after a single project.

The internal barriers are probably common for all companies facing big changes. But with web 2.0, the suppliers and other collaborators form a major obstacle. As a difference to ERP, web 2.0 are usually somewhat stand-alone systems; they are designed to boost communication and collaboration. ERPs on the other hand are designed to efficiently manage different functions in the company. This said, web 2.0 might not seem very appealing. Companies might be more interested in investing in multipurpose systems, rather than single function software, although it also could be beneficial. Web 2.0 true potential is revealed when there are enough users i.e. critical mass is achieved (Adebajo and Michaelides 2010). So in order for that to happen, different parties should see web 2.0 as an important improvement for the whole collaboration network. Interviewee E said; *"ERP provides value through transactional data. Web 2.0 and other systems should provide different kind of value, and could support decision-making"*.

For web 2.0 tools to become more popular in B2B context, the companies should understand the potential value of collaborative tools and the effects of business networks. This would need the creation mutual trust among the trading partners to overcome issues relating to fear of misuse and opportunism (Liu and Liu 2008). Trading partners should also create mutual motivators and win-win thinking to get organisations to adopt mutual systems, which would enable the increasing of potential network. Employees in all the companies in the network should be educated on how to use the systems, and what are the mutual guidelines how to work and behave on the collaborative sites in order to decrease possibilities of humane errors and misuse (Angeles *et al.* (2007).

## 7.6 Future systems in supply management

The interviewees had pretty much similar ideas about what the future is going to bring to purchasing and SCM. More data will be created by companies and devices, and the amount of shared data will increase. The processing of the data will become more important, and cloud based services will be more important. All shared the opinion, that digitalization will increase in the future, and systems such as IoT and Big Data will be more important in the future.

Overall the interviewees see that collaboration with suppliers and other stakeholders will increase in the near future. So in a way, the future of purchasing and SCM is based more on processes rather than systems. Probably the most “important” systems, such as ERP, are mostly already in use, and it is hard to see what could be a replacement for that. There is no big “game changer” systems in sight, but internet-enabled applications are making their way to purchasing. As internet is becoming more important, and devices will be connected to the internet even more, IoT and Big Data will be more important and relevant for manufacturing companies. Even though IoT and Big Data would not be used directly by procurement itself, it will probably be used by some other function that will affect the way procurement will work. Only few interviewees had ever heard about industry 4.0, so it will not likely have big impacts on the company in the near future. But the most evident aspect is that the amount of data will increase, and companies need the right tools to support data exchange. It is hard to say if web 2.0 tools are the right tools for the job, but there is a lot of potential in web 2.0, and the importance of efficient communication tools cannot be underestimated.

But the interviewees also thought that some traditional tools cannot be fully replaced. For example, interviewee A said that *“New systems may improve collaboration, but does not replace face-to-face meetings”* and C said *“systems can be “cold”, the human contact easily disappears”*. This implies that although how good the systems are, people still need live meetings and social interaction in order to be able trust and to fully understand each other. Another counter-argument for the increasing digitalization, said by interviewee A, was that systems; *“They are just tools; they do not do the work for you”*. This is true, because although purchasing can be automated, there will still be need for purchasing experts and employees to handle more complex orders. And at the end of the day, it is always a human who makes the decisions, for now.

## 7.7 Limitations and future research

This study was conducted as a single company case study. This means that the results cannot be directly generalized to cover other industries or businesses. Secondly, 5 interviews are a rather small subject group, and this does not give a full picture about what is going on in a company. The interviewees were selected by voluntary basis, and it could be that some information remains unrevealed. There is also the possibility that the interviewees have not revealed their true opinions. Most of the interviewees were not familiar with the concept of web 2.0, so this may have affected the results.

The phenomenon of web 2.0 has spread all over the world, but according to the interviews and academic literature, the use in the business world and especially in purchasing and SCM, is still very limited. Web 2.0 is not a new invention, and new technologies are already emerging, so it could be that companies will not pursue for these technologies in a large scale. So the nature of this study is somewhat speculative, and there is only little “hard evidence” available to support arguments.

The next step would be to repeat this study in a larger scale after a couple of years, and it would be interesting to study different companies and industries to see if the practices differ. This would show whether different businesses have different practices in internal and external buyer-stakeholder communication and collaboration. Studying the same company would show if there have been any developments in communication and collaboration systems. After a few years, it would also be more clear what new systems and practices the future would bring to purchasing and SCM.

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## **Appendix 1: interview questions**

### **Introduction**

1. How does your company currently communicate, share information and collaborate with suppliers/other stakeholders? In your opinion, are these methods sufficient enough?
2. Does your company use alternative sources to collect data about suppliers i.e. sources other than the supplier to evaluate their performance? (for example crowdsourcing, public sources etc.)
3. In your opinion, what are the disadvantages in current systems regarding communication, information sharing and collaboration with suppliers?

### **Companies using Web 2.0 tools**

4. In your company, do people working with purchasing/SCM (including yourself) use any of the following tools as a part of their work (or in other ways relevant to work e.g. improving knowledge)? How are these tools used?
  - a. Blogs
  - b. Mashups
  - c. Wikis
  - d. Collaborative websites
  - e. Social Networking Sites
  - f. Voice over IP
  - g. Podcasts and Multimedia sharing services
  - h. Really simple syndication (RSS)
5. What value do these tools provide for you and the company? How does this value differ from value generated by other systems (such as ERP)?
6. If using multiple tools, are some tools perceived to be more beneficial than others? how?
7. In your opinion, what are the risks related to using these tools?



**If not using web 2.0 in purchasing and SCM**

8. If the company is not using web 2.0 tools in purchasing/SCM, what is your view of the reasons for not implementing these? What are the enablers and barriers for implementation?
9. If your company does not use web 2.0 tools in purchasing/SCM, would you still see them as potential ways to improve purchasing/SCM operations internally and with suppliers?
  - a. If yes, what tools could be useful as a part of daily activities (or other relevant ways related to work and performance)?
  - b. If not, why?

**Other possibilities for supplier communication**

10. In your opinion, what are the emerging trends and systems in procurement, buyer-supplier collaboration and related processes?
11. How do you think the internet will change purchasing in the future?
12. To your knowledge, does your company pursue in any of the following in as a part of purchasing/ supplier collaboration/ SCM?
  - a. Internet of Things
  - b. Big Data and analytics
  - c. Machine learning
  - d. Industry 4.0
13. What are the benefits and bottlenecks in sharing online and “intelligent” data with partners?