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Master of Science in Management Engineering

Cloud Platforms for the management of the Supply Chain processes: an empirical analysis

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ABSTRACT

There has been growing competition in the global market nowadays and the organizations have been trying to find new solutions to decrease their costs and creating value-added experiences to customers by increasing the level of service offered. Therefore, they should consider opening their boundaries to third parties and become a part of the supply chain. They should take into consideration the views of both their suppliers and customers in the process of decision-making.

With the enhancements in digital technologies, it has become more easier to ensure efficiency and effectiveness within the supply chain management (SCM). Companies can establish strong relationships with the players in upstream and downstream of supply chain. The adoption of digital technologies in SCM has introduced e-Supply Chain Management (e-SCM); hence, there is an increase in both the efficiency of executive activities and the effectiveness of collaborative ones.

Cloud computing technology is one of the most crucial enhancements in the digital technologies and has undeniable effects on e-SCM processes such as increase in flexibility and efficiency and reduction of operational costs. The number of companies who are offering cloud platforms for the SCM has increased and the implementation of cloud platforms has raised over the years by organizations operating in various industries. Therefore, this research study focuses on cloud computing technology with the objectives of understanding the level of diffusion and adoption of cloud platforms among SCM of the organizations, analyzing the characteristics and identifying the main benefits and criticalities of the solutions.

The methodology of the study has been divided into three phases to better structure the flow of the analysis: (i) literature review, which is crucial to have the theoretical background about the research subjects, (ii) empirical analysis, including the census of cloud platforms in SCM and interviews of both provider and user companies, (iii) findings and results, a discussion on the main evidence come to light from the census and the interviews to meet the objectives of the study.

Keywords: Supply Chain Management; e-Supply Chain Management; Cloud Computing; Cloud Platforms; Cloud Computing in Supply Chain Management; Cloud Platforms in SCM

ABSTRACT

Oggigiorno si riscontra una crescente competizione nel mercato globale e le organizzazioni stanno cercando nuove soluzioni per diminuire i loro costi e per creare esperienze che abbiano valore aggiunto per i consumatori, aumentando il livello del servizio offerto. Pertanto, dovrebbero considerare l'opportunità di aprire le loro frontiere a terzi e diventare parte della supply chain. Dovrebbero prendere in considerazione i punti di vista sia dei loro fornitori che dei loro clienti nei processi decisionali. Con il miglioramento delle tecnologie digitali, è diventato più facile garantire efficienza ed efficacia all'interno del Supply Chain Management (SCM). Le compagnie possono instaurare forti rapporti con gli attori a monte e a valle della supply chain. L'adozione delle tecnologie digitali nel SCM ha introdotto l'e-Supply Chain Management (e-SCM); quindi, vi è un aumento dell'efficienza delle attività esecutive e dell'efficacia delle attività collaborative.

La tecnologia cloud computing è uno dei miglioramenti più importanti nelle tecnologie digitali e ha effetti innegabili sui processi di e-SCM quali l'aumento della flessibilità, la riduzione dei costi operativi e l'aumento dell'efficienza. Il numero di compagnie che offre piattaforme cloud per SCM è in aumento e l'implementazione di piattaforme cloud è cresciuta nel corso degli anni in diversi settori. Pertanto, questo studio di ricerca si concentra sulla tecnologia di cloud computing con gli obbiettivi di capire il livello di diffusione e di adozione delle piattaforme cloud tra le organizzazioni, analizzarne le caratteristiche e identificare i principali benefici e criticità delle soluzioni.

La metodologia di studio è stata suddivisa in tre fasi per strutturare meglio il flusso di analisi: (i) revisione della letteratura, che è fondamentale al fine di avere il background teorico sui soggetti di ricerca, (ii) analisi empirica, che include le piattaforme cloud in SCM e le interviste a provider e società di utenti, (iii) risultati, una discussione sulle principali evidenze emerse dal censimento e dalle interviste per raggiungere gli obbiettivi di studio.

Parole chiave: Supply Chain Management; e-Supply Chain Management; Cloud Computing; Piattaforme Cloud; Cloud Computing nel Supply Chain Management; Piattaforme Cloud nel SCM

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List of Abbreviations

3PL	Third Party Logistics
ARM	Archive and Record Management
AWS	Amazon Web Services
B2B	Business-to-Business
BOL	Bill of Lading
BOM	Bill of Materials
CPFR	Collaborative Planning, Forecasting and Replenishment
CPU	Central Processing Unit
CRM	Customer Relationship Management
CRP	Continuous Replenishment Program
DaaS	Desktop as a Service
e-SC	e-Supply Chain
e-SCM	e-Supply Chain Management
EDI	Electronic Data Interchange
ERP	Enterprise Resource Planning
FaaS	Function as a Service
GSCF	Global Supply Chain Forum
IaaS	Infrastructure as a Service
IT	Information Technology
KPI	Key Performance Indicator
PaaS	Platform as a Service
POS	Point-of-Sales
R&D	Research and Development
RFI	Request for Information
RFID	Radio Frequency Identification
RFP	Request for Proposal
RFQ	Request for Quotation
RFx	Request For x
ROI	Return on Investment
SaaS	Software as a Service
SaaS	Storage as a Service
SC	Supply Chain
SCC	Supply Chain Council
SCM	Supply Chain Management
SCOR	Supply Chain Operations Reference
SME	Small Medium Enterprise
SRM	Supplier Relationship Management
VAT	Value Added Tax
VMI	Vendor Managed Inventory
VMR	Vendor Managed Replenishment
WMS	Warehouse Management System

EXECUTIVE SUMMARY

Reference Framework

Supply Chain Management (SCM) has become one of the key issues among businesses in order to create competitive advantage.

The research study is about applications of cloud platforms in the management of supply chain processes and prepared for research team of Digital Innovation Observatories of the School of Management, which found in 1999 to raise cultural awareness in all the principle areas of digital innovation. One of the topics on which companies are focusing in recent years is cloud computing. It has a broad-ranging effect on information technology (IT) services, information systems architecture, business, software engineering and data storage. According to the best-known IT consulting corporations, it is one of technology that emerges rapidly and now, more and more companies are willing to adopt in order to improve their efficiency (Toka, Aivazidou, Antoniou & Arvanitopoulos-Darginis, 2013) because it represents a fundamental change in the way which IT services are invented, developed, deployed, scaled, updated, maintained and paid for. (Marston, Li, Bandyopadhyay, Zhang & Ghalsasi, 2011).

Objectives

This study is prepared as a graduation research at Management Engineering Department of Politecnico Di Milano. The main goals of the study are:

- To understand and spread knowledge about cloud platforms in the management of supply chain processes and examine which supply chain functions cloud platforms support.
- To collect and analyze data about cloud platforms in SCM processes which are developed and used in various locations in the world, mapping them regarding different parameters and filling out a census;
- To understand in which areas (industries, functions in SCM, locations, business sizes, etc.) within the SCM the cloud platforms are used;
- To assess the level of adoption of cloud-based solutions;
- To identify the impacts of cloud platforms in supply chain functions.

Once the objectives and the methodology of the research have been defined, the study has been divided into three phases to better structure the flow of the analysis: (i) literature review, (ii) empirical analysis (census and interviews), (iii) findings and results.

Literature Review

In order to obtain theoretical background for developing this research study, literature review has been fundamental. The academic literature review has started with Supply Chain Management and carried out with e-Supply Chain Management and their tools, benefits and criticalities. After having theoretical base on these two topics, cloud computing has been analyzed with its benefits and risks. The implementations of cloud computing in Supply Chain Management have been also examined.

Supply Chain Management

The definitions and the reference frameworks of Supply Chain and Supply Chain Management have been examined and their benefits and criticalities have been discussed. The most well-accepted definition of Supply Chain has been introduced by Supply Chain Council (1997) and it is described as "the supply chain – a term increasingly used by logistics professionals – encompasses every effort involved in producing and delivering a final product, from the supplier's supplier to the customer's customer. Four basic processes – plan, source, make, deliver – broadly define these efforts, which include managing supply and demand, sourcing raw materials and parts, manufacturing and assembly, warehousing and inventory tracking, order entry and order management, distribution across all channels, and delivery to the customer.". The definition of Supply Chain Management includes collaboration between other supply chain members such as third parties, suppliers, customers and so on.

e-Supply Chain Management (e-SCM)

Supply Chain Management requires "an integration of key business processes from end user through original suppliers that provides products, services, and information that add value for customers and other stakeholders." as described by The Global Supply Chain Forum (Cooper & Lambert, 2010). This integration has gained significance in terms of establishing better collaboration and relationships between suppliers. In order to sustain the integration, firms have started to establish e-business technologies (Auramo, Aminoff & Punakivi, 2002; Cagliano, Caniato & Spina, 2003; Chen & Holsapple, 2012; Wiengarten, Humphreys, Mckittrick & Fynes, 2013).

In order to have an efficient and effective supply chain, implementation of e-business technologies within supply chain has become very crucial and these e-business technologies are considered as IT. They have played an enabling and supporting role in all the collaboration practices (Pramatari, 2007). Therefore, IT can be considered as an essential technology to have an efficient and effective supply chain processes.

According to Bertelé et al. (2004), e-Supply Chain Management can be divided into two main categories: (i) e-Supply Chain Execution, which is divided into different sub categories that are pre-sales support, order issuing, logistics, administrative-accounting cycle and after-sales support (all these phases are the steps of Order-Payment cycle and managed digitally.); (ii) e-Supply Chain Collaboration, which consists of monitoring and control of supply chain, collaboration on planning activities, new product development and communication and marketing. All these activities include collaboration between two or more supply chain partners (Bertelé et al., 2004).

Besides the e-Supply Chain Execution and e-Supply Chain Collaboration, e-Procurement is another process of e-Supply Chain Management, but it took place before the e-Supply Chain Management. e-Procurement is defined as the use of electronic functionalities such as electronic catalogues, workflow management, Request for x (RFx) such as request for information, proposal and quotation, electronic invoicing, etc. to support the purchasing process for indirect goods, which cover a large number of orders with a low value (Min & Galle, 1999).

Cloud Computing

Cloud computing is one of the trending technologies today with the broad-ranging effects on IT services, information systems architecture, business, software engineering and data storage. The definitions of cloud computing and their scope have been investigated to develop general overview about this technology. According to the NIST definition, "Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction." (Mell & Grance,2011). The definition of cloud computing includes the essential characteristics which are on-demand self-service, measured service, rapid elasticity, broad network access and resource pooling. Moreover, in order to have better understanding about cloud computing, different services and deployment models have been examined. According to Leukel, Kirn and Schlegel (2011), cloud computing can be divided mainly in three service models; Software as a Service (SaaS), Infrastructure as a Service (IaaS) and Platform as a Service (PaaS). According to the Heisterberg and Verma (2014), cloud computing offers different deployment models which can be divided or combined to one of the below users; public, private, community and hybrid cloud. Cloud computing is an easy to adopt technology with simple and the latest architecture. It provides some benefits and includes some risks which have been discussed in detail.

In addition, for further research about the scope of supply chain management on cloud platforms, definition in SCM and implementation processes have been analyzed. There are several supply chain activities that can be facilitated by applying cloud technology such as forecasting and planning, sourcing and procurement, logistics, service and spare part management and also collaborative design and product development. Moreover, risks and benefits of cloud technology in SCM have been discussed as well.

Empirical Analysis

Census

During the census mapping and filling, more than 500 cloud platforms have been determined and 298 solutions were selected to be examined in detail regarding the objectives of study. 202 platforms were eliminated according to three main aspects. These eliminated platforms are; platforms that offer services which are not related with SCM, platforms that operate in industries which are not related with manufacturing and operational activities and platforms that operate in SCM but support different activities which is not in the scope of this study.

Secondary resources are mainly used for census mapping and filling as follows: database from previous census, internet researches and websites of cloud platform providers. In order to analyze the cloud platforms in detail, following information have been collected throughout research study:

- General information about cloud platform provider company (number of employees, year of foundation, location of foundation, website link, description);
- Information about customers of cloud platforms (number, locations, business size (small, small medium, medium, large enterprises), names);
- Information about partners of cloud platform provider company (number and names);
- Classification and functionalities of cloud-based solution (clusters in SCM process, sub-clusters in SCM and clusters in e-SCM and sub-clusters in e-SCM);
- Information about main industries that use corresponding cloud platform;
- Pricing models;
- Service models of cloud platforms,
- Extra services offered by provider company;
- Benefits and obstacles about the solution received from user and provider companies.

After collecting all the necessary information related with census, analysis was conducted to obtain results to attain goals of the study.

Interviews

The main purpose of the interviews with provider companies is to have better understanding of services they offer to their clients and examine benefits, criticalities and future developments of the technology from their point of view. On the other hand, the main goal of conducting interviews with user companies to analyze how cloud platforms support their SCM and assess the benefits, criticalities and future improvements of the technology from their perspective. In order to understand the functionalities of cloud platforms, a questionnaire has been prepared and interview questions were created in four main sections:

- General information about company;
- Cloud platforms in SCM;
- Identification of risks and benefits of cloud platforms in SCM;
- Further improvements and future project related with cloud platforms in SCM.

Before interview arrangement, contact details of related people have been researched through online platforms such as LinkedIn, company websites and database of the university. After having contact information of people in related department, interviews were arranged through e-mail. The interviews lasted about 30 minutes and were structured in order to learn four sections in detail. Interviews were made via Skype call, phone call or e-mail.

Findings and Results

Census

As regards to the literature research, cloud platforms are categorized into two main groups as SCM process and e-SCM process. Platforms can perform in both management processes and after this classification, from 298 cloud platforms, 284 of them are serving for SCM and 248 platforms are grouped in e-SCM. Within these two main groups, there are different main clusters separately. In Supply Chain Management, there are Supply Chain Planning, Extended Enterprise and Execution clusters whereas there are four main clusters in e-Supply Chain Management processes; e-Supply Chain Execution, e-Procurement, e-Supply Chain Collaboration and e-Document Management. The platforms that are serving more than one cluster called multi-cluster.

Table 1: Supply Chain Management Processes

Cluster Type	**Supply Chain Processes**		
Cluster	**Supply Chain Planning**	**Extended Enterprise**	**Execution**
Sub-cluster	Production Planning	Supplier Relationship Management	Production
	Inventory Planning	Customer Relationship Management	Logistics
	Transportation Planning	Product Lifecycle Management	Maintenance
	Demand Planning	Others	Quality
	Others		Others

Table 2: e-Supply Chain Management Processes

Cluster Type	**e-Supply Chain Management Processes**			
Cluster	**e-SC Execution**	**e-Procurement**	**e-SC Collaboration**	**e-Document Management**
Sub-cluster	Pre-sales Support	Need analysis	Monitoring & Control	Record Management
	Order Issuing	e-Sourcing	Planning Activities	
	Delivery	Contract Management	Communication & Marketing	
	e-Invoicing	Catalog management	New Product Development	
	After-sales Support	Others	Others	
	Others			

General analysis is conducted in terms of geographical distribution of cloud platform provider companies, geographical distribution of cloud platform user companies, business sizes, service models of platforms, pricing models of platforms, number of employees and number of partners. After having general knowledge about the cloud platforms, to deepen the analysis, cloud platforms are examined in two different categories as mentioned above. The main analysis for SCM and e-SCM are done in terms of distribution of clusters, sub-clusters, geographical distribution of clusters, main functionalities of each cluster, industry analysis and business size analysis of each cluster.

From the analysis, following outcomes are observed:

Results of General Analysis:

- Geographical: America is the leading location (218, 73%) for both cloud platform providers and user companies among Europe, Asia, Oceania, Middle East and Africa. Based on the dataset, within 298 cloud platforms, there is no platforms developed in the Middle East.
- Business size: Among different business sizes such as small enterprises, medium enterprises, small medium enterprises (SMEs) and large enterprises, cloud platform user companies are mainly medium enterprises (240, 90%), followed by SMEs (164, 62%) and large enterprises (162, 61%).
- Service model: All the analyzed cloud-based solutions have SaaS (298, 100%) and web-based model (294, 99%). IaaS and PaaS models are very less in number compared to others (6, 2% and 4, 1%).
- Pricing model: Pay per time and pay per time/user are offered by developer companies as payment options. The developer companies which offer pay per time/user (83, 59%) is slightly high in number compared to pay per time (57, 41%).
- Enterprise size of provider companies: Number of employees working in provider companies are mostly within the range of 11-50 (33%) and 51-200 (22%).
- Number of partners: Number of partners of cloud-based solutions are mostly within the range of 11-50 (121, 49%).

Results of Supply Chain Management Analysis:

- Execution is the leading cluster in cloud-based solutions in SCM (186, 65%), followed by Extended Enterprise (145, 51%) and Supply Chain Planning (120, 42%). There are 119 (42%) platforms in multi cluster.
- In Supply Chain Planning cluster, demand planning is the most significant sub-cluster (70, 58%); in Extended Enterprise cluster, the number of platforms in supplier relationship management (SRM) sub-cluster (90, 62%) is slightly higher than customer relationship management (CRM) sub-cluster (74, 51%); in Execution, transportation and logistics (117, 63%) is the main sub-cluster.
- In supply chain planning, almost all of the platforms have planning and control function (112, 93%); reporting and analytics function is used by most of the platforms (95, 79%). From the results of Extended Enterprise cluster, it can be realized that SRM (31, 70%), sourcing (26, 59%), contract management (26, 59%) are the key functionalities. In addition, transportation, inventory and warehouse management are the main functions

that serve for Execution cluster since the number of platforms in transportation and logistics sub-cluster is high (117, 63%).

- The companies operating in manufacturing (203, 73%), logistics (189, 68%), food and beverage (143, 51%) and healthcare (131, 47%) industries are the main users of cloud-based supply chain solutions. On the contrary, fashion (47, 17%), aerospace and defense (36, 13%) and chemicals (37, 13%) industries are the less preferred ones considering the implementation of cloud solutions in their supply chain management.

Results of e-Supply Chain Management Analysis:

- e-Supply Chain Execution is the leading cluster (189, 76%) for cloud platforms in e-SCM, followed by e-Procurement (101, 41%), e-Supply Chain Collaboration (98, 40%) and e-Document Management (40, 16%) respectively. There are 118 (48%) platforms in multi cluster.
- In e-Supply Chain Execution, delivery is the leading sub-cluster (157, 83%) and the number of platforms in e-Invoicing sub-cluster is substantially high (86, 46%) which is followed by order issuing (69, 37%). In e-Procurement, e-Sourcing (79, 78%) and need analysis (78, 77%) are the two main sub-clusters, and there are significant number of platforms in contract management (58, 57%). In e-Supply Chain Collaboration, monitoring and control is the leading sub-cluster (90, 92%), followed by collaborative planning activities (47, 48%). Besides, e-Document Management has only one sub-cluster which is records management.
- In e-Supply Chain Execution, reporting and analytics (120, 63%) is one of the major features in this cluster as well as the functions of inventory, warehouse, order, stock and transport management are substantially served by analyzed platforms. In e-Procurement, reporting and analytics tool is one of the key features (81, 80%); and since e-Procurement depends on the suppliers and their relationship with companies, supplier management (67, 66%) and SRM (66, 65%) are significant functions for this cluster. In e-Supply Chain Collaboration, supplier management (76, 78%) and SRM (75, 77%) are the main functionalities. In e-Document Management, main features are reporting and document management.
- Companies operating in logistics (171, 70%), manufacturing (176, 68%) and food and beverage (120, 49%) industries are the main users of cloud platforms. On the other hand, aerospace and defense (24, 10%), chemicals (31, 13%) and construction (41, 17%) industries are used significantly less than others.

Interviews

This part of the research has been conducted through direct interviews with both provider companies (Infor, Logiwa, RELEX Solutions, DXC Technology) and user companies (Kraft-Heinz, Beko-Arcelik, Prysmian Group).

In order to obtain information in a more structured way, a set of lists of questions have been created separately for user and provider companies. For user companies, questions include general information about company, cloud computing solutions in their SCM, identification of risks and benefits of cloud platforms in supply chain projects and future improvements related with cloud platforms. For provider companies, questions related with general information about company, main services they offer to their clients, identification of risks and benefits of cloud platforms in SCM and future trends related with cloud technology were asked.

- **General information about company:** For user companies, the objective of this question is to gather general information about the company such as number of employees, revenue, industry which company operates in, its business size and its relationship with other actors. For provider companies, the objective of this question is to get information referred to business size, number of employees, number of customers, geographical location, number of partners, service models of cloud platforms that offered, pricing models and industry served.
- **Cloud computing solutions in supply chain projects:** For user companies, the aim of this question is to understand which functions in SCM that are supported by cloud platform solutions were examined. For provider companies, the aim of this section is to understand main services that the cloud platform provider companies offer and the functions they are supported.
- **Identification of risks and benefits:** In this section of the interview, the aim is to examine the benefits and criticalities of the cloud platforms from both user and provider companies' perspective. It is fundamental to understand the benefits of the solution in terms of privacy, speed, costs and security. On the other hand, criticalities were questioned in order to understand the possible implementation and usage barriers.
- **Further improvements:** The purpose of this section is to understand future implementations of cloud platforms in SCM. Furthermore, to have better understanding of provider companies' perspective, improvements in current technologies that they offered and future plans of the company were analyzed.

CHAPTER 1: LITERATURE REVIEW

1.1 Supply Chain

The concept of supply chain has been arousing interest increasingly from 1980s since firms realized the benefits of collaborative relationships within and beyond their own organization (Lummus & Vokurka, 1999). During the past 30 years, several definitions of "supply chain" and "supply chain management" has been introduced to the academic literature. The definition, which is presented by Supply Chain Council (SCC), is one of the most accepted and defines the concept as "the supply chain – a term increasingly used by logistics professionals – encompasses every effort involved in producing and delivering a final product, from the supplier's supplier to the customer's customer. Four basic processes – plan, source, make, deliver – broadly define these efforts, which include managing supply and demand, sourcing raw materials and parts, manufacturing and assembly, warehousing and inventory tracking, order entry and order management, distribution across all channels and delivery to the customer." (Supply Chain Council, 1997). Another definition has been offered by APICS Dictionary, the dictionary of the Association for Operation Management, where the supply chain is described as "the processes from the initial raw materials to the ultimate consumption of the finished product linking across supplier-user companies, and the functions within and outside a company that enable the value chain to make products and provide services to the customer." (APICS, s.d.). Despite these definitions, there are various explanations in the literature that are well describing the concept of supply chain. (Table 3).

Table 3: Supply Chain Definitions

Christopher, 1992	*A Supply Chain is the network of organizations that are involved, through upstream and downstream linkages, in the different processes and activities that produce value in the form of products and services delivered to the ultimate consumer.*
La Londe & Masters, 1994	*Normally, several independent firms are involved in manufacturing a product and placing it in the hands of the end user. One firm might produce a raw material and sell it to a second firm which uses the material to produce a component. A third firm buys the component and assembles it into a product which is sold to a fourth firm such as a wholesale distributor. The wholesaler in turn sells the product to a fifth firm, such as a retail merchant, and the fifth firm sells the product to a consumer. The set of firms which pass these materials forward can be referred to as a supply chain.*

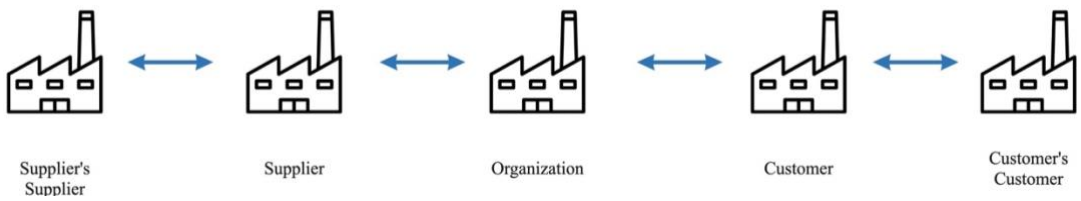
Quinn, 1997	*All of those activities associated with moving goods from the raw-materials stage through to the end user. This includes sourcing and procurement, production scheduling, order processing, inventory management, transportation, warehousing, and customer service. Importantly, it also embodies the information systems so necessary to monitor all of those activities.*
Lambert, Stock & Ellram, 1998	*A Supply Chain is defined as the alignment of firms that brings products or services to market.*
Lummus & Vokurka, 1999	*All the activities involved in delivering a product from raw material through to the customer including sourcing raw materials and parts, manufacturing and assembly, warehousing and inventory tracking, order entry and order management, distribution across all channels, and the information systems necessary to monitor all of these activities.*
Mentzer, Keebler, Nix, Smith & Zacharia, 2001	*A Supply Chain is defined as a set of three or more entities (organizations or individuals) directly involved in the upstream and downstream flows of products, services, finances, and/or information from a source to a customer.*
Mahesh S. Raisinghani, 2009	*A network of facilities and distribution options that performs the functions of procurement of materials, transformation of these materials into intermediate and finished products, and the distribution of these finished products to customers.*
Juzhi Zhang, Erfeng Zhou, Qinglong & Susan Li, 2014	*A system of organizations, people, technology, activities, information and resources involved in moving a product or service from supplier to customer.*

After giving wide range of definitions, the scope of the supply chain should be determined to understand the parties involved in the supply chain. It is defined according to the number of firms, activities and functions that are taking place in the supply chain (Cooper, Lambert, & Pagh, 1997). In addition to this definition, Stevens expanded this scope from upstream by including the source of supply to downstream by including the point of consumption and it is the most accepted definition of scope in the literature (Stevens, 1989). As regards to the number of firms, number of tiers involved in the supply chain can be considered. In order to understand the number of tiers, the structural dimension of the network should be identified. The supply chain network has three structural dimensions. The first dimension, "horizontal structure", indicates the number of tiers across the supply chain (Lambert & Cooper, 2000). Tier 0 is the focal firm, tier 1 is the focal firm's suppliers and customers, tier 2 is suppliers' supplier and

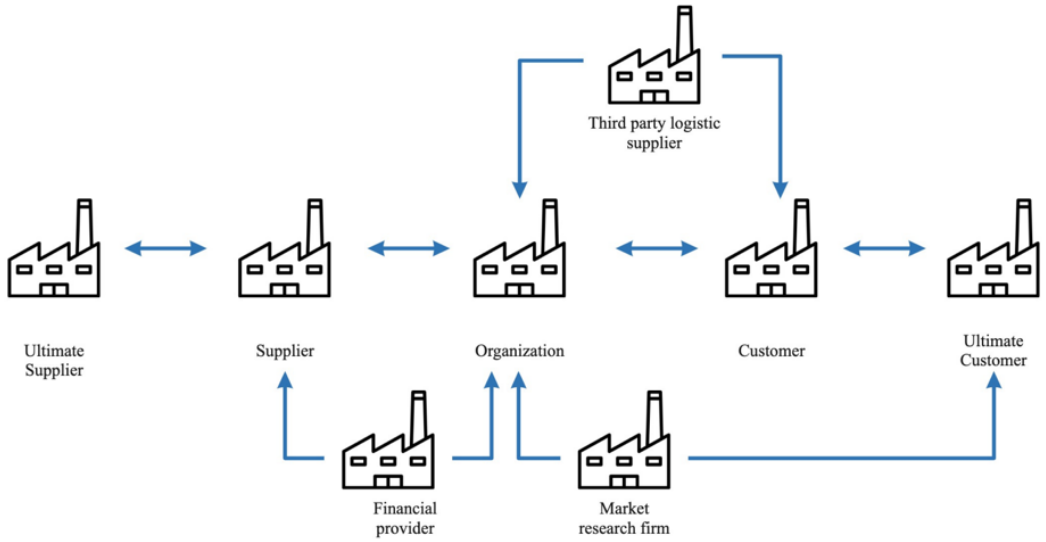
customers' customer and it continues to n-th tiers in the both sides of upstream and downstream. The second dimension, "vertical structure", indicates the number of suppliers/customers represented within each tier (Lambert & Cooper, 2000). The third structural dimension is "the company's horizontal position within the supply chain" where the focal firm can be positioned somewhere between the endpoints of the supply chain (Lambert & Cooper, 2000). Considering the activities and functions involved in the supply chain, it is agreed within the literature that the need for information systems integration, as well as planning and control activities (Cooper et al., 1997). Besides, the members of the supply chain should have cooperative efforts together in the areas such as research, development, sales, marketing, product design and total system/value analysis (Cooper et al., 1997).

To have complete understanding, three degrees of supply chain complexity are introduced related with the definition of the number of tiers and activities included in the supply chain (Mentzer et al., 2001). Mentzer et al. (2001) describes these three degrees as "a 'direct supply chain' consists of a company, a supplier, and a customer involved in the upstream and/or downstream flows of products, services, finances, and/or information; an 'extended supply chain' includes suppliers of the immediate supplier and customers of the immediate customer, all involved in the upstream and/or downstream flows of products, services, finances, and/or information; an 'ultimate supply chain' includes all the organizations involved in all the upstream and downstream flows of products, services, finances, and information from the ultimate supplier to the ultimate customer." (Mentzer et al., 2001). Figure 1 illustrates the defined degrees of supply chain by Mentzer et al. (2001).

a) The Direct Supply Chain



b) The Extended Supply Chain



c) The Ultimate Supply Chain

Figure 1: Supply Chain Configurations (Mentzer et al.,2001)

In today's competitive business environment, the concept of supply chain has become more important than the past since the organizations are operating in a business market where there are several technological improvements taking place and the competition among the firms has been more severe than before. In this competitive environment, the benefits of the supply chain such as inventory reduction, improved delivery service and shorter product development cycles are undeniable (Fawcett, Magnan & McCarter, 2008). Since 1980, the organizations have encountered an increase in competition and weak economic conditions; therefore, they have begun to develop supply chain initiatives and assessed these initiatives by using return on investment (ROI) analysis. However, the firms have faced many difficulties while applying traditional ROI analysis properly to assess the benefits for the following reasons (Grey, Shi, Bagchi & Katircioglu, 2005):

- Quantifying the benefits of implementing supply chain processes is difficult and relies on assumptions considering the operational improvements.
- There are some overlapping benefits and it could be counted twice while measuring ROI.
- The firm may neglect other significant metrics and the initiatives could have short-term benefits rather than providing long-term impacts to the company.
- The analysis may neglect risks.

Therefore, traditional ROI analysis could be useful if there is a direct impact of the investment in supply chain to the financial performance of the company. However, the benefits of the supply chain initiatives are related more on the operational performance and hence, while assessing the impacts, the company should go beyond ROI analysis to have more accurate results about the financial performance of the initiatives (Grey et al., 2005). For quantifying the impacts of supply chain initiatives, it is crucial to understand the relation between the impact and value drivers of the company. Grey et al., (2005) states that a supply chain value driver is an operational metric that has to satisfy two significant conditions: first one is that it must be directly affected by a supply chain solution; and second, the metric must have an impact on at least one of the firm's Key Performance Indicators (KPIs) (Grey et al., 2005). Thus, value drivers could be more accurate while assessing the benefits of the supply chain initiatives.

1.2 Supply Chain Management (SCM)

1.2.1 Supply Chain Management Overview

Definitions of SCM

The concept of SCM was presented by consultants in 1980s and has gained popularity increasingly and become a very important topic for the firms (Cooper & Lambert, 2000). There are several definitions in the literature about SCM. The Global Supply Chain Forum (GSCF), a group of non-competing firms and a team of academic researchers, defines SCM as follows: "Supply Chain Management is the integration of key business processes from end user through original suppliers that provides products, services, and information that add value for customers and other stakeholders." (Cooper & Lambert, 2000). In spite of the definition of GSCF, there are various descriptions of SCM by several authors in the academic literature (Table 4).

Table 4: Supply Chain Management Definitions

Jones & Riley, 1985	*Supply chain management deals with the total flow of materials from suppliers through end users.*
Houlihan, 1988	*Differences between supply chain management and classical materials and manufacturing control: "1) The supply chain is viewed as a single process. Responsibility for the various segments in the chain is not fragmented and relegated to functional areas such as manufacturing, purchasing, distribution, and sales. 2) Supply chain management calls for, and in the end depends on, strategic decision making. "Supply" is a shared objective of practically every function in the chain and is of particular strategic significance because of its impact on overall costs and market share. 3) Supply chain management calls for a different perspective on inventories which are used as a balancing mechanism of last, not first, resort. 4) A new approach to systems is required—integration rather than interfacing."*
Stevens, 1989	*"The objective of managing the supply chain is to synchronize the requirements of the customer with the flow of materials from suppliers in order to effect a balance between what are often seen as conflicting goals of high customer service, low inventory management, and low unit cost."*
La Londe & Masters, 1994	*Supply chain strategy includes: "... two or more firms in a supply chain entering into a long-term agreement; ... the development of trust and commitment to the relationship; ... the integration of logistics activities involving the sharing of demand and sales data; ... the potential for a shift in the locus of control of the logistics process."*
Cooper et al., 1997	*Supply chain management is "... an integrative philosophy to manage the total flow of a distribution channel from supplier to the ultimate user."*
Monczka, Trent & Handfield, 1998	*SCM requires traditionally separate materials functions to report to an executive responsible for coordinating the entire materials process, and also requires joint relationships with suppliers across multiple tiers. SCM is a concept, "whose primary objective is to integrate and manage the sourcing, flow, and control of materials using a total systems perspective across multiple functions and multiple tiers of suppliers."*
Mentzer et al., 2001	*Supply chain management is defined as "the systemic, strategic coordination of the traditional business functions and the tactics across these business functions within a particular company and across businesses within the supply chain, for the purposes of improving the long-term performance of the individual companies and the supply chain as a whole."*

Even though the description of SCM has some differences among the authors, they can be classified in three groups: a management philosophy, implementation of a management philosophy and a set of management processes (Mentzer et al., 2001).

Considering SCM as a management philosophy, SCM adopts a systems approach to view the supply chain as a single entity, instead of viewing it as a set of fragmented parts, each performing its own function (Ellram & Cooper, 1990; Houlihan, 1988; Tyndall et al., 1998). Therefore, SCM can be considered as a set of beliefs that each company in the supply chain directly and indirectly affects the performance of all the other supply chain members, as well as the overall supply chain performance (Cooper et al., 1997). Further description is proposed by Mentzer (2001) stating that SCM as a management philosophy has the following features:

- A system approach which has capability to manage the total flow of goods inventory from the supplier to customer and consider supply chain as a whole;
- A system which has strategic orientation towards cooperative efforts in order to converge and synchronize intrafirm in terms of operational and strategic capabilities into a unified whole;
- A system which had driven to lead customer satisfaction will focus on creating unique and individualized customer value.

Regarding SCM as a set of activities to implement a management philosophy, companies should implement management practices that permit them to act or behave consistently with the philosophy. According to several authors, there are some activities that establish SCM. From the previous research, different activities are listed to properly implement SCM philosophy as follows (Mentzer et al., 2001):

Table 5: Set of Activities to implement SCM (Mentzer et al., 2001)

1. Integrated Behavior
2. Mutually Sharing Information
3. Mutually Sharing Risks and Rewards
4. Cooperation
5. The Same Goal and the Same Focus on Serving Customers
6. Integration of Processes
7. Partners to Build and Maintain Long-Term Relationships

Considering SCM as a set of management processes, some authors have focused on the management processes instead of focusing on the set of activities that establish supply chain

management. As regards to this philosophy, processes are defined as a structured and measured set of activities designed to produce specific output for a particular customer or market (Davenport, 1993). Another definition states that "SCM is the process of managing relationships, information, and materials flow across enterprise borders to deliver enhanced customer service and economic value through synchronized management of the flow of physical goods and associated information from sourcing to consumption." (La Londe & Masters, 1994). Besides, supply chain process can be described as "a process which is a specific ordering of work activities across time and place, with a beginning, an end, clearly identified inputs and outputs, and a structure for action" (Cooper et al., 1997; Ellram & Cooper, 1990; Novack, Langley & Rinehart, 1995; Tyndall et al., 1998). To successfully apply SCM, all organizations should adopt a process approach (Lambert et al., 1998). The traditional functions differ from the process approach in terms of two main aspects: the focus of every process is on meeting the customer's requirements and the firm is organized around these processes (Ellram & Cooper, 1990; Novack, Langley & Rinehart, 1995; Cooper et al., 1997; Cooper, Lambert & Pagh, 1997; Tyndall et al., 1998). It is suggested to include key processes such as customer relationship management, customer service management, demand management, order fulfillment, manufacturing flow management, procurement, and product development and commercialization (Lambert et al., 1998).

SCM research can be classified into three groups: operational, design and strategic (Huan, Sheoran & Wang, 2004). Regarding to the operational aspect, the daily operational activities held in the plant are considered in order to fulfill customer orders in a most profitable way (Huan et al., 2004). In terms of design aspect, it focuses on "the location of the decision spots and the objectives of the chain" (Mourits & Evers, 1995). As regards to strategic aspect, dynamics and the development of the objectives of the supply chain must be well analyzed by the business managers in order to make successful strategic decisions (Gopal, 1992). According to Huan et al. (2004), for the supply chain strategic decision making, the most promising model is supply chain operations reference (SCOR) model which was developed by SCC (Huan et al., 2004). The SCOR model has described the business activities related with all phases of satisfying a customer's demand and it contains six primary management processes: plan, source, deliver, return and enable, shown in Figure 2 (Supply Chain Council, 2012). The model illustrates all the interactions between customers, the material transactions and the market interactions. The objective of the model is to define "the way processes interact, how they perform, how they are configured and the requirements (skills) on staff operating the process"

(Supply Chain Council, 2012). The SCOR reference model consists of four major sections as shown in Table 6 (Supply Chain Council, 2012).

Table 6: Sections of SCOR Model

Performance	Standard metrics to describe process performance and define strategic goals
Processes	Standard descriptions of management processes and process relationships
Practices	Management practices that produce significant better process performance
People	Standard definitions for skills required to perform supply chain processes

The model provides a complete set of supply chain performance metrics, industry best practices and systems' functionality. Besides, it provides a common supply chain framework and a standard terminology. Therefore, by using the model, companies can perform a supply chain analysis on the basis of facts and common terminology (Huan et al., 2004).

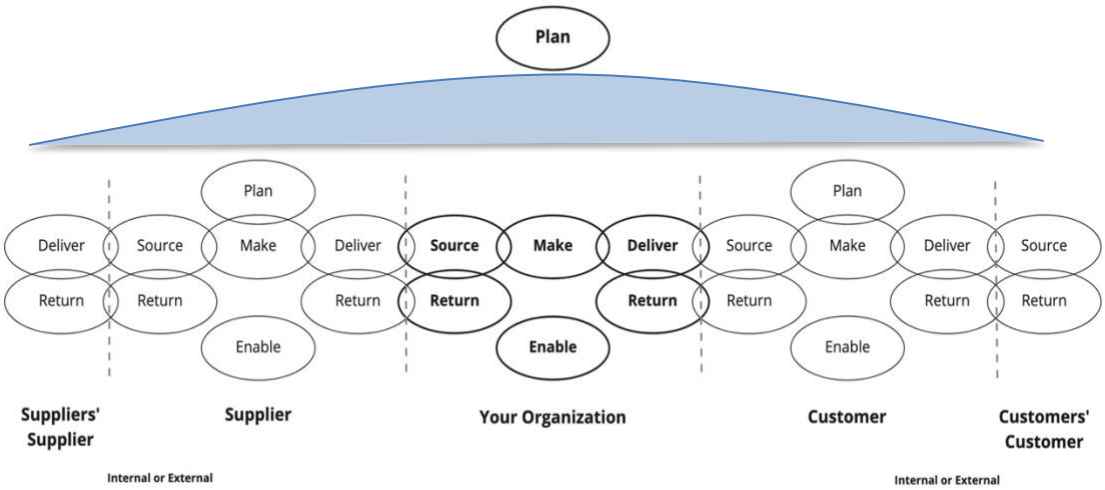


Figure 2: SCOR Model (Supply Chain Council, 2012)

In order to have complete understanding of SCM, Mentzer et al. (2001) have developed a model for SCM. The developed model represents a side view of a pipeline and illustrates the directional flow of supply chain including products, services, financial resources, the information associated with these flows, and the informational flows of demand and forecasts (shown in Figure 3) (Mentzer et al., 2001). It is stated that "the traditional business functions of marketing, sales, research and development, forecasting, production, procurement, logistics,

information technology, finance, and customer service manage and accomplish these flows from the supplier's suppliers through the customer's customers to ultimately provide value and satisfy the customer." (Mentzer et al., 2001). From Figure 3, it is obvious that the customer value and satisfaction have paramount importance to gain competitive advantage for the firms as well as their supply chains (Mentzer et al., 2001). In addition, the interaction between companies and functions should be well-examined to better understand the model. Inter-functional coordination has significant aspects in terms of trust, commitment, risk, and dependence on the viability of internal functional sharing and coordination. On the other hand, inter-corporate coordination focuses more on the aspects including "functional shifting within the supply chain, the role of various types of third-party providers, how relationships between companies should be managed, and the viability of different supply chain structures" (Mentzer et al., 2001).

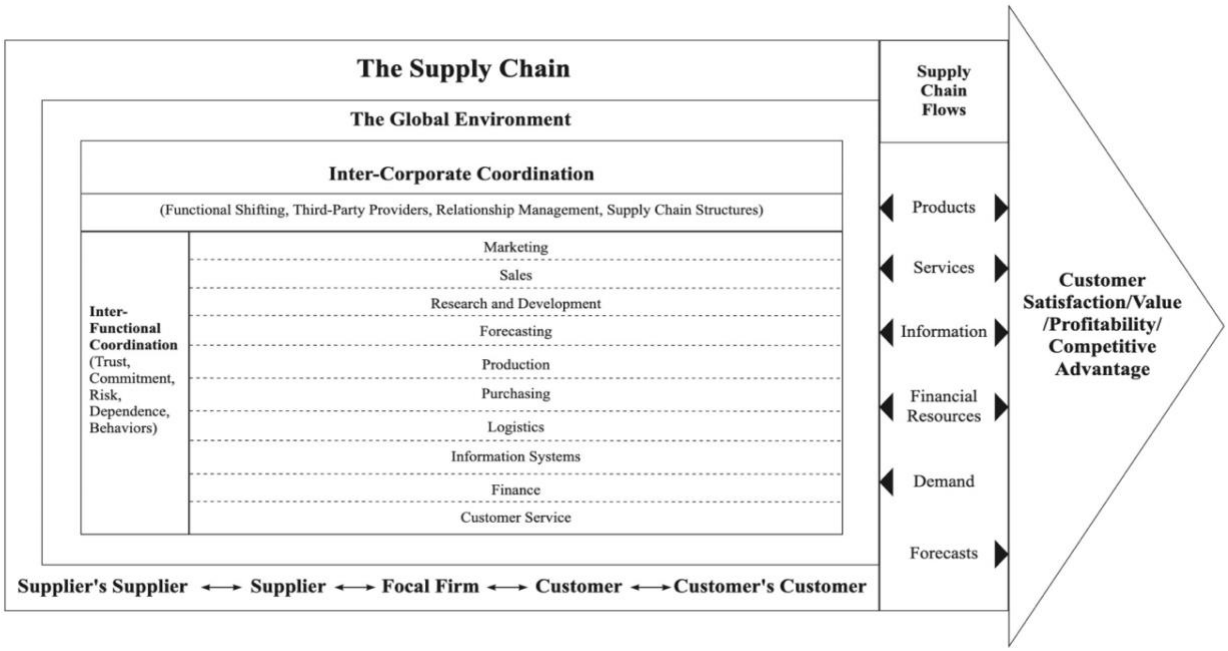


Figure 3: Supply Chain Management model (Mentzer et al., 2001)

1.2.2 Benefits and Criticalities

After having a clear definition of SCM, it is important to determine the possible benefits and barriers generated by SCM; and for the barriers, some solutions should be identified to overcome them. The most discussed benefits of the SCM are increased inventory turnover, increased revenue and cost reduction across the supply chain (Daugherty, Richey, Genchev, & Chen, 2005; Attaran, 2004; Ferdows, Lewis & Machuca, 2004; Leonard & Cronan, 2002; Fine, 2000). Collaboration among the supply chain also enables the delivery of inventory to customers faster. Increased revenues and decreased costs are two important results of SCM

(Fawcett, et al., 2008). Other significant benefits are decreased order cycle times and increased product availability (Leonard & Cronan, 2002; Stank, Crum & Arango, 1999; Sheridan, 1999; van der Vorst & Beulens, 1999). In addition to these benefits, further advantages could be listed as market responsiveness, added economic value, capital utilization, decreased product time to market and logistics cost reduction (Lee, 2004; Mentzer, Foggin & Golicic, 2000; Tyndall, 2000; Christopher & Ryals, 1999). As a result, SCM has significant benefits for the players in the chain and creates value for all of them. Nevertheless, it should be considered that there are some potential barriers of SCM.

According to Fawcett et al. (2008), the nature of the organization and people that compose the organization can be reasons of the barriers of SCM; and these barriers can be classified into two categories: "inter-firm rivalry" and "managerial complexity" (Park & Ungson, 2001). Inter-firm rivalry can be considered as "a misalignment of motives and behaviors among partners within the strategic supply chain" (Park & Ungson, 2001). The possible barriers related with this category could be internal and external turf protection, poor collaboration among chain partners and lack of partner trust (Fawcett, et al., 2008). As regards to the second barrier, managerial complexity, it can be considered as "misalignments in allying firms' processes, structures and culture (Park & Ungson, 2001). In this category, barriers are related with information system and technological incompatibility, inadequate measurement systems, and conflicting organizational structures and culture (Fawcett et al., 2008). Since every firm use their own information systems, it is expected that information and technology systems are one of the barriers (Fawcett et al., 2008). Besides, people are resistant to changes and they have fear of sharing information with others; therefore, it is obvious that firms are facing some challenges related to organizational structure and culture when adopting SCM (Fawcett et al., 2008).

In order to attain a successful SCM, after having identify all the barriers, some bridges should be created and implemented. In the literature research, there are three promising solutions and all focus on the collaboration among supply chain partners (Fawcett et al., 2008). These solutions are: transparent information systems, cross-functional collaboration and collaborative planning across the supply chain (Kulp, Lee & Ofek, 2004; Mentzer et al., 2000; Monczka et al., 1998). Other possible suggestions are adopting a strategic SC vision, paying attention to human factors, and supply-base reduction and certification in order to better adopt SCM (Barratt, 2004; Metz, 1998; Tan, Kannan & Handfield, 1998). Figure 4 shows the mentioned benefits, resisting forces, implementation barriers and bridges for effective SCM clearly.

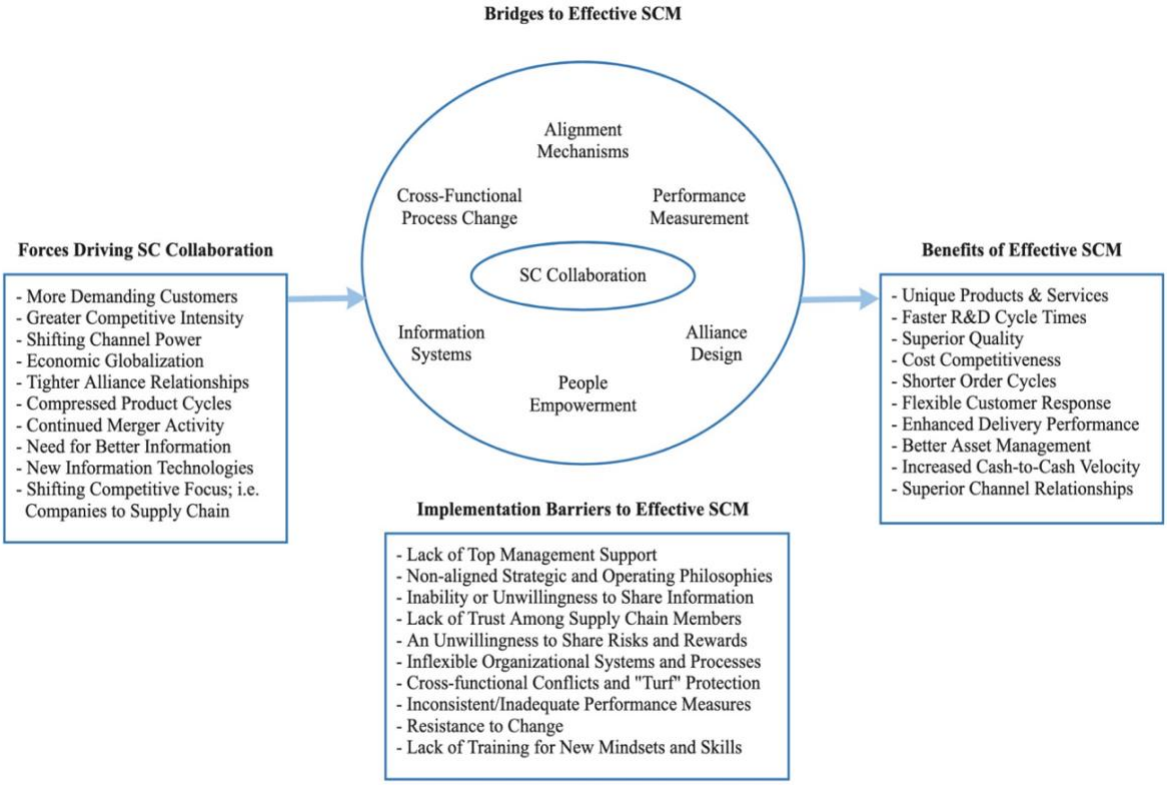


Figure 4: A Framework for Understanding SC Implementation (Fawcett et al., 2008)

1.3 e-Supply Chain Management (e-SCM)

1.3.1 e-Supply Chain Management Overview

Definition of e-SCM

As the knowledge of SCM has increased over the years in the literature, after the early 1990s, the integration of trading partners has been significant in SCM (Barratt & Oliveira, 2001). According to Bowersox, Closs and Stank (2000), organizations collaborate in the way of "leveraging benefits to achieve common goals". In parallel, it is stated that "supply chain collaboration occurs when two or more companies share the responsibility of exchanging common planning, management, execution, and performance measurement information" (Anthony, 2000). Anderson and Lee (1999) suggest that "industry participants 'collaborate on planning and execution' of supply chain strategy to achieve a synchronized supply chain". In particular, the dimension of supply chain integration and collaboration among supply chain partners can be classified in four categories by Lee and Whang (2001):

Table 7: Supply Chain Integration Dimensions (Lee & Whang, 2001)

Dimension	Elements	Benefits
Information Integration	• Information sharing & transparency • Direct & real-time accessibility	• Reduced bullwhip effect • Early problem detection • Faster response • Trust building
Synchronized Planning	• Collaborative planning, forecasting & replenishment • Joint design	• Reduced bullwhip effect • Lower cost • Optimized capacity utilization • Improved service
Workflow Coordination	• Coordinated production planning & operations, procurement, order processing, engineering change & design • Integrated, automated business processes	• Efficiency & accuracy gains • Fast response • Improved service • Earlier time to market • Expanded network
New Business Models	• Virtual resources • Logistics restructuring • Mass customization • New services • Click-and-mortar models	• Better asset utilization • Higher efficiency • Penetrate new markets • Create new products

Since the supply chain integration has been gaining great importance, in order to implement the supply chain coordination and collaboration, firms have started to establish e-business technologies (Auramo et al., 2002; Cagliano et al., 2003; Chen & Holsapple, 2012; Wiengarten et al., 2013). According to Pramatari (2007), IT has played an enabling and supporting role in all collaboration practices. In the last decade, attention to internet-based tools have increased as the sharing of information in the supply chain has been gaining more importance and it is often considered as e-business (Caniato, Cagliano, Kalchschmidt, Golini & Spina, 2009). Considering the traditional supply chain (shown in Figure 5), the flow of information and products is linear, from customers to suppliers (Basu, 2001). On the other hand, in e-supply chain, the flow of information and products can be considered as an ecosystem of supply web (shown in Figure 6) including all suppliers and customers to the end-user or consumers suppliers' customers and customers' suppliers and so on (Basu, 2001).

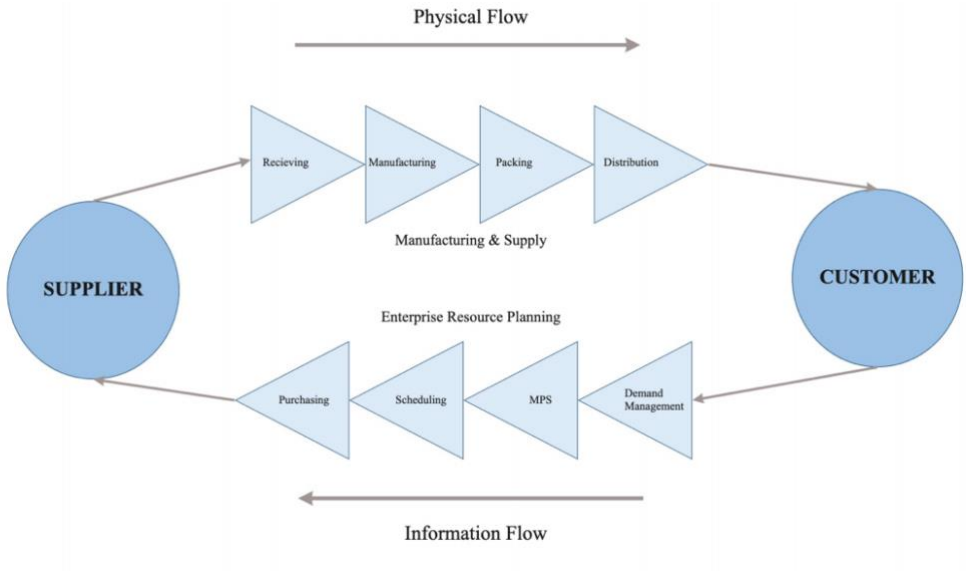


Figure 5: Traditional Supply Chain

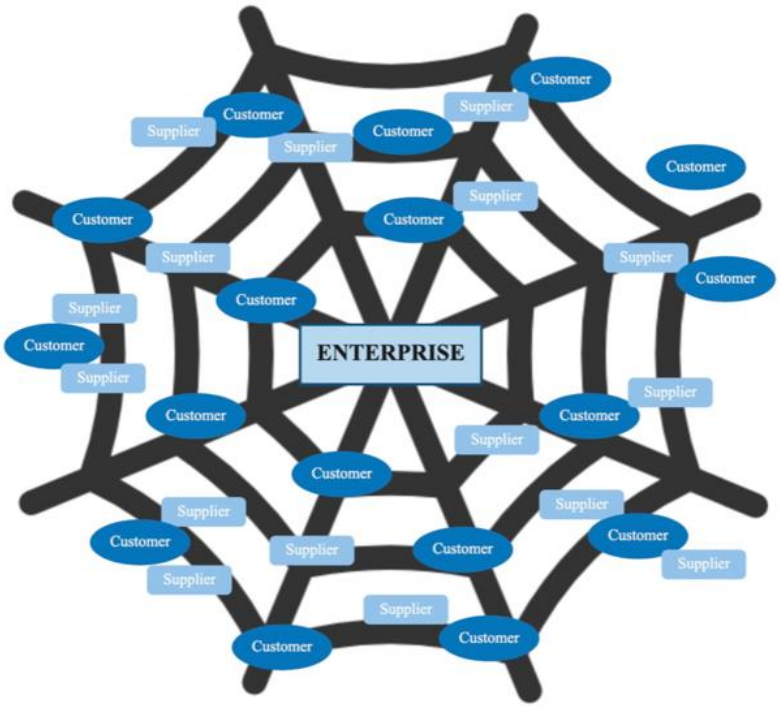


Figure 6: e-Supply Chain or e-Web

Reference Model

In order to achieve higher level of performance in both efficiency and effectiveness, integration among the supply chain players and IT have to be considered (Tan, 2001). Technological innovations, especially internet, enhance SCM by reducing distances and multiplying the communication (Michelino, Bianco & Caputo, 2008). However, it is important to realize that

benefits cannot be obtained by only internet adoption; technological innovations, and internet should be considered as enablers to satisfy customer requests (Chandrashekar & Schary, 1999; Michelino et al., 2008). According to Porter (2001), IT is only a part of the organizations' strategy and it enables the integration through changing SC relationships, boundaries and mutual influence. Michelino et al. (2008) states that SCM supported by internet (e-SCM) has three different aspects and cannot be considered separately (shown in Figure 7):

- SCM processes;
- inter-firm relationships governance;
- internet-based tools.

Michelino et al. (2008) underlines the main idea by stating that "benefits cannot be achieved only through technology adoption, being the result of a number of different technical and managerial issues". In order to be in line with the firm's business strategy, e-SCM strategies should contemplate "SC structure features, inter-firm relational aspects and coordination mechanisms among players" (Michelino et al., 2008).

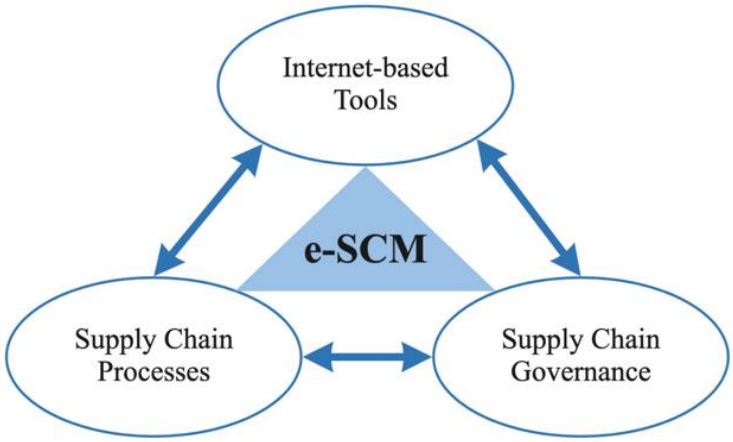


Figure 7: e-Supply Chain Management elements (Michelino et al., 2008)

In order to have complete and better understanding of e-SCM, it is important to define e-business clearly. Lee and Whang (2001) describe the term e-business as "e-business— as distinct from e-commerce — can be used to describe this exciting adoption of the Internet to accelerate the goal of supply chain integration. e-Business, specifically refers to the planning and execution of the front-end and back-end operations in a supply chain using the Internet.". In other words, in the context of SCM, e-business strategy is one of the firm's strategies related to the implementation of internet tools to achieve the integration (Caniato et al., 2009). In

addition, Frohlich and Westbrook (2001) state that due to the e-business, supply chain integration increases and the relationship between the companies across supply chains become stronger.

1.3.2 Benefits and Criticalities

According to the literature, e-business can be described as the use of systems and open communication channels for information exchange and knowledge sharing between companies in the context of supply chain; and therefore, has various impacts on the decision making in SCM (Croom, 2005). With the adoption of e-SCM, several improvements in the following areas are identified by Tan (2001):

- cost performance (from improved productivity and lower input prices);
- customer service (service quality);
- process capability (quality consistency);
- productivity and dependability (from increased control of material flows along the supply chain).

Besides, it is pointed that SCM supported by e-business has great contribution to the relationships between customers and suppliers (Avlonitis & Karayanni, 2000). Another contribution of the e-SCM is in the fulfillment field where collaborative planning, forecasting and replenishment (CPFR) take place and it leads to opportunities to reduce bullwhip effect in the supply chains as well (Frook, 1998; Lewis, 2001; Lee, Padmanabhan & Whang, 1997).

However, barriers in adopting e-business in SCM cannot be neglected. Since several firms have encountered various challenges while adopting e-business due to the unclear business strategies and lack of technological expertise, these e-business initiatives failed in the adoption process (Dubelaar, Sohal & Savic, 2005). The symptoms of failure are identified as poor business performance and repetitive application of existing behavior (Thorne, 2000). The difficulties during the adoption process of e-business in SCM are described as follows by Bowde, Clark, Corner, Gibb, Kearins, and Pavlovich (2000):

- low customer use of e-business solutions;
- uncertainty of financial benefits;
- limited size of target market;
- lack of time to start new projects;
- high costs of computing technology.

Furthermore, in terms of economic aspects, high risks and costs related with e-business projects have made many executives reconsider to implement; and as a result, they have given low priority in their business strategy (Rodgers, Yen & Chou, 2002). Additionally, the lack of well-defined e-business strategy has created barriers in the adoption of e-SCM; and is highlighted as "An e-business initiative, like productivity and-quality improvement initiatives must be undertaken within a strategic framework" (Bracke & Webb, 2000).

1.3.3 e-Supply Chain Execution

1.3.3.1 Definitions and framework

e-Supply Chain Execution can be defined as "the integration and digitalization of the Order-to-Payment cycle, including logistics and administrative activities, pre and post selling processes and all the logistics, administrative and accountant phases in the middle." (Balocco, Perego & Perotti, 2010). One of the main aims of the e-supply chain solution is to automatize and create easier phases between different trade partners (Bertelè et al., 2004). The trading process integration can be achieved by exchanging structured electronic documents. In this way, it can be directly processed by the buyer's information system or even manage the trading process as a single in-house action process (Perego & Marazzi, 2010).

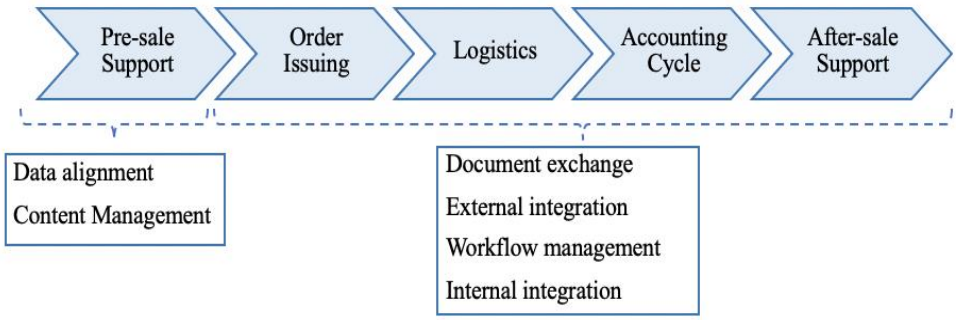


Figure 8: E-supply Chain Execution Process (Bertelè et al., 2004)

e-Supply Chain Execution processes divided into different phases that are pre-sales support, order issuing, logistics, administrative-accounting cycle and after-sales support (Bertelè et al., 2004):

Pre-sales support: This phase consists of all relevant information related with products, prices, availability, terms of delivery for the subsequent phase of order issuing in which this information shared between both parties (buyer and seller);

Order issuing: This phase starts from the order creation which also considers the phase of configuration of complex products and it continues until the confirmation by the supplier of the economic and logistics conditions;

Logistics: This phase starts from the preparation of goods to the delivery to logistics structures of the customer;

Administrative-accounting cycle: This phase starts from the issue of the invoice to the management of the payments which includes accounting reconciliation activities;

After-sales support: This phase consists of different activities which are strongly dependent on the sectors that is operating. For example, it includes the management of the addresses, the complaints management, the technical support requirements, sharing of accounting information.

The solutions that can be identified as e-Supply Chain Execution are the ones supporting one or more phases of the previous phases and can be summarized with the following list:

According to Bertelè et al. (2004), e-Supply Chain Execution can be classified according to their functionalities:

- Tools to support content management;
- Tools to set and support document workflow management;
- Tools which allow the integration with internal transactional applications within the company;
- Tools for document exchange management with customers and suppliers;
- Tools for integration with external applications of customers or suppliers;
- Tools for data alignment (catalogs and price lists).

e-Supply Chain Execution has benefits in terms of increasing both efficiency and effectiveness. (Gunasekaran & Ngai, 2004; Bertelè et al., 2004; Hong, Tran & Park, 2010). It decreases the search time, data entry and possible errors (Pramatari, 2007; Piotrowicz & Irani, 2009; Perego & Salgaro, 2010) and also, consumption of the paper by integrating the management process (De Boer, Booijink, Liezenberg, Nienhuis, Bryant & Pruneau, 2008; Perego & Salgaro, 2010). In addition to these, it brings the reduction of operating costs for the coordination of economic transactions and production (Malone et al., 1987; Bertelé et. al., 2004; Ronan, 2004; Balocco et al., 2010) and the improvement of the customer service level (Bertelé et. al., 2004) by the help of automation.

In fact, the e-Supply Chain Execution solutions allow the reduction of search time, data entry and errors (Pramatari, 2007; Piotrowicz & Irani, 2009; Perego & Salgaro, 2010), and paper

consumption, by dematerializing and integrating the management processes (De Boer et al., 2008; Perego & Salgaro, 2010). Moreover, the automation of the activities brings the reduction of operating costs for the coordination of economic transactions and production (Malone et al., 1987; Bertelé et. al., 2004; Ronan, 2004; Perego et al., 2010) and the improvement of the customer service level (Bertelé et. al., 2004).

After the classification of phases, there is another important classification as regards to the processes and their characteristics impacted by the e-Supply Chain Execution that refers to the whole supply chain. According to the Bertelé et al. (2011), characteristics of the processes are:

- Larger boundaries compared to that of a single firm and the involvement of the different actors distributed across the multiple levels of the supply chain;
- The output of the process depends on the actions of each single actor involved;
- The actions of each actor have an impact on the performance (KPIs) of all the other actors involved.

The processes which are impacted by e-Supply Chain Execution are identified as transactional, planning, design, traceability and marketing processes (Bertelé et al., 2011).

1. **The transactional (trade) process:** It starts from the Order-Delivery-Invoicing-Payment cycle to the pre and post-sales activities with the exchange of their relative information (Bertelé et al., 2011). As an example, it is possible to share information about the product specifications and its availability in the pre-sale phase. Furthermore, information regarding the evaluation of vendor performance, the service requests, the maintenance and the reverse logistics in post-sales phase.
2. **The planning process:** It includes information in terms of what to buy, produce, store and distribute, in where and when (Bertelé, et. al. 2011). Demand forecasting, inventory definition (Karthik, 2009), organization of delivery, planning and management of production and procurement (Bertelè, et al., 2011) are also in this process.
3. **The design process:** It includes all the possible steps from the definition of the requirements and features of the products, process or plant to its detailed design (Michelino et al., 2008; Bertelé et al., 2011).
4. **The traceability process:** All the activities that are related with tracking and tracing (Michelino et al., 2008). Tracking allows to locate product at any point of supply chain to be able to withdraw or recall it. In fact, tracing gives opportunity to identify the origin and characteristics of a product at any stage of the supply chain (Bertelé et al., 2011).

5. **The marketing process:** The purpose of the marketing process is to create coherent marketing strategy according to planning phase. Thus, generation of suitable value creation will satisfy the need of customer by developing the marketing 4Ps; product, place, price and promotion strategy (Bertelé et al., 2011).

1.3.3.2 The transactional process

As it is explained above, the transactional process (Order-Delivery-Invoicing-Payment cycle) is the main focus of the e-Supply Chain Execution. Transactional process is defined by Bertelé et al. (2004) as the set of activities which occurs from the customer's demand to its satisfaction through the purchasing of products and services. This process is divided into three sub-component that are pre-transactional, transactional and post-transactional.

Figure 9: Sub-components of Transactional Process (Bertelé et al.,2004)

The pre-transactional process gives customers the possibility to define products or services according to their needs, product requirements that product must have and selection of the most suitable supplier. Therefore, there is an alignment between supply and demand. There are different actors like purchase department of customer and the marketing and sales department of supplier.

The transactional (Business-to-Business (B2B) trade) process is composed by the whole order cycle that includes order issuing, delivery, invoicing and payment.

The post-transactional process includes activities that close the commercial transaction. For example, the vendor rating that is the evaluation of supplier performance according to pre-defined KPIs and claims management.

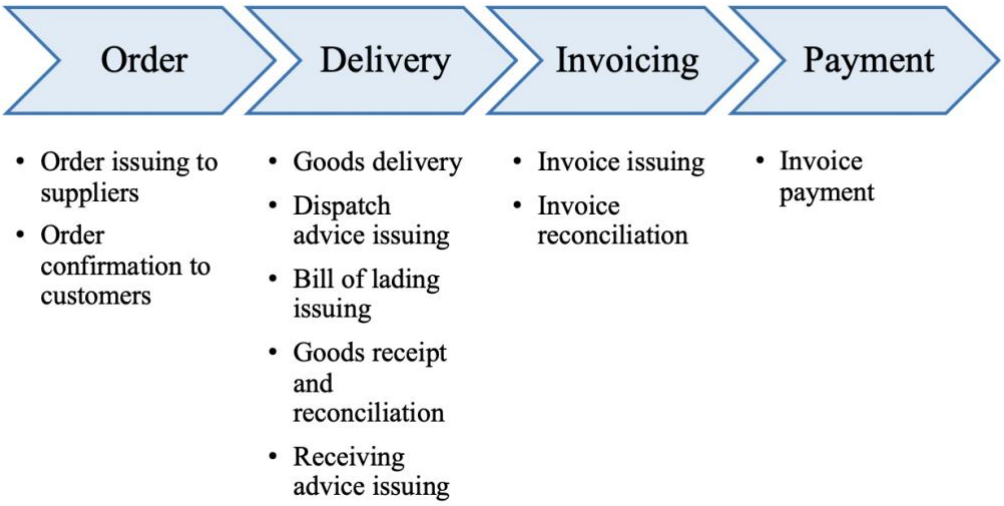


Figure 10: Post-transactional Process (Perego & Salgaro, 2010; Bertelé et. al., 2011)

Moreover, B2B trade - composed by Order, Delivery, Invoicing and Payment phases (Perego & Salgaro, 2010; Bertelé et. al., 2011) will be the main focus as it is fundamental to understand the core of e-Supply Chain Execution.

The process starts from the retailer's decision to issuing of a purchase order to a manufacturer. This can happen typically in two ways; the retailer can issue an order directly to the manufacturer, or the second, an agent periodically visits the retailers and collects the orders for the manufacturer. Then, order is reached by the sales department and the manufacturer. The availability of the goods and the financial position of the retailer will be checked later. As soon as they verified, the manufacturer sends an order confirmation to the retailer who assures that this confirmation matches the original order in which the physical process starts. The Delivery Note is attached when the goods are delivered and then, when the retailer receives the load, the Delivery Note is checked against the goods and the Order. In the meantime, the Invoice is prepared and sent by manufacturer to the retailer who will check against the Delivery Notes and the Orders when it arrives. The payment is initiated after verifying these two by the manufacturer in the case of direct debit or by the retailer with credit transfer. Manufacturer receives the payment and checks its correspondence with one or more Invoices. In case of problems during the checks which occur in the entire cycle, the effects vary on the base of the issue: a phone call is sufficient for problems with the purchase Order; new documents should be issued in case of problems with credit or debit notes; in case of errors in the delivery phase, the manufacturer delivers different goods (Perego & Salgaro, 2010; Indicod-ECR, 2016).

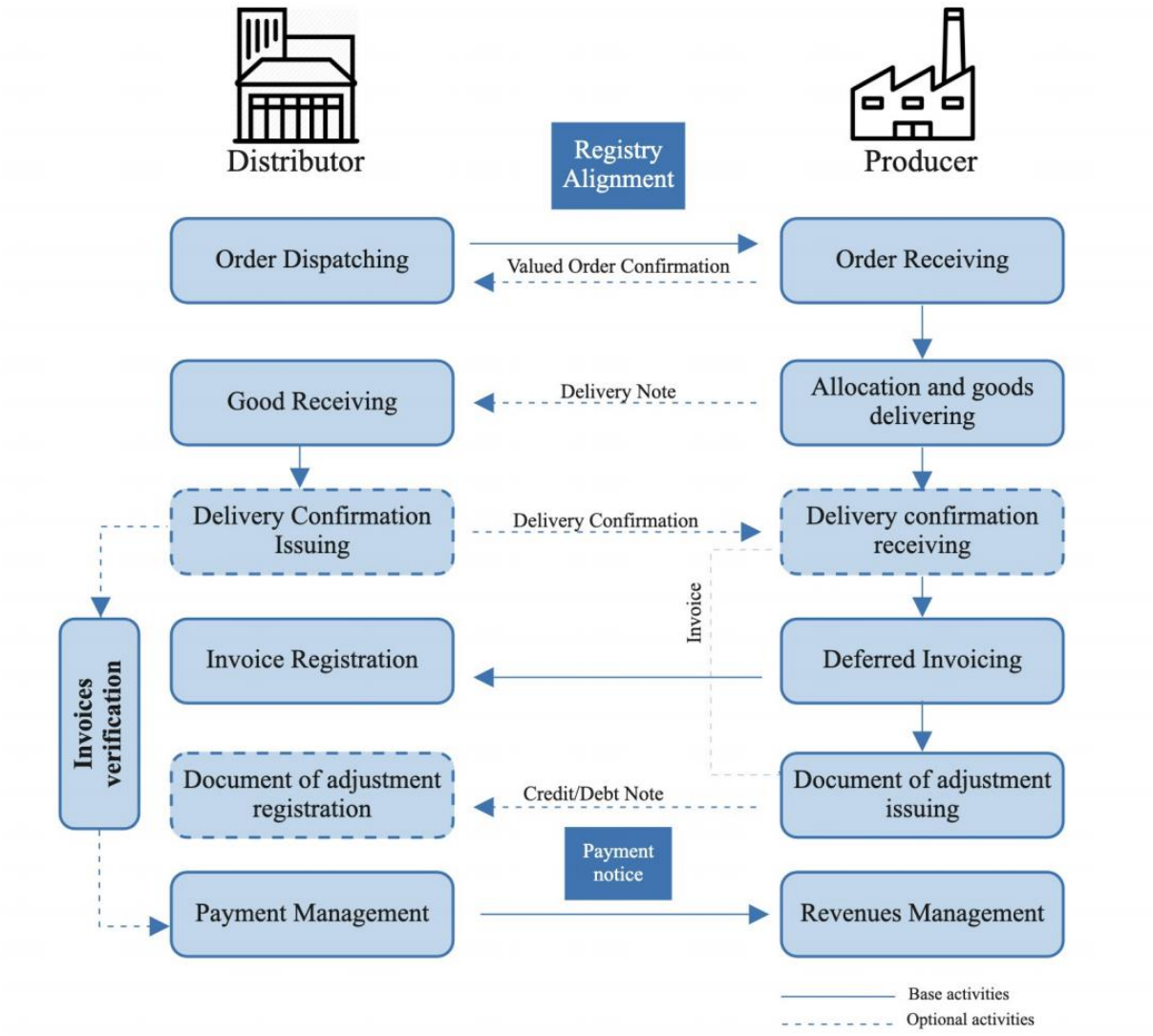


Figure 11: Fast Perfect Order (Indicod-ECR, 2016)

The types of documents exchanged during each of the four phases of the cycle are explained as follows:

1.3.3.2.1 Order

Order document is done by the client company after determining the good or services and supplier. This document consists of the structured information about the customer, the supplier, the requested products, their quantities, prices, delivery times and transportation. Then, the customer will send this document to the supplier who will process the document by verifying the fairness of the information and the availability of goods. The supplier company will make the order confirmation on which the receipt of the order is confirmed, or latest changes are reported.

1.3.3.2.2 Delivery

Delivery is related with the physical set up of the goods and delivery to the customer. During the shipment phase, the following documents are involved:

- **Bill of lading (BOL),** which was introduced in place of the packing list, justifies the transfer of goods from the assignor to the assignee through the transport, in case of the latter occurs directly by customer or supplier, or even in case of its outsourcing. Before the delivery of the good, it has to be issued and contain the main information of transaction. This document could be replaced by Invoice which includes information such as the serial number, the date, assignor, assignee and carrier information, quantity and quality of products. This document should be issued in minimum two copies; one for the issuer to archive and the other for the assignee to be delivered with the goods.
- **Delivery Note** that must be filled by the assignor and put together with the goods on the vehicle used for this activity by carrier. It should contain data about the hauler (personal and fiscal, including the record number to the haulers register), the assignor, the loader and the owner of the goods; the data of goods in terms of type, quantity and weight, place of loading, place of unloading, place and date of note filling; compiler data (who fill the note in the name and on behalf of the assignor) and the signature.
- **Dispatch Advice** includes information about the delivery and supplier sends it to the customer before physical arrival of goods.
- **Receiving Advice** which certifies the receipt of goods;
- **Responsibility Note** is sent by the hauler to attest that responsibility of the goods were taken while waiting for the shipment.

1.3.3.2.3 Invoicing

Invoice is set up by the supplier and sent to the customer when the order and delivery date are matched. The Invoice is a commercial document which has civil consequences, financial, financial (Value Added Tax (VAT) deduction, and deductibility of costs) and penalties (tax crimes and failures). It is a sensitive document which is regulated by the legislator. Customer reconciliation between Invoice and the documents exchanged before take place in invoicing phase. Possible errors can be corrected through credit or debit notes.

1.3.3.2.4 Payment

Payment is the final phase of the order cycle. It is the payment of the invoice by customer. The customer could send back a payment notice. In this phase, payments and receipt management are also carried out.

1.3.3.3 Benefits and Level of Integration

According to the Dearing (1990), e-Supply Chain Execution solution provides different kinds of benefits in terms of both operational and strategic. The strategic benefits are related with having better relationship with trade partners which turns out in a long-lasting relationship and an increase in information flows (Perego & Salgaro, 2010). The operational benefits are related with the reduction of processes execution time and cost, better process accuracy and reduction in the space occupied to archive fiscal documents which are explained below in detail.

- **Reduction in the execution costs** is the result of an improvement in workforce productivity (Sanders & Premus, 2002; Fink, 2006; Iyer, Germain & Claycomb, 2009; Perego & Salgaro, 2010). Workforce becomes more productive and at the same time, cost of expendable materials decreases. By the help of software and standardization procedures, human intervention is necessary only for the controlling activities and managing the exceptions in the document management activities (Perego & Salgaro, 2010).
- **Improvement in process accuracy**, is attained by the reduction or elimination of manual activities completely (Pramatari, 2007; Piotrowicz & Irani, 2009; Perego & Salgaro 2010). Moreover, improvements in process accuracy reduce the costs related to the management of non-conformity issues (Fink, 2006; Perego & Salgaro 2010).
- **Reduction in the space occupied** to archive fiscal documentation (De Boer et al., 2008; Perego & Salgaro, 2010).
- **Cut-back in process execution (or cycle) times** is a result of simplified activities and the processes can be controlled via "workflow" logic. (Power, 2002; Pramatari, 2007; Davis & Leonard, 2006; Pawar & Driva, 2000; Piotrowicz & Irani, 2009; Perego & Salgaro, 2010).

The level of integration between trade parties is necessary to have all these benefits. The higher level of B2B Supply Chain integration brings the better performance (Iyer et al., 2009). The level can be classified according to increasing order of integration of e-Supply Chain Execution as follows:

- **Conventional scenario:** No integration and dematerialization of the order-to-payment cycle (Iyer et. al., 2009, Perego & Salgaro, 2010);
- **Intermediate scenario:** There are some activities that are supported and integrated electronically; however, others are still managed conventionally (Perego & Salgaro 2010; Perego & Marazzi, 2010);

- *Unilateral exchange of orders or invoices*: The customer sends a structured electronic order to the supplier, meanwhile, it is assumed that the customer company does not receive structured documents from the supplier. For the unilateral exchange of Invoice, the opposite is applied. The supplier sends a structured electronic invoice to the customer and the former does not receive structured documents from the latter (Perego & Marazzi, 2010);
- *VAT-compliant electronic Invoicing:* The supplier sends the Invoice as electronic document by applying their specific digital signature and time stamp that will guarantee their authenticity and integrity. In addition, electronic Invoicing agreement has to be signed by trading partners to exchange the invoice. Then, both customer and supplier have to archive electronically the electronic Invoice by applying on the batch of Invoices, the time stamp and digital signature (Perego & Marazzi, 2010);
- *Integration of the Invoice-to-Payment Cycle:* Exchanges related to administrative and financial activities (invoices, credit or debit notes, payment orders and receipts, transaction notifications) take place through structured electronic documents, on the basis of shared process rules. However, the archives - payables or receivables - remain in paper format (Perego & Marazzi, 2010);
- *Integration of the Order-to-Invoice Cycle:* Structured electronic documents based on shared process rules, are used to exchange data related to the logistical-commercial aspects (orders, order confirmations, transportation documents, sending notifications, invoices). Even in this process, the archives remain in paper format (Perego & Marazzi, 2010).

- **Full integration of the trade process:** The entire document flow is managed and transferred in structured digital format that maximizes the electronic tools integration and they can directly be processed by the firm's information systems. Both the account payables and receivables archives are electronic, in accordance with electronic Invoicing legislation (Perego & Salgaro, 2010; Perego & Marazzi, 2010).

1.3.3.4 Barriers

e-Supply Chain Execution provides many benefits to the trading parties; however, it requires the ability to overcome different barriers. The main issue related to e-Supply Chain Execution is that companies tend to underestimate their benefits and overestimate the needed effort

(Bertelè et al., 2005). The causes of benefits' underestimation are lack of process KPIs, local optimization and lack of process view that are explained below in detail.

- **Lack of process view:** Operative processes are usually divided into elementary phases under the responsibility of many different functions driving to a lack of process view;
- **Lack of process KPI:** When the processes are divided into different phases, it brings the difficulties to measure KPIs such as total cost, order cycle lead time, inaccuracy, etc.;
- **Local optimization:** Electronic data exchange projects usually start into single functions to increase the local performances.

In order to implement an e-Supply Chain Execution project in an accurate way, it is essential to start with strong redesign of order-delivery-invoice-payment cycle, especially in terms of the interfaces with the supply chain partners (Bertelè et al., 2005). Moreover, it is important to be dedicated on standards availability. Standards are required at different levels (document level, codification level and processes level) in order to provide low cost and high speed of interface processes integration.

1.3.4 e-Supply Chain Collaboration

1.3.4.1 Definitions and framework

Since e-Supply Chain Collaboration has tremendous impacts on the supply chain processes, it is inevitable to discuss e-Supply Chain Collaboration considering e-SCM. There are various definitions about e-Supply Chain Collaboration in the academic literature from different authors as follows (Table 8):

Table 8: e-Supply Chain Collaboration Definitions

Macneil, 1981	*Collaboration is about organizations and enterprises working together and can be viewed as a concept going beyond normal commercial relationships. "… underlies spot market transactions to a relational exchange, as the roles of supplier and buyer are no longer narrowly defined in terms of the simple transfer of ownership of products."*
Bowersox, 1990; Mentzer et al., 2000; Muchstadt et al., 2001; Matopoulos et. al., 2007	*The notion implies that the chain members, two or more, become involved and actively work together in coordinating activities which span the boundaries of their organizations in order to fulfil and satisfy customers' needs.*

Anderson & Lee, 1999	*Supply chain collaboration occurs when industry participants collaborate on planning and execution of supply chain strategy to achieve a synchronized supply chain.*
Anthony, 2000	*Supply chain collaboration occurs when two or more companies share the responsibility of exchanging common planning, management, execution, and performance measurement information.*
Simatupang & Sridharan, 2003; Whipple, 2007	*Collaboration is defined as occurring when two or more independent companies work jointly to plan and execute Supply Chain operations with greater success than when acting in isolation.*
Bertelé et. al., 2004	*It involves sharing of electronic information to support operational planning processes (demand planning, inventory management, Supply Chain monitoring and control), the development and design of new products, aiming at improving process efficiency through collaboration in decision-making and execution phases.*
Glenn Richey, 2009	*The e-SC Collaboration encompasses planning and management as well as coordination and collaboration with channel partners, which can be suppliers, intermediaries, third-party providers, and ultimately consumers.*

The general framework (shown in Figure 12), which is suggested by the current literature for supply chain collaboration, has two pillars that are distinguished as follows: one pillar is related with "the design and the government of supply chain activities", and the other is about "the establishment and the maintenance of supply chain relationships" (Matopoulos, Vlachopoulou, Manthou & Manos, 2007).

Considering the first pillar, "design and government of supply chain activities", it is composed of three elements. The first one is about selecting the right partner for the company. As firms have large number of suppliers and customers, it is difficult to establish close relationships with all of them; therefore, a selection is a must as regards to the expectations, perceived benefits and drawbacks, and the "business fit" of companies (Matopoulos et. al., 2007). The second element is about selecting the activities where the collaboration is generated. It is known as "width" of the collaboration in the literature. Since the activities requires different levels of involvement and closeness, it is necessary to determine which processes need collaboration (Sahay, 2003). After the selection of the activities, as a third element, it is crucial to determine the level of collaboration among players (Matopoulos et. al., 2007). In the literature, this

tactical, operational and strategic decision creates "depth" of collaboration (Stevens, 1989; Chopra & Meindl, 2001; Fawcett & Magnan, 2002; Matopoulos et. al., 2007). As a last element, decision of the selection of appropriate technology and technique in order to enable information sharing easily and accurately has paramount importance in the design and governing of supply chain activities (Matopoulos et. al., 2007).

The second pillar, "establishing and maintaining supply chain relationships", consists of less tangible elements related to relationships. In this context, the significant elements can be considered as "mutuality of benefits, risks and rewards sharing" (Stank et al., 1999; Barratt & Oliveira, 2001; Matopoulos et. al., 2007). In addition, La Londe (2002) states that trust and risk issues are very significant in supply chain relationships due to the interdependence between firms.

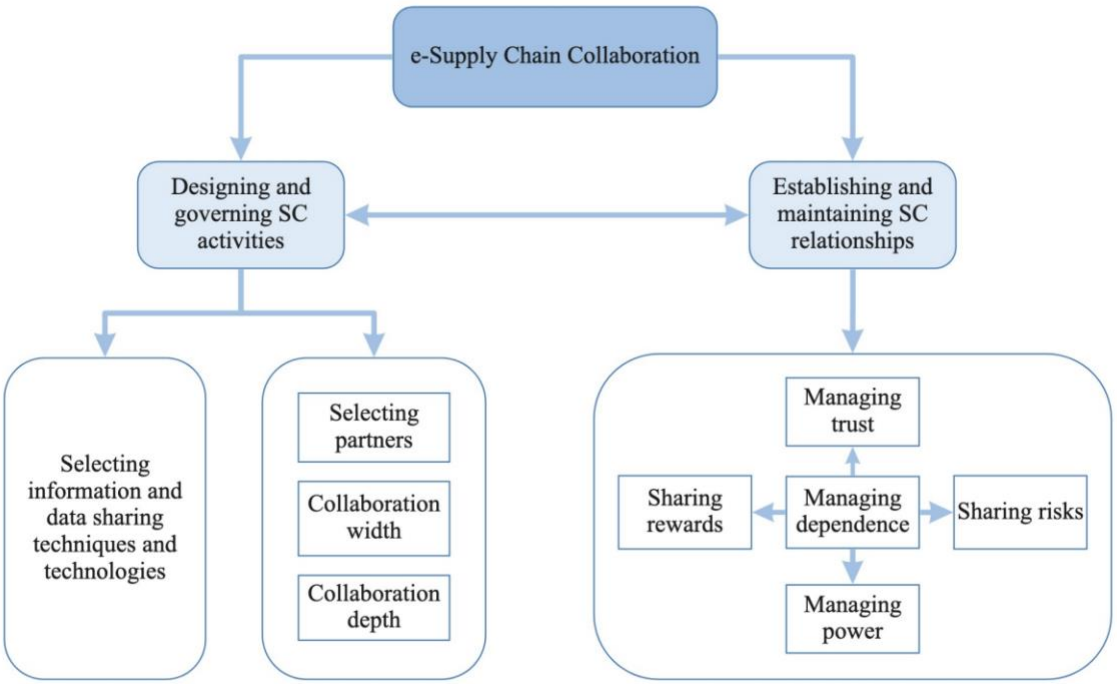


Figure 12: e-Supply Chain Collaboration Framework (Matopoulos et. al., 2007)

According to Bertelé et al. (2004), in order to better comprehend e-Supply Chain Collaboration, the main application fields should be identified as follows (shown in Figure 13):

- **Monitoring and control of supply chain;** starting from information sharing (sales data, production capacity data, etc.) and sharing of the key performance metrics to the reporting of supply chain management such as depletion of certain products' stock (Bertelé et al., 2004).

- **Collaboration on planning activities;** starting from demand forecasting to promotion management and inventory management where CPFR models are applied (Bertelé et al., 2004). Before introducing CPFR, it is significant to understand Vendor Managed Inventory (VMI) and Continuous Replenishment Program (CRP). VMI has been described as "a form of supply chain collaboration where the supplier resumes replenishment responsibility on the customer's behalf" (Harrison & van Hoek, 2002; Disney & Towill, 2003; Vigtil, 2007). CRP, on the other hand, is more developed concept of VMI and demand is revealed from the retailers' stores (Pramatari, 2007). Regarding CPFR, it can be considered as an evolution of VMI and CRP. CPFR includes replenishment, joint demand forecasting and promotions planning (Holmström et al., 2002). Pramatari (2007) describes CPFR as "extended information sharing between retailer and supplier, including point-of-sales (POS) data, forecasts and promotion plans".
- **Collaboration on new product introduction and development;** starting from sharing the main technical documents to project workflow management (Bertelé et al., 2004).
- **Collaboration on communication and marketing management;** starting from the information sharing about product and price data, phase-in and phase-out plans, etc. to the activities related with customer relationship management such as, development of a customized offer, information request management and technical assistance, etc. (Bertelé et al., 2004).

The following categories of functionalities can be supported by e-Supply Chain Collaboration solution and help decision makers to better manage the supply chain (Bertelé et al., 2004):

- Document exchange management tools (sharing of CAD drawings, forecast plans, POS sales data);
- Content and knowledge management tools;
- Collaboration supporting tools;
- Integration tools for transactional activities within the company;
- Communication and event management tools.

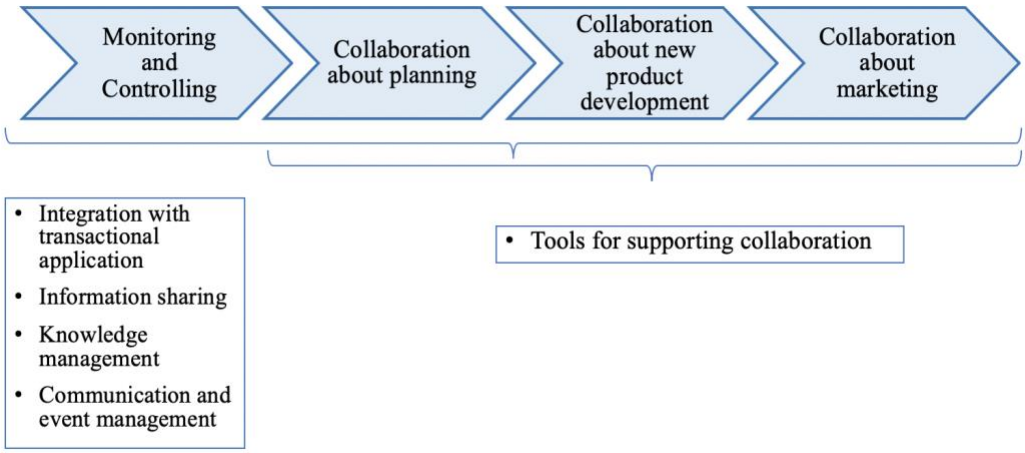


Figure 13: e-Supply Chain Collaboration Process (Bertelé et al., 2004)

1.3.4.2 Models

In the academic literature, different authors suggest various models for e-Supply Chain Collaboration since there are several categories of functionalities as described above (Holweg, Disney, Holmström & Småros, 2005). Holweg et al. (2005) suggest a model for e-Supply Chain Collaboration to classify the possible areas of collaboration in terms of two dimensions; planning collaboration and inventory collaboration (shown in Figure 14). According to Holweg et al. (2005), there could be other possible dimensions such as promotions or new product introductions; nevertheless, these are the most common ones to establish a model.

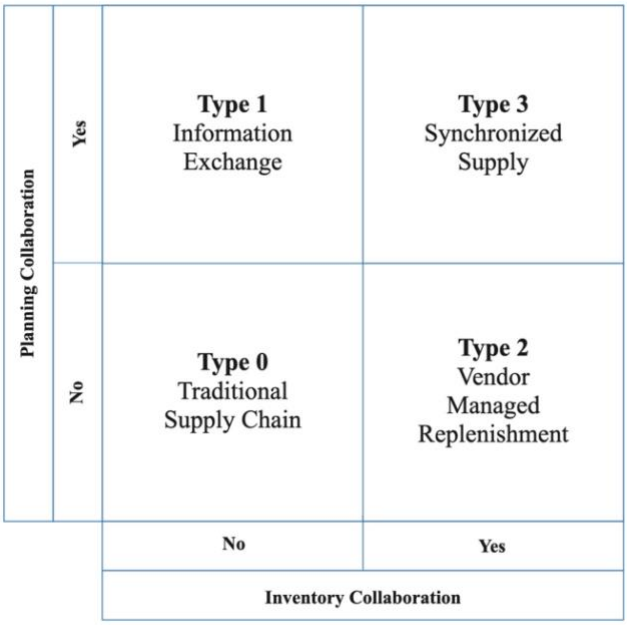


Figure 14: e-Supply Chain Collaboration model (Holweg et al., 2005)

Type 0 – Traditional Supply Chain: Issuing production orders and replenishment of stocks are done at each level of supply chain without considering the situation of both upstream and downstream tiers of supply chain; in other words, there is no collaboration among the supply chain players (Holweg et al., 2005). The only information exchange with the suppliers is the purchase order issued by the retailer and it creates bullwhip problem since there is no visibility of the actual demand (Holweg et al., 2005). Hence, in order not to stock out, Carlsson and Fuller (2000) listed some problems that could be encountered due to the bullwhip effect as follows: "excessive inventory investments throughout to cope with the increased demand uncertainty, reduced customer service due to the inertia of the production/distribution system, lost revenues due to shortages, reduced productivity of capital investment, increased investment in capacity, inefficient use of transport capacity, and increased missed production schedules."

Type 1 – Information Exchange: In this type, retailer and supplier still order independently but information about demand and action plans are shared in order to manage their forecasts better for the capacity planning (Holweg et al., 2005). When considering end customer sales, forecasting at supplier level is a crucial improvement compared to relying only on the orders sent by the retailer because of reducing delays and unnecessary uncertainty (Holweg et al., 2005).

Type 2 – Vendor Managed Replenishment (VMR): In VMR, is also known as vendor managed inventory (VMI), supplier is responsible for creating replenishment order, maintaining the retailer's inventory and the retailer's service levels (Holweg et al., 2005). In this setting, customers give responsibility for placing replenishment orders to suppliers; and hence, they can manage the inventory as having full visibility of the stock at the customer's site which leads to potential decrease in investments on maintaining customer service level (Holweg et al., 2005).

Type 3 – Synchronized Supply: In this type of collaboration, the replenishment decision is merged with the production and materials planning of the supplier. Supplier is responsible for customer's inventory replenishment on the operational level and with this visibility, manages his supply activities (Holweg et al., 2005). Considering the demand uncertainty problem, with the help of collaboration, suppliers can better manage these variabilities; and also, there are some improvements related to the inventory turnover. Nonetheless, several companies have faced with challenges to integrate customer demand information into their production and inventory control processes (Holweg et al., 2005).

Another model for e-Supply Chain Collaboration is proposed by Whipple and Russell (2007). It is suggested that there are three types of collaboration based on two dimensions that are number of participating companies and expected sustainable pay-off, and the classification is as follows (shown in Figure 15); Collaborative Transaction Management (Type I), Collaborative Event Management (Type II) and Collaborative Process Management (Type III) (Whipple & Russell, 2007).

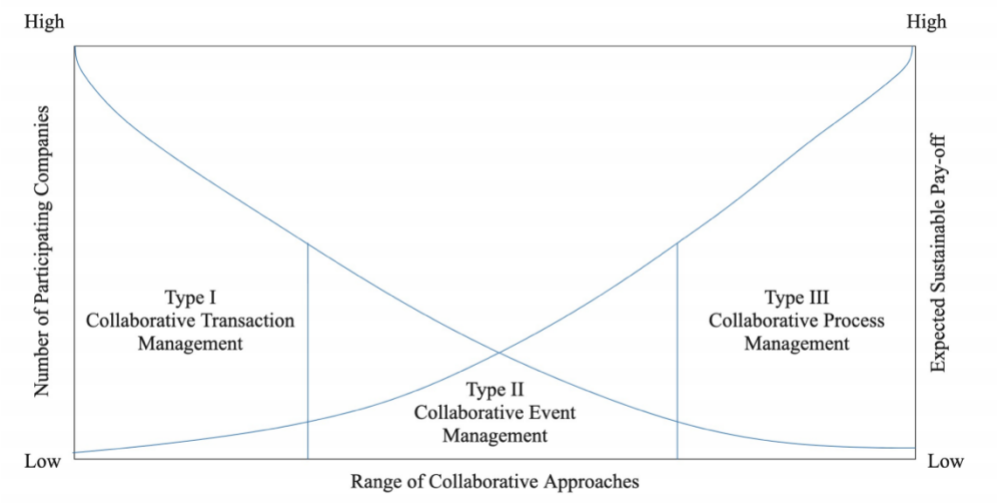


Figure 15: Typologies of Collaborative Approaches (Whipple & Russell, 2007)

Type I – Collaborative Transaction Management: The main focus of this type is on providing the exchange of transaction data and establishing a strong base of collaboration (Whipple & Russell, 2007). The name of this typology may lead to misunderstandings; however, it is not only related to transactions but also, it focuses on a form of collaboration where both operational level decisions and transactional data exchanges are performed (Whipple & Russell, 2007). In order to be successful in collaborative transaction management, standardization of transactional data and supporting technologies that makes data exchange automatic are the key factors (Whipple & Russell, 2007).

Type II – Collaborative Event Management: In this type, information sharing, and relationships are built on planning and decision making around key activities such as creating a joint business plan, sharing information regarding new product introductions, and so on. (Whipple & Russell, 2007).

Type III – Collaborative Process Management: The main focus is on both supply and demand activities in order to establish right cross-functional integration (Whipple & Russell, 2007). In this type, both sales and order forecast processes are managed through joint planning

(Whipple & Russell, 2007). In addition to type II collaboration, there is collaboration in the areas of supply processes such as production scheduling, truckload utilization, warehouse management, order replenishment, etc. so as to increase supply chain efficiency (Whipple & Russell, 2007).

1.3.3.3 Benefits and Criticalities

There are several benefits of supply chain collaboration according to literature and some of them can be listed as follows:

- Enabling better customer service levels (Holweg et al., 2005);
- Potential reduction in inventory (Holweg et al., 2005);
- Elimination of bullwhip effect (Småros, Lehtonen, Appelqvist & Holmstromet, 2003; Holweg et al., 2005);
- Better utilization of production capacity and reduction in capacity buffers (Waller, Johnson & Davis, 1999; Holweg et al., 2005);
- Better utilization of transportation resources (Le Blanc, Krieken, Fluren & Krikke, 2004; Holweg et al., 2005);
- Better control of the risk for constrained components or materials (Holweg, et al., 2005);
- Improved forecast accuracy (Fliedner, 2003);
- Faster and flexible delivery (Matopoulos et. al., 2007);
- Faster product development (Matopoulos et. al., 2007).

However, collaboration could cause some risks and may end up with a failure (Dwyer, Schurr & Oh, 1987). Regarding failure, the risks can be identified as "the loss of significant investments in money, time and delay or abandonment of business plans" (Matopoulos et. al., 2007). Collaboration activities may not be appropriate for all relationships between companies (Krause, 1999). Besides, in some cases, the dependency of one company to another, which has increased with the collaboration may lead to some risks in terms of power of the companies (Matopoulos et. al., 2007). Moreover, collaboration in supply chain can cause an increase of complexity in operations and companies put more effort to succeed; and as a result, it may end up with termination of the collaboration (Matopoulos et. al., 2007).

1.3.5 e-Procurement

1.3.5.1 Definitions and framework

1.3.5.1.1 Definitions

In the following chapter, it will be discussed another important macro process, that usually takes place before e-SCM, e-Procurement, which could be defined as the use of electronic functionalities (i.e. electronic catalogues, workflow management, RFx, electronic invoicing, etc.) to support the purchasing process for indirect goods, which cover a large number of orders with a low value (Min & Galle, 1999). e-Procurement applications have roles both in operations to make traditional purchasing procedures more efficient and cost effective (Turban et al., 2006; Wu, 2007; Caniato, Golini, Luzzini & Ronchi, 2010) and also, in strategy such as facilitating continuous information exchange between buying and supplying organizations and the creation of long-term relationships (Wu, 2007; Caniato et al., 2010).

e-Procurement has been defined in many ways and its definition has evolved during time (Aboelmaged, 2010). Some definitions found in literature are shown in Table 9:

Table 9: e-Procurement Definitions

Essig & Arnold, 2001; Puschmann & Alt, 2005	*e-Procurement is more than just a system for making purchases online. It provides an organized way to keep an open line of communication with potential suppliers during a business process and it helps with the decision-making process by keeping relevant eProcurement is interpreted as the result of applying e-commerce technologies to an organization's purchasing activities. This concept currently encompasses activities ranging from purchasing via electronic catalogues to participation in a wide array of online auctions and markets, all aimed at enhancing and automating as much as possible the chain of value.*
Roche, 2001	*e-Procurement is automating the whole purchasing process and making order and requisition information available along the entire Supply Chain.*
Presutti, 2003	*An e-procurement system is an information technology-based purchase system which is at the input end of the Supply Chain.*
Lancioni, et. al., 2003; Sherry X. Sun et al., 2011	*e-Procurement, which has been widely adopted to facilitate the acquisition of commodities through the Internet, mainly focuses on automating the major steps of a purchasing process, such as definition of product requirements, search and selection for suppliers, negotiation and contracting with suppliers.*
A. J. C. Trappey et al., 2004	*e-Procurement system, is an electronic purchasing channel where users can find, select, buy and return goods via the Internet.*

Tatsis, et al., 2006; Hidayanto, et al., 2012	*The integration, management, automation and the empowerment of an organization's procurement process, using tools and electronic technology, and web-based applications.*
A.K. Pani et. al., 2007; Jose Maria Alvarez-Rodriguez et. al., 2014	*The term e-Procurement refers to the use of electronic communications to deal with business process between sellers and buyers. It can be considered as the linking and integration of inter-organization business process and systems with the automation of the requisitioning, the approval purchase Order management and accounting processes through Internet-based protocols.*
Lutz et al., 2010	*The term "e-Procurement" identifies the process of purchasing online goods, works or services, in a business to business or business to government transaction.*
Giner Alor-Hernandez, et al., 2013	*e-Procurement is more than just a system for making purchases online. It provides an organized way to keep an open line of communication with potential suppliers during a business process and it helps with the decision-making process by keeping relevant information neatly organized and time- stamped.*
Centobelli Piera et al., 2014	*It is a set of e-businesses and e-solutions that support the buying process. In this specific case, the focus along the chain moves from downstream, and then from the last links in the chain, to upstream, directly in contact with the supply network. With eProcurement the entire procurement process is handled online, so the company decided to make the purchases of various types, from raw materials to services, using B2B systems.*

1.3.5.1.2 Drivers

In literature, there are some emerged drivers which push towards e-Procurement adoption. These six main drivers are mainly organizational objectives (Wu, 2007; Garrido et al., 2008) and explained below in detail (Caniato et al., 2010):

- Efficiency, in terms of reduction of purchasing process costs;
- Decentralization (which is linked to the first one), firms try to decentralize operational procurement process to centralize more value-added activities by the help of automation;
- Control, increasing control on the total spending;
- Maverick buying reduction, in order to increase compliance to pre-negotiated contracts;
- Supply base rationalization, thanks to e-Procurement, it is possible to manage the supply base in a more efficient and effective way;

- Transparency, e-Procurement provides higher transparency on the overall purchasing process to both customers and suppliers.

1.3.5.1.3 Benefits and Barriers

The e-Procurement adoption provides many benefits that can be economical and organizational (Garrido et al., 2008; Dai & Kauffman, 2006; Caniato et al., 2010). The e-Procurement allows improvements in efficiency in terms of productivity and purchasing process quality and accuracy (Harrigan, Boyd, Ramsey, Ibbotson & Bright, 2008; Garrido et al., 2008; Caniato et al., 2010). Therefore, it implies an increased efficiency in the organizational structure of the firms since the processes become faster, flexible and more agile (Garrido et al., 2008; Caniato et al., 2010). Moreover, it lowers costs and enhances the service to the final customers (Garrido et al., 2008; Caniato et al., 2010).

On the other hand, e-Procurement has also some difficulties according to studies. Firms have security concern about the data that are exchanged in electronic environment and they are reluctant to share data with the trading partners. Moreover, there is "wait-and-see" attitude among firms when they have to select the e-Marketplaces and the service providers for procurement (Huber, Sweeney & Smyth, 2004).

Table 10: Benefits and Difficulties of e-Procurement

Benefits	**Difficulties (**Huber et al., 2004)
Efficiency improvements in terms of productivity and purchasing process quality and accuracy (Harrigan et al., 2008; Garrido et al., 2008; Caniato et al., 2010)	Security and confidentiality concerns of the data
Increased control on the spending (Davila,Gupta &Palmer, 2003; Kauffmann & Mohtadi, 2004; Puschmann & Alt, 2005)	Be reluctant to share data with the trading partners
Transparency in the relationship with suppliers (Kauffmann & Mohtadi, 2004; Croom, 2005; Puschmann & Alt, 2005)	The lack of "feasibility of custom-made products" for pooling initiatives
Maverick-buying reduction (Kim & Shunk, 2004; Davila et al., 2003; Puschmann & Alt, 2005)	The lack of standardization
Decentralization of procurement activities (Henriksen & Andersen, 2003; Puschmann & Alt, 2005)	Uncertainty over trust and commitment among the trading partners.
Supply base rationalization (Kim & Shunk, 2004; Davila et al., 2003).	

1.3.5.1.3 Classification models and framework

e-Procurement interactions are classified into two models according to the type of interaction between agents (Alvarez-Rodriguez, 2014).

- **Sell-side model:** A web-based system is an example of this model where an online supplier offers its services, online catalogue and buying system via web application. This model is generally used in SMEs (Alvarez-Rodriguez, 2014).
- **Buy-side model:** In this model, the buyer firm needs to acquire some product or service. Therefore, different suppliers participate in the buying process. The buyer has to select the most appropriate seller according to different criteria to optimize solutions. In order to do this, the buyer needs to obtain the data automatically from the sellers to decide the right one (matchmaking process between buyer requirements and seller profile) (Alvarez-Rodriguez, 2014).

Rangone and Balocco (2002) is proposed a consistent framework and B2B solutions could be classified into the following two dimensions:

- **The application owner:** The subject, which owns the application, can be represented by a specific company, by an intermediary, or by another operator.
- **The application features:** They depend on the needs that the application intends to satisfy. There are transactional functionalities and non-transactional functionalities. The transactional activities that include the functionalities related with buying and selling products and services. The non-transactional functionalities meet other requirements, such as the possibility to inform, communicate and interact with other companies.

The following e-Procurement models can be identified by crossing different functionalities with subjects (Rangone & Balocco, 2002):

- **"Many to many" models (e-Marketplace):** These solutions are B2B intermediaries that support any chain business relationship, even the non-transactional ones; they simply match supply and demand without allow the closure of the online transaction (Rangone & Balocco, 2002).
- **Extranet-based models:** These solutions are the Internet applications which are developed by single company in order to interact with business partners (customers, suppliers, new products development partners). These applications have the possibility to support the processes of purchase or sale or to offer different functionalities to its supply chain partners such as the possibility of access to commercial information,

control the in-stock inventory, interact with company personnel (Rangone & Balocco, 2002).

- **"One to many" models:** In this solution, the subject can assume the characteristics of an e-Distributor, supporting the sale of products and services or the subject simply offers to the partners various services such as information content (Rangone & Balocco, 2002).

Another classification is proposed by Monczka et al. (2004), Van Weele (2004) and Spina (2007), the purchasing activities are classified into three different macro-processes; strategic purchasing, sourcing and supply (Caniato et al., 2010). Strategic purchasing consists of activities which are strategically relevant such as make or buy decisions and supplier relationship management. Therefore, these are long-term and low-frequency decisions. On the contrary, sourcing and supply are more tactical and repetitive. These decisions include everything related with supplier selection (i.e. sourcing) and the Order fulfilment (i.e. supply). The last phase is quite different while dealing with direct (operations-driven) goods or indirect (non-operations-driven) goods (Caniato et al., 2010). In order to support the operational processes of sourcing and supply phases, many tools have been developed which are e-Auctions, e-Tenders, RFx (request for information, proposal, quotation) and so on (Teich et al., 2004; De Boer et al., 2008; Caniato et al., 2010) as e-Sourcing tools. Moreover, e-Catalogs, workflow management applications, e-Invoicing, etc. are considered e-Supply or e-Procurement tools (Puschmann & Alt, 2005; Caniato et al., 2010). Merging the two previous models, it is possible to represent a framework scheme as follows:

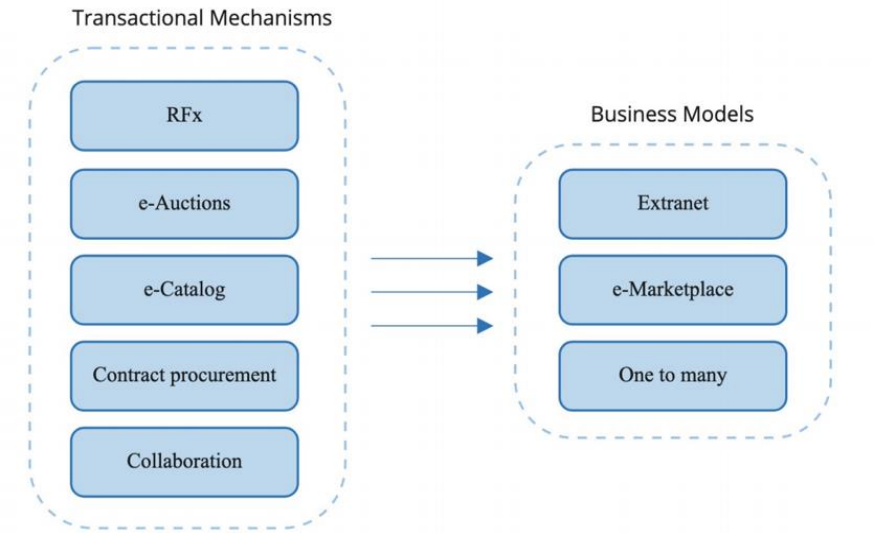


Figure 16: B2B Procurement Framework (Hitech Dimensions, 2002)

1.3.5.2 e-Sourcing

1.3.5.2.1 Definitions and Framework

Within e-Procurement processes, e-Auctions, e-Tenders, RFx, etc. can be considered as e-Sourcing tools as well as the activities related to supplier selection, relationships and so on (Caniato et al., 2010). The main phases of e-Sourcing should be examined in detail to have complete understanding. There are five major phases of this process according to Bertelé et al. (2004):

- **Needs analysis:** It aims to identify and classify the main expense items and determine the supply requirements of the company;
- **Scouting of suppliers:** For each product category, this activity aims to determine the potential suppliers;
- **Supplier qualification:** It aims to evaluate suppliers as regards to certain KPIs;
- **Offer request:** It enables buyer to request a proposal or an estimate in a structured way to suppliers in terms of needs;
- **Trading phase:** It can be conducted through RFx or auction.

After describing the main phases of e-Sourcing, tools to support these activities can be defined as follows (Bertelé et al., 2004):

- **Data analysis tools:** It enables data processing for purchases in order to support decision making process.
- **Scouting tools:** It allows to support the pre-qualification of suppliers through web form or workflow system.
- **RFx systems:** These tools support the management of requests for information, proposal and quotation; and hence, manage asynchronous interaction with suppliers.
    - *Request for Information (RFI):* It is a tool for buyer to request general information such as turnover, number of employees, product range, certifications to seller company.
    - *Request for Proposal (RFP):* It is a tool for buyer to ask the seller for possible proposal that includes the specific needs (both technical and economical specifications of product or service) of the buyer that is determined in advance.
    - *Request for Quotation (RFQ):* It is a tool for buyer to request a proposal from the seller for purchase price of specified product or service.
- **e-Tender/e-Auction tools:** They allow synchronized negotiations with multiple suppliers. In other words, the online auctions for purchasing process can be considered

as a dynamic negotiation tool which enables the buyer to make a competition between certain number of suppliers where the suppliers offer lower prices and the buyer rewards one of them by buying the supply orders if the desired price is achieved. There are some variables that define the online auction (Bertelé et al., 2004):

- *Evaluation method:* Offers can be evaluated in two ways, either mono-attribute or multi-attribute. In mono-attribute, it is based on one criterion, price and it could be the total price of the order or a weighted average of the prices of a part of the specifications. In multi-attribute, it is based on the weighted average of more than one price. It could include quality, service level, payment method, etc.
- *Starting price:* It determines the starting transaction of the auction.
- *Reserve price (Target price):* It determines a threshold under which trading is not valid.
- *Negotiation mechanism:* There are various types of negotiation mechanisms in the auctions and the main ones are:
  - English: In a certain time, bidders can relaunch offers. This time can be extended as bidders increase the price and it lasts until no one is able to raise the last amount.
  - Dutch: The price is changing at constant time intervals and bidders lower the price until they close the contract.
  - Japanese: The price subsequently decreases, and bidders have chance to exclude themselves if the price does not suit them. It continues until the last bidder stays in the auction.
- *Aggregation mechanisms:* Negotiation is achieved through combinatorial aggregation. It is used when there are many different product lots and each lot has varying number of products. It is possible to bid for different lots at the same time.
- *Award mechanism:* It depends on the type of the auction. In some cases, it is determined automatically as an outcome of the auction but in some cases, auctioneer selects the winner of the auction regardless of the outcome.
- *Award price:* It can be the price offered by the winner, or the second-best price.

- **e-Collaboration tools:** They are tools to support the relationship between the buyers and suppliers so as to decide the specifications of supply in a collaborative way.

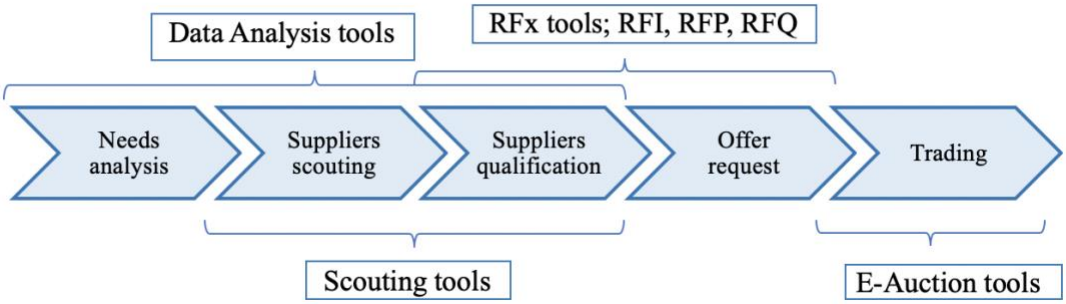


Figure 17: e-Sourcing Processes and Tools (Bertelé et al., 2004)

1.3.5.2.2 Benefits and Criticalities

While examining the benefits and criticalities of e-Sourcing, both buyers and sellers should be considered. According to the academic literature, the most significant benefits of adopting e-Sourcing for buyers are diminished prices of purchase and increase in efficiency in overall process (Bartezzaghi & Ronchi, 2005). Reduction in purchase price is obtained due to receiving more bids and buyers have chance to select among many suppliers (Bartezzaghi & Ronchi, 2005). In previous years, for simple products or services, buyers have more power on suppliers and if the products or services become more complicated, suppliers have more power since the products require much more technical knowledge and specialization. However, thanks to the introduction of online auctions, all the specifications of the complex products are determined in advance; and hence, buyers can obtain price reduction for complex products now (Bartezzaghi & Ronchi, 2005). As mentioned, one of the most crucial benefits is the increase in efficiency since the buyers are able to receive many bids within minutes (Bartezzaghi & Ronchi, 2005). Compared to the past, it is much faster because collection of bids has taken several working days before the introduction of e-Sourcing tools. In addition, buyers can trace and monitor their expenditure better with these tools (Bertelé et al., 2004).

On the other hand, there are some criticalities regarding the buyer side. First, it is difficult for companies to make spend analysis and decision of the purchase during the auctions because generally, companies start with the less significant product purchases and continues with the high critical products (Bartezzaghi & Ronchi, 2005). Moreover, identification of the number of sellers who are going to be invited to an auction is another issue. If there are few sellers, there will be the chance to collude for keeping the price higher; and therefore, suppliers should be homogenous in terms of price, quality, service level and reliability (Bartezzaghi & Ronchi, 2005). Another issue will be sampling process since the buyer cannot perform sampling process before the auction; thus, there can be a risk that winner would not meet the requirements

decided by buyer (Bartezzaghi & Ronchi, 2005). In addition, winner selection process is a crucial issue and this process can be in two ways; one is deciding the winner based on the lowest bid and the second is taking into consideration other information not necessarily related with the bids. However, this information may influence the buyer decision regardless the bidding price, and in this case, it could create transparency problems between participants; hence, buyer should be careful with his decision and implementation of second option (Bartezzaghi & Ronchi, 2005).

Considering the sellers, they can benefit from the e-Sourcing tools as well. According to Bertelé et al. (2004), since information asymmetry decreases with the implementation of e-Sourcing tools, there are more opportunities for the companies, especially for more competitive ones. Besides, e-Auctions bring more transparency and suppliers also can see the others' bid offers during the event; and hence, they have chance to benchmark their bid offers and compare their conditions with competitors (Bartezzaghi & Ronchi, 2005). Moreover, as the duration of auctions decreases with e-Sourcing tools, suppliers can negotiate with more customers in less time (Bartezzaghi & Ronchi, 2005). As a result, online negotiation can increase the chance of making more agreements with buyers.

1.3.5.3 e-Catalog

1.3.5.3.1 Definitions and Framework

e-Catalog is a recursive buying process which relies on electronic catalog that is accessible through Web according to predefined supply conditions, such as price of products and services. In the concept of e-Catalog, the purchases, which are connected with replenishment, production planning and bill of materials (BOM), are not included (Bertelé et al., 2004).

This process can be divided into its main phases as follows (Bertelè et al., 2004):

- **Catalog management:** It is uploading and updating of catalog content;
- **Purchase request generation:** It describes the product or services that satisfy certain needs of customers, by surfing the e-Catalog and at obtaining the estimate, it is accompanied with supply condition confirmation;
- **Authorization and Order issuing:** It is the expenditure authorization according to buyer decision and the order issuing to suppliers;
- **Logistics:** It is the preparation of good, its delivery, reception and conformity check;
- **Management of the administrative/accounting cycle:** It includes the checking of contractual condition, the invoicing and payment.

The tools to support the above process are (Bertelé et. al., 2004):

- **Web catalog interface** which defines the structure in terms of categories, attributes and also includes searching tools of the products;
- **Tools supporting the content management,** such as update of product list;
- **Workflow** for the management of the approval of purchasing request;
- **RFx tools** which support the purchase of products excluded from the catalog or to manage variations in the specifications;
- **Tools for integration** (middleware), with internal and external applications.

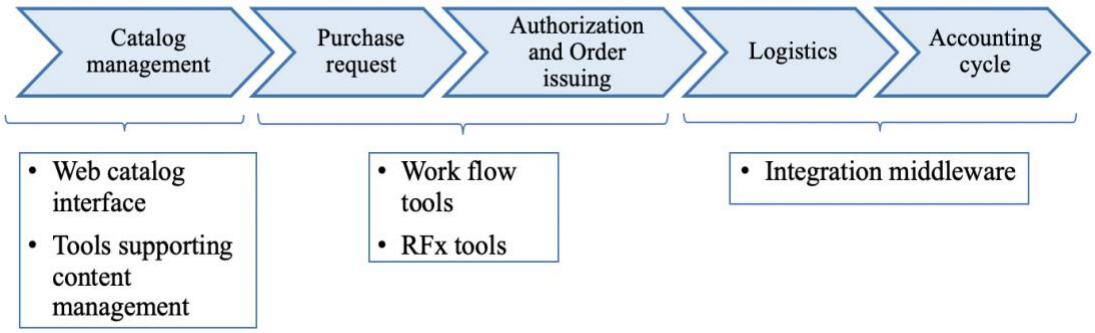


Figure 18: e-Catalog Process and Tools

1.3.5.3.2 Benefits

According to Bertelé et al. (2004), e-Catalog provides different kinds of benefits to the buyer.

- Increase in the recursive purchasing process's efficiency, both in internal (workflow automation) and in external (automation of accounting cycle);
- Thanks to the ease of management of purchasing and order request, supply times are reduced;
- Prices decrease by using the web catalog, rationalization of suppliers' number, number of the products' portfolio and reduction of the Maverick effect (i.e. the phenomenon whereby office workers tend to bypass the traditional process, by performing some supplies in first person, and then filling in the relative expense note);
- Process quality improvement thanks to the centralization and optimization of purchasing.

While the main benefits for the sellers are (Bertelé et al., 2004):

- Order fulfillment process efficiency is increased, when it is considered that the supplier has integrated the e-Catalog with its own enterprise applications;
- Customer switching costs increase since customer has invested in the relationships.

1.3.6 e-Document Management

In supply chain management businesses, tremendous amount of paperwork is generated and used daily. The processes such as storage, management and retrieve of this huge number of documents can generally be time-consuming and costly (Hajmiragha, 2001). Nonetheless, the worst scenario would be the loss of these significant documents or errors in documentation. Companies have been spending significant amount of money for the management of documents and their correct storage procedure; however, they still encounter many problems such as finding needed documents, archiving them accurately and so on (Hajmiragha, 2001). A recent alternative option is to process and store data in the electronic environment which means that an organization or individual can store and process their data online (Navetta, 2009). There is an evidence which shows that the use of e-document management solutions has started to increase more for the storage of digital collections during the years (Brown & Fryer, 2014; Oliver, 2014; Oliver & Knight, 2015; Zander, 2014). Digital document management functions by transforming old paper documents into digital format. It provides services for creation, archiving, processing and sharing of document among autonomous agencies within the incumbent administration structure (Metaxiotis & Psarras, 2004; Patterson & Sprehe, 2002). Consequently, data will be always available in the companies' server for authorized employees anytime. However, changing structure of document management from in-house to the electronic needs to analyze in terms of risk management which mean a loss of control where interruptions in the service may make data inaccessible and there may be a lack of clarity about where data is stored (Duranti & Rogers, 2012).

Document management is generally referred as an archive and record management (ARM). According to the Duff and McKemmish (2000), records "serve as objective evidence of the activities and transactions that support the creation of products or the provision of services" (Duff & McKemmish, 2000). In most of the organization records are created, shared, stored and used. Archival records support accountability protects the rights, aid decision making and can create value which has to be compliance with an organization's regulatory requirements (Strodl, Petrov & Rauber, 2011).

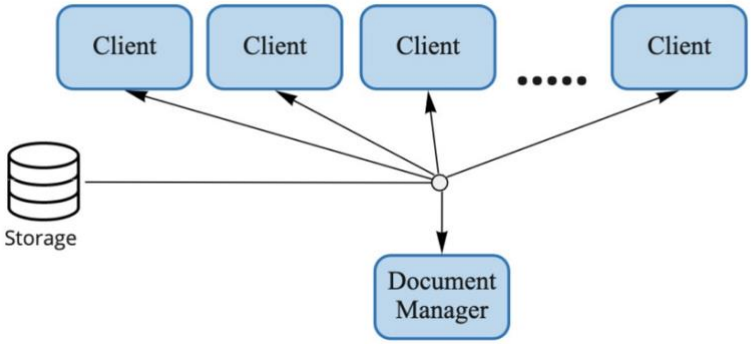


Figure 19: Document Management Framework **(**Hajmiragha, 2001)

The record management provides services to reuse information and subsequent changing of the context of information within the control of the organization. The document manager can perform remote document archiving, document collaboration, digital document signing, document context indexing, document publication and external document storage for clients.

1.3.6.1 Benefits and criticalities

Benefits

e-Document Management builds paperless operations and gives opportunity to the companies in order to deal with great number of data in a daily basis. It helps company to save their expenses greatly by decreasing the stationary costs (no rental for storage) and arrange the records conveniently by providing accessibility of documents/records to the any authorized employee at any time. Furthermore, even if the documents are well-organized and indexed properly, it is difficult to find and use them for later cases; therefore, it is difficult to recover the documents once they are stored (Hajmiragha, 2001). Thus, digital document management brings more efficient solutions in terms of time and usage of paper. There is also benefit for software provider in the perspective of economies of scale since they can share the hardware between several clients (Stuart & Bromage, 2010).

Moreover, digital document management has multi-level transition in authorization which provides security for the confidential files. In general, paper (physical) files are more prone to information leaks and theft since it may need to pass many employees before reaching the right people. On the contrary, in digital document management, people who will authorize to see or change the documents can be restricted. In addition to this, e-document keeps the history of employees accessing each file. In case of information leak, it gives opportunity trace particular person (Stuart & Bromage, 2010).

Criticalities

Firstly, one of the issues about e-Document Management is the reliability of the hardware because it can cause great data loss in the system which will disrupt all operations. Cyber risks are another concern in the case of e-applications such as underlined the threat of viruses, malwares, system malfunctions and hackers. After from traditional method to the electronic version, there can be need of updates in software from time to time (Stuart & Bromage, 2010). Moreover, there is an issue of being satisfactorily destroyed records at the end of their life since organizations need to demonstrate legal requirements. They can dispose records legally but also, they need to show how they dispose (Pelz-Sharpe, 2009).

1.4 Cloud Computing

Cloud computing is one of the most significant technology trends today, with broad-ranging effects on IT services, information systems architecture, business, software engineering and data storage. It represents a fundamental change in the way which IT services are invented, developed, deployed, scaled, updated, maintained and paid for (Marston et al., 2011). According to the best-known IT consulting corporations, cloud computing is one of the technologies that has emerged rapidly and now, more and more companies are willing to adopt in order to improve their efficiency (Toka et al., 2013). More specifically, as stated by International Data Corporation, investments in new technologies such as cloud computing are expected to increase by approximately 18% per year and reach at least 80% of IT spending by 2020 (Gens, 2011).

In literature, there are several definitions for the cloud computing, of which the most precise and complete are:

Table 11: Cloud Computing Definitions

Agarwal & Lucas, 2005	*The concept of IT efficiency also embraces the ideas encapsulated in green computing, since not only are the computing resources used more efficiently, but further, the computers can be physically located in geographical areas that have access to cheap electricity while their computing power can be accessed long distances away over the Internet. However, as the term business agility implies, cloud computing is not just about cheap computing — it is also about businesses being able to use computational tools that can be deployed and scaled rapidly, even as it reduces the need for huge upfront investments that characterize enterprise IT setups today.*

Buyya, Yeo & Venugopal, 2008	*Cloud is a type of parallel and distributed system consisting of a collection of interconnected and virtualized computers that are dynamically provisioned and presented as one or more unified computing resources based on service-level agreements established through negotiation between the service provider and consumers.*
Haag & Cummings, 2008	*Cloud computing as a technology model, with the ability to provide all the web-based application in a paper use and on demand resource pooling model.*
Armbrust, Fox, Griffith, Joseph, Katz, Konwinski, Lee, Patterson, Rabkin, Stoica & Zaharia, 2009	*Cloud Computing refers to both the applications delivered as services over the Internet and the hardware and systems software in the data centers that provide those services. The services themselves have long been referred to as Software as a Service (SaaS), the datacenter hardware and software is what we will call a Cloud.*
Jun& Mei, 2011	*Definition of cloud computing is that cloud computing distributes computing tasks into a large number of resources pools of computer constitute, making different application system according to the requirements to acquire computing power, storage space and all kinds of software service. Special cloud computing refers to the manufacturers through distributed computing and virtualization technique building data center or the super computer, to provide data storage, analysis and scientific computing etc. services by free or on-demand renting methods to technical developers or enterprise customers.*
Marston et al., 2011	*It is an information technology service model where computing services (both hardware and software) are delivered on-demand to customers over a network in a self-service fashion, independent of device and location. The resources required to provide the requisite quality-of- service levels are shared, dynamically scalable, rapidly provisioned, virtualized and released with minimal service provider interaction. Users pay for the service as an operating expense without incurring any significant initial capital expenditure, with the cloud services employing a metering system that divides the computing resource in appropriate blocks.*
NIST definition (Mell & Grance, 2011)	*Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction.*

Mohsen Attaran, 2017	*The term 'cloud' has been used to refer to platforms for distributed computing- a cluster of servers, network, software, interface, etc. which are required for the user to execute a particular task. 'Computing' refers to the delivery of this cluster as a service to the user where the user can use it as and when required.*
W.Kim, 2019	*Cloud computing represents a convergence of two major trends in information technology. One is related with the IT efficiency in which the power of modern computers is utilized more efficiently through highly scalable hardware and software resources. Second one is business agility, whereby IT can be used as a competitive tool through rapid deployment, parallel batch processing, use of compute-intensive business analytics and mobile interactive applications that respond in real time to user requirements.*

1.4.1 Cloud Computing Characteristics

Cloud computing is composed of essential characteristics described as follows;

- **On-demand self-service:** Cloud computing can automatically provide information processing capabilities when it is needed, such as server time and network storage, automatically without the need for human interaction with each service provider (Mell & Grance, 2011). The cloud is accessible in a pay-as-you-go model; clients can pay for just what they utilize (Bhoir & Principal, 2014).
- **Measured service:** Cloud often appears as a single point of access for all consumers' computing needs. Cloud systems control and optimize resource utilization by leveraging an appropriate level of abstraction capability automatically (e.g. type of services such as storage, processing and active user accounts). Use of resources can be controlled, monitored and reported to both parties that are using cloud system transparently (Mell & Grance, 2011).
- **Rapid elasticity:** Cloud computing provides users the ability of selecting IT resources according to their changing business needs. Software features and other resources can be added or removed on demand automatically or quickly depending on triggers or parameters (Zimara, 2013). The capabilities available to the consumer for provisioning are usually non-limited and can be allocated at quantity at any time (Mell & Grance, 2011).
- **Broad network access:** Cloud computing capabilities are available to the users in all different networks and access mechanism (e.g. smartphones, tablets, laptops and

workstations) which provide versatility for users so that they can focus their principal tasks even if at out of their workplace (Mell & Grance, 2011).

- **Resource pooling:** Cloud computing capabilities are pooled to serve multiple users by using multi-tenant model in which different type of physical and virtual resources assigned and reassigned on the need of used demand (Mell & Grance, 2011).

1.4.2 Stakeholders in Cloud Computing

The main stakeholders are providers and consumers in cloud computing. Consumers have possibility to use, own, maintain and upgrade the system and providers deal with the sale, installation, licensing, consulting and maintenance of the cloud technology requested. Besides the traditional stakeholders, there are also enablers due to the unique nature of the delivery model for the service (Marston et al., 2011).

- **Consumers;** are the subscribers in a cloud computing environment. They purchase the use of system from provider which belongs to operational expenses. The corporate users of cloud computing play a role to ensure that cloud computing ends up delivering on its promise of revolutionizing corporate computing, by establishing relationships with industry groups, national and international regulators.
- **Providers;** are the operators of cloud computing systems. They have the responsibility of delivering service to third parties, then performing maintenance and upgrading system if needed according to customer needs. Generally, cloud computing provider companies have large datacenter and software infrastructure.
- **Enablers;** are the organizations that will sell products and services that facilitate the delivery, adoption and use of cloud computing. They construct the infrastructure for a hybrid system in which some services are transferred to the cloud, while the rest of it is maintained in-house. In addition, enablers include specialized software firms that offer monitoring software and platform migration software.

1.4.3 Cloud Computing Service Models

Computing is a service-oriented architecture (Gold, Mohan, Knight & Munro, 2004; El-Gayar & Deokar, 2013; Erol, Sauser & Boardman, 2014) which can be divided mainly in three models (Software as a Service, Platform as a Service and Infrastructure as a Service), providing different advantages according to the business needs (Leukel et al., 2011; Heisterberg & Verma, 2014). However, there are also other three different models which emerge according

to business needs during the years (Storage as a Service, Desktop as a Service, Function as a Service). In addition, there are on-premises cloud infrastructure which is located on-site at the customer's physical business location to support cloud services or activities (Ranjith & Jeyakumar & Kumar, 2016).

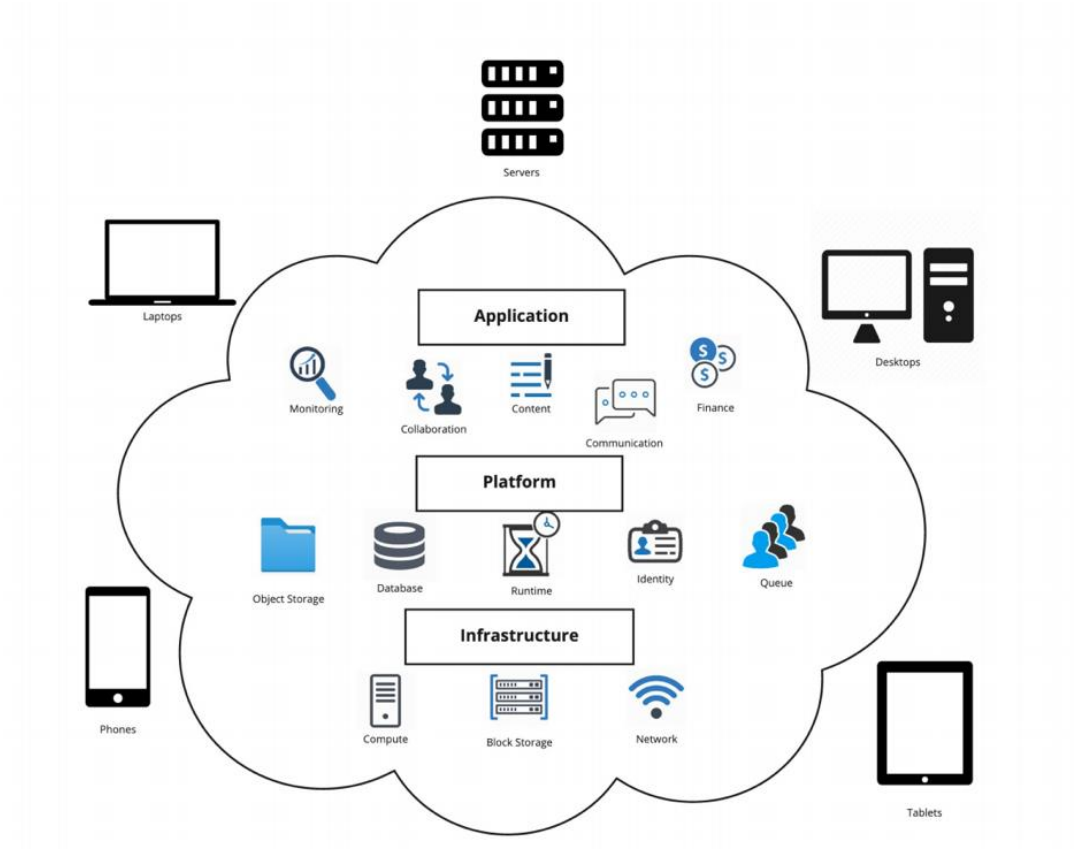


Figure 20: Cloud Computing Service Models (Attaran, 2017)

***Software as a Service (SaaS)*:** It is a software delivery model that offers on-demand access to applications (Garg & Buyya, 2012). Cloud providers install and operate application software in the cloud and application is accessible through either in a client interface, such as a web browser or a program interface. The cloud users do not manage the cloud infrastructure and platform on which the application is running but have control over the deployed applications and possible configuration settings for the application-hosting environment (Mell & Grance, 2011). This can be an attractive and low-cost solution to acquire demanding software capabilities without the need of applying and maintaining traditional software and hardware (McPherson, 2010). SaaS model offers mobility as an advantage in which applications and information could be accessed over the Internet in any place and at any time and it generally use a pay-per-use model (Karvela, Panagiota, Kopanaki, Evangelia, Geogopoulos & Nikolaos, 2015). The SaaS model has become very popular in recent years due to the benefits it offers such as high adoption, low initial costs and seamless integration to all types of businesses.

Moreover, SaaS provides rapid, effective and efficient access innovative supply chain solutions which is suited B2B integration/collaboration is required (Vemula & Zsifkovits, 2016). An example of SaaS is Google Apps (e-mail, calendar, documents), Intuit-QuickBooks, Salesforce for CRM (which is also divided into several categories such as Sales Cloud, Service Cloud, Data Cloud, Collaboration Cloud and Custom Cloud) (Toka et al., 2013) and Intacct.com for ERP use.

Infrastructure as a Service (IaaS): It is a platform which provides general purpose of supporting services including infrastructure services such as database, storage capacity, networking and other computing resources. The user has control over operating systems and deployed applications. This model is referred to as utility computing (Attaran, 2017). In other words, the user buys these resources as a fully outsourced service instead of buying servers, software and network equipment (Conway, 2011). IaaS model offers scalable resources that are necessary to unexpected change of demand. IaaS is a pay-per-use model and the customer could control operating systems, storage and network, but could not affect cloud infrastructure. IaaS is better to implement where the demand is volatile (Karvela et al., 2015). Example of the IaaS providers are Amazon Web Services (AWS), Rackspace Open Cloud, IBM SmartCloud Enterprise, CenturyLink and Rackspace (Attaran, 2017).

***Platform as a Service (PaaS)*:** In PaaS, cloud providers host a typical computer environment, such as the operating system, database and programming language execution environment where users develop and deploy applications (Sujay, 2011). Consumers do not manage or control the underlying cloud infrastructure (e.g. network, servers, operating systems or storage) but have control over the deployed applications and possible configuration settings for the application-hosting environment (Mell & Grance, 2011). Users can rent virtualized servers for running existing hardware or developing new ones without the cost and complexity of buying and managing the related hardware and software (Conway, 2011). The PaaS model offers a higher level of abstraction compared to the IaaS model that provides raw access to virtual or physical infrastructure (Garg & Buyya, 2012). PaaS is generally used by developers to control the deployed applications, but do not manage or control the hardware (servers, storage, network). PaaS uses a pay-per-use model, which relies on provider's infrastructure. It combines the benefits of SaaS with the customized applications that are needed at the exact time or the exact firm (for example PaaS is extremely useful where there is sales information that needs to be analyzed and combined with order forecasts) (Karvela et al., 2015), Google App Engine, Windows Azure Cloud Services and Force.com are the examples of the PaaS platforms.

Windows Azure is a service provided by Microsoft, where someone can build, deploy and manage all the applications on a data center network based on a Microsoft environment.

Storage as a Service (SaaS): In SaaS, users access the data storage interface and the platform charges them according to the amount of storage used. The interface can be used by any of the other three types of service model architecture or accessed directly by users (Attaran, 2017). Amazon's really simple storage example of SaaS.

Desktop as a Service (DaaS): Desktop operating system and applications are delivered safely with remote infrastructure (Attaran, 2017).

Function as a Service (FaaS): The newest trend in cloud service model which called serverless cloud computing. In FaaS, the cloud automatically figures out which server setup that an application requires (Attaran, 2017).

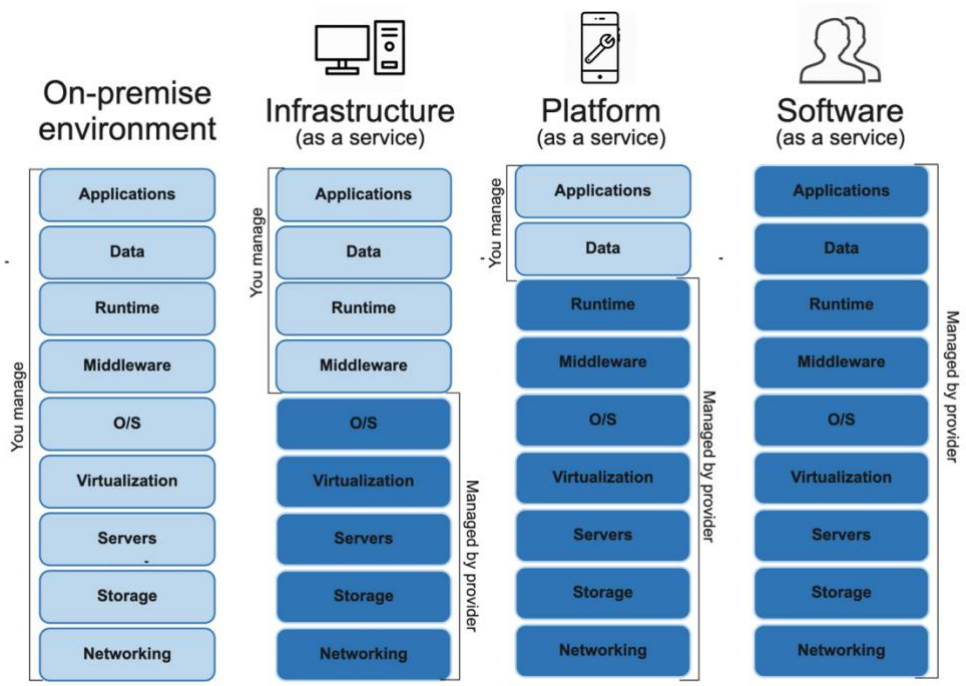


Figure 21: Cloud Computing Service Models (Wely,2011)

The service models are characterized according to customization, cost and slow time to value in Figure 21 from left to right which indicates that the degree of standardization increases, costs decrease and the time to value is faster when moving to the right (Vemula & Zsifkovits, 2016).

1.4.4 Cloud Computing Deployment Models

Cloud computing offers different deployment models, which meet the different IT needs of the firm. Therefore, it can be divided or combined to one of the below deployment models (Heisterberg & Verma, 2014; Goyal, 2010).

Public cloud: It is designed for public use by the general public or a large industry group. It can be managed and operated by a company or multiple partners, and externally located at the cloud provider's premises (Mell & Grance, 2011). Public cloud has an advantage against in-house system which company does not have to concern about building or maintaining systems (Pires & Carmago, 2010). The end user can obtain an inexpensive set-up because the application costs are met by the third-party provider. Furthermore, it is a cost-effective way to deploy, especially for small or medium sized businesses, because customers only pay for the CPU, storage, or bandwidth they consume and use resources quickly to start the business ideas (Zhou, Zhu, Lin & Bentley, 2012). Google Apps is a prominent example of a public cloud that is used by leading public cloud providers that include Amazon Web Services (AWS) for many organizations of all sizes, Microsoft Azure, IBM SoftLayer and Google Compute Engine. (Attaran, 2017).

Private cloud: The cloud infrastructure is provided for private use by a single organization of multiple consumers (e.g. in business units). It may belong to the organization or a third-party or combination of two and may be managed, operated and located within or outside the facility (Mell & Grance, 2011). It is more suitable for firms which have a well-established IT infrastructure and need autonomy since it provides a greater control over business infrastructure (Karvela et al., 2015)

Community cloud: It is designed to share cloud service to the environment which is available to a limited set of organizations or employees have shared concerns such as banks or heads of trading firms in terms of mission, security requirements, policy and compliance considerations. It may belong to one or more organizations in the community, a third-party or a combination of them and also, may be managed and operated in or out of the facility (Mell & Grance, 2011).

Hybrid cloud: It is a combination of two or more different cloud infrastructures (private, public or community) with editing and automation between them. By using these combinations, non-critical information is kept in public cloud and scaled according to demand; on the other hand, mission-critical workloads or sensitive data are kept in private clouds under the control of the organization. The hybrid cloud computing provides users to take advantage of the flexibility of cloud while gaining value from the traditional infrastructure (Mell & Grance, 2011). Network companies can use this infrastructure to exchange information and products using the benefits of public and private cloud computing. This combination is an effective way to test ideas or new business opportunities as well (Karvela et al., 2015).

1.4.5 Cloud Computing Benefits and Risks

1.4.5.1 Cloud Computing Benefits

Major benefits of cloud computing are categorized in two main groups which are business and technology efficiency. Key advantages of adopting cloud technology are explained below in Table 12.

- **Lower cost of entry for business:** It gives opportunity to benefit from computing intensive business analytics for small firms. These computational exercises typically involve large amounts of computing power for relatively short amount of time and cloud computing makes such dynamic provisioning of resources possible (Armbrust et al., 2009). Moreover, cloud computing providers also enable IT services in the countries where the resources for the deployment IT services lack or are not developed (Marston et al., 2011).
- **Converting capital expenses to operating expenses (CapEx to OpEx):** Defining IT expenses as an operational expense which helps to reduce the upfront costs in corporate computing. Therefore, the absence of up-front capital expense allows capital to be redirected to core business investment. Cloud computing provides adaptive infrastructure which can be shared by different end user and each user might use it according to their different business needs. Users are completely separated from each other and the infrastructure provides flexibility that allows more users to instantly balance computing loads while joining the system. As the number of users increases, the demand load for the system becomes more balanced in a stochastic sense even if the economies of scale expand (Marston et al., 2011).
- **Make scaling easier:** Enterprises scale their services more easily by using cloud computing since the computing resources are managed through software. It can be deployed very fast as new requirements arise. In fact, "the goal of cloud computing is to scale resources up or down dynamically through software APIs depending on client load with minimal service provider interaction." (Dubey & Wagle, 2007).
- **Make possible new classes of applications and delivers services that were not possible before:** Cloud computing acts as an enabler to create new applications and services such as mobility interactive applications, parallel batch processing and business analytics. Mobile interactive applications have awareness about location, environment and context which can respond in real time to provide need of users. Batch processing provides an advantage of huge amounts of processing power to analyze

terabytes of data for relatively small periods of time. Business analytics manage the vast amount of computer resources to understand customers, their habits and supply chains (Marston et al., 2011).

- **Improve collaboration:** Cloud computing technology allows dispersed groups to meet virtually and share information so as to improve collaboration. The cloud often appears as a single point of access for all consumers' computing needs (Attaran, 2017).
- **Decrease loss of productivity:** Cloud computing provides business continuity planning by protecting data and systems. The providers of cloud services have advanced strategies to ensure that critical data is backed up and protected in a secure and safe location. Cloud storage gives the ability to conduct business that minimizes downtime and loss of productivity (Attaran, 2017).

Table 12: Benefits of Cloud Computing Technology (Attaran, 2017)

Categories	Efficiency Categories	
	Business efficiency	Technology efficiency
Benefits	-Business continuity -Cost proficient: pay per use, based on resources consumed -Enables full customer self-service Release resources when no longer needed -Predictive cost modeling for a growing organization -Turns capital investment/fixed cost into operating costs/variable costs -Reduced cost – take advantage of economies of scale across users of cloud -Rapid development/improved mobility -Disaster recovery: able to store massive amount of data cheaply -Can be provided by 3rd party (e.g. Amazon) or on in-house network -Leverage on big data analytics and mobile computing -Easy customization -Continuous improvement -Improved collaboration by allowing dispersed groups of people to meet virtually and easily share information	-Reduced system administration overhead; automated provisioning -Increased utilization through sharing of resources -No need for design deployment environment to meet maximum load -Increased reliability and security -More flexibility: acquire resources on demand -Better alignment of IT resources -Elastic Scalability -Ability to mix and match public and private cloud as well as co-located and on-premises physical infrastructure -Built-in disaster recovery capabilities and expertise -Choice and agility -Little to no maintenance -Less environmental impact- fewer data centers worldwide and more efficient operations, less real estate required

Cloud technologies and approaches can create numerous challenges in a way that they would allow for significance and rapid growth. These risks that have been attributed to the implementation of the technology in businesses including platform inconsistency, network vulnerability, data unreliability, business discontinuity, some security gaps and human errors. Table 13 summarizes the major risks and the main ones are explained below in detail.

- **Security and data control*:*** These are the big issues with the implementation of the cloud. Network security, data security and compliance are some of the security concerns in cloud computing. According to the survey, the top three major security problems facing enterprises in the cloud adaptation are legal issues, compliance and loss of control over data (Gonzalez, Miers, Redígolo, Carvalho, Simplicio, Näslundy & Pourzandiy, 2012). Other studies show that top security threats are loss of physical control, trusting vendor's security model, customer inability to respond to audit findings, quality of service guarantees and business discontinuity (Winkler, 2011; Raguram, 2014).
- **Threat of cyberattack:** Since the cloud platform is an open and shared resource, cloud systems and services are subject to malicious attacks from both insiders and outsiders. Therefore, management of side-channel attacks needs to be carefully analyzed and maintained (Attaran, 2017).
- **Adoption of cloud services:** According to study conducted in Taiwan, IT professionals have concerns with regard to the adoption of cloud services. These concerns of IT managers and software engineers are generally compatibility of the cloud with company policies, IT development environment and business needs with the relative advantages of adopting cloud solutions (Angela & Chen, 2012).
- **Cost and time manage the cloud:** These are other challenges for both in implementation step and utilization. In case of certain customizations, the cost of the cloud service will increase rapidly. For the time concern, large files can take long time to upload causing frustration and inconvenience (Attaran, 2017).

Table 13: Risks of Cloud Computing Technology (Attaran, 2017)

Categories	Efficiency Categories	
	Business efficiency	Technology efficiency
Risks	• Business discontinuity • Performance inconsistence due to sharing of resources with various other companies • Transparency: not getting a whole lot of insight into your network • Fewer options • Lock-in	• Network vulnerability • Platform inconsistency • Availability of features • Lack of control and options for scalability • Reliability and security • Security gaps & human errors

1.4.6 Key Players in Cloud Computing Industry

Lists of some key players currently in the cloud computing area and their main contributions in terms of products, services or innovations are given in Table 14. It includes established players such as IBM, Google, Microsoft and also small but promising startups such as the Irish cloud computing provider Vordel.

Table 14: Key Players in Cloud Computing and Contributions (Marston et al., 2011)

IBM	It provides cloud computing services called Blue Cloud, which offers companies access to tools that allow them to manage large scale applications and database via IBM's Cloud. The company offers consulting services to help companies integrate their infrastructure into the cloud. Recent partnership with Google to work with several universities in order to promote new software development methods which will help students and researchers address the challenges of the cloud applications of the future.
Google	Google's App Engine offers client organizations access to Google's cloud-based platform that provide tools to build and host web applications. Its premier SaaS offering is Google Apps, a set of online office productivity tools including e-mail, calendaring, word processing and a simple Web site creation tool. Its recent acquisition of Postini, which offers a set of e-mail and Web security services, makes it a credible player in the area of electronic corporate communications.
Microsoft	The company has slated Windows Azure, the "cloud operating system" PaaS to appear in early 2010. Additionally, they are creating the Azure Services Platform to run on the Windows Azure operating systems giving client organizations access to several online Microsoft services like Live, .Net, SQL, SharePoint, and Microsoft's Dynamic CRM.

AT&T	It provides two cloud services: Synaptic Hosting, through which client companies will be able to store Windows serve, Linux client server applications and web applications on AT&T's cloud; and Synaptic Storage, enabling clients to store their data on AT&T's cloud.
SalesForce.com	SalesForce.com is the first well-known and successful SaaS application. Riding on its coattails, the company has now introduced Force.com, an integrated set of tools and application services that independent software vendors and corporate IT departments can use to build any business application and run it on the same infrastructure that delivers the Salesforce CRM applications. More than 100,000 business applications already run on the Force.com platform. It includes the company's Apex programming language.
Vordel	Offers several hardware and software products that help enterprises deploy could-based applications. It provides the governance, performance, interoperability and security framework to enable enterprises to exploit cloud computing.
Amazon	Offers its Amazon Web Services, a suite of several services which include the Elastic Compute Cloud (EC2), for computing capacity, and the Simple Storage Service (S3), for on-demand storage capacity. In addition to these core offerings, Amazon offers the SimpleDB (a database Web service), the CloudFront (a Web service for content delivery) and the Simple Queue Service (a hosted service for storing messages as they travel between nodes). Like IBM and Google, Amazon is working with universities, by giving access to their large databases and their engineers teaching classes on web-scale development.
Cisco	A relatively late entrant in the cloud computing space, Cisco is actively working on a set of standards that will allow portability across providers. One crucial aspect of that work is ensuring workload portability from one autonomous system to another, which includes the consistent execution of the workload on the new system

1.5 Cloud Platforms in Supply Chain Management

Cloud computing concept in the management of supply chain is an innovative practice that generates a new field of study (Toka et al., 2013). Cloud computing has created a significant impact in SCM applications, and the adoption of cloud platforms is expected to continuously grow during the years. Schramm, Wright, Seng and Jones (2010) divide the era of SCM in cloud computing into three parts as shown in Table 15.

Table 15: Implementation Process of SCM on Cloud Platforms

Time range	Processes and providers characteristics	User	Examples
2010-2011	-In early cloud SCM needs innovation and continuous improvement. Testing attitude also needed. -Support and administrative processes. These can easily be abstracted and isolated and do not require complex integration.	Companies with highest pressure for operational excellence and through competition, e.g. Consumer Goods, High-Tech	-Capability development/training delivery -Simple analytics
2011-2013	This era captures maturing phase, first providers disappears from the market and other invest to grow and improve service offering. -Higher focus on core and rather complex processes.	Broader industry scope, companies with higher integration needs will start using cloud-based services as part of their operating model	-Pricing optimization -Replenishment planning -Order processing -Transportation load building
2013-2018	-Here consolidation phase starts and major player in each category of SCM defined. -SCM accept well establish models for usage and payment of cloud-based services. -Complex process covered in cloud e.g. requiring collaboration between many entities and tighter integration with other processes and perhaps involving physical capacity constraints.	All industries that applied cloud-based processes	-Collaborative engineering -Warehousing and distribution of physical product -Reverse logistics/returns processing -Fleet management

A cloud supply chain definition is given below:

"A cloud supply chain is two or more parties linked by the provision of cloud services, related information and funds" (Lindner, Galan, Chapman, Clayman, Henriksson & Elmroth, 2010).

"A set of services that provide supply chain management functions to any cloud user in an efficient, scalable, reliable and secure way" (Bhoir & Principal, 2014).

Cloud platforms for SCM provide applications that include e-Procurement, warehouse management systems, shipping management systems, supply chain planning and solutions including business intelligence and analytics (Bhoir & Principal, 2014). In Figure 22, extension of cloud-based manufacturing and its relationship with other supply chain parties are presented.

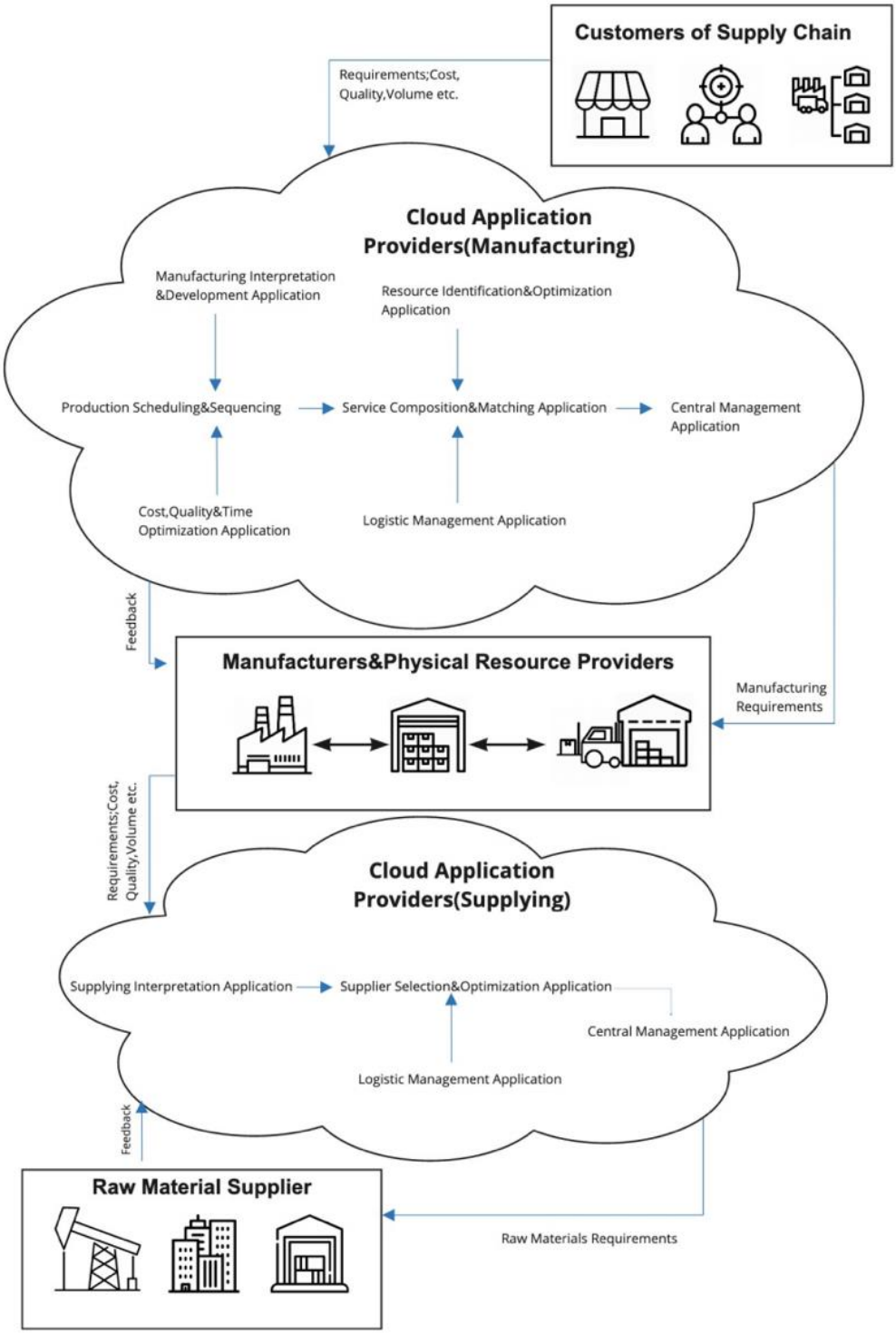


Figure 22: Cloud-based Global SCM (Akbaripour, Houshmand & Valilai, 2015)

There are five groups in Figure 22; supply chain customers, cloud application providers (manufacturing), physical resource providers (manufacturers), cloud application providers (supplying) and raw material suppliers. Interactions between these five groups are considered as a service in cloud-based SCM (Akbaripour et al., 2015).

Customers: The needs of customers can change and cloud-based SCM attempts to respond to a variety of customer necessities. In this model, customers are the subscribers of the cloud services upon purchasing them from cloud application providers (manufacturing). Customers describe the object through presenting its design, schedule, quality, size, the acceptable limit for manufacturing cost, etc. These specifications and other requirements are submitted to cloud application providers (manufacturing) for analyzing and interpretation. Then, customer will receive desired object as a service and pay their costs through automated invoice system.

Cloud application providers (manufacturing): They have the capability to interpret needs of customers into data required for fabrication of the desired objects. They offer some production scenarios including production planning, scheduling and sequencing. The cloud solution providers consider cost and quality at the same time with some production scenarios. In addition, they have the capability to identify resources and optimize their utilization to remain competitive.

Physical resource provider: They are the owner of manufacturing processes, abilities and capacities, and apply them to deliver the entire life cycle of the manufacturing process. They are not limited by location and person; it can be a person or small group in anywhere.

Cloud application providers (supplying): They offer an application for manufacturer-supplier interactions in which supplying functions are delivered to physical resource providers. In addition, manufacturer can reach information about their supplier (lead times, cost, quality, capacity, and capabilities of candidate suppliers) easily via supplying cloud assist which helps to decrease response time.

Raw material supplier: There is no restriction of location for raw material suppliers. They are distributed all over the world but providing shorter lead time, lower cost and higher quality to the customer will get more change to be selected. They collect the raw material data such as type, quality, volume and deliver it according to the needs of manufacturers.

However, before shifting from a traditional supply chain to a cloud supply chain, there are technical requirements for companies to migrate all activities to cloud. Transformation process can be executed by using the cloud lifecycle, which includes multiple steps that allows the process of transformation to be evaluated and improved recurrently (Lindner et al., 2011). All the factors about the changes has to be evaluated in order to assess the implementation of cloud.

Both benefits and challenges which stakeholders have to face while using cloud computing should be answered before moving the cloud supply chain (Schramm et al., 2010).

1.5.1 Cloud Computing in Supply Chain Activities

Cloud computing can be applied in order to facilitate each supply chain process. The applications of cloud technology on the several supply chain activities are forecasting and planning, sourcing and procurement, logistics, service and spare parts management, collaborative design and product development, and are explained below.

- **Forecasting and planning:** Cloud based platforms are designed to help companies in order to improve their service level by collaborating the supply chain network's partners which are retailers, suppliers and distributors (Toka et al., 2013). These cloud-based platforms are available for capturing sales data via internet, performing basic analytics and also executing more accurate statistical demand forecasts for all partners in supply chain (Schramm et al., 2010). This will help to decrease the distortion of information among different stages of supply chain which is called Bullwhip effect (Lee et al., 1997). It gives opportunity to all stakeholders to be aware of real demand volatility they have to cope with.

  As shown in Figure 23, when customers generate demand, distributors send the data to the public cloud making the information available at the same time to the entire supply chain (Pires & Camargo, 2010).

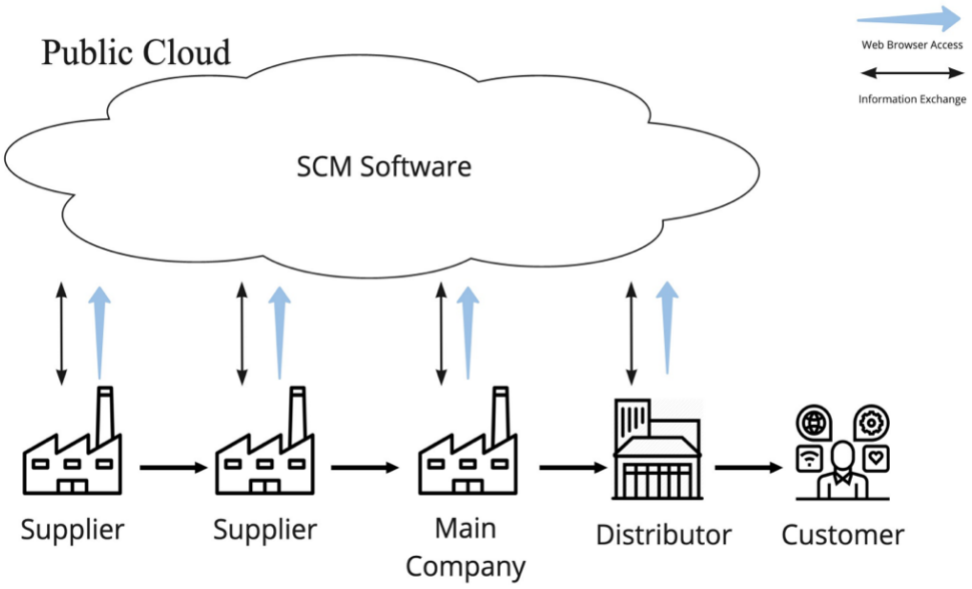


Figure 23: Supply Chain Processes Combining EDI (Pires & Camargo, 2010)

- **Sourcing and procurement:** Sourcing is composed of acquisition, taking receipt and inspection of incoming materials and selection of the appropriate suppliers (Schrödl & Turowski, 2011). Cloud based platforms operate on database that contains multiple data from different suppliers. This provides significant and different benefits for companies that transact with numerous suppliers. Thus, companies are able to select between their suppliers which of them are able to provide appropriate materials according to their specification and time limit. In addition, cloud-based collaboration allows companies and suppliers to develop contracts and improve contact management (Schramm et al., 2010).
- **Logistics:** It includes process of material acquisition, warehousing and transportation process. Cloud computing is also useful for inventor, warehouse and transportation management as it offers tracking operations to multiple supply chain partners. Processes such as global trade compliance, replenishment planning, order processing, and transportation load building, fleet management and transportation route planning can migrate to the cloud supply chain. By the help of cloud computing, inventory can be reduced, and transportation can be managed more efficiently. Especially in the logistic sector, cloud applications seem essential for 3PL companies in terms of preparing itinerary and warehousing management for many different customers in one single system (Toka et al., 2013).
- **Service and spare parts management:** According to Guide, Harrison and Wassenhove (2003), cloud computing gives opportunity to companies to integrate forward logistics with reverse logistics at the same closed-loop supply chain model. Reverse logistics are the last supply chain stage that should be taken into consideration in order to increase profits. Inventory management enhanced by many organizations using barcoding technologies and wireless services. RFID technology can be integrated with the cloud based centralized data management system to deliver the global identification and tracking of any items or goods across the global supply chain management lifecycle (Supriya & Djearamane, 2013). As a result, inventory's route can be visible to all supply chain partners, from the manufacturer to the customer and vice versa. In a single platform, warranty validation, returns processing, spare parts inventory and distribution or technician dispatch can be hosted efficiently (Schramm et al., 2010).

- **Collaborative design and product development:** Collaborative product development includes the use of product design and development techniques across multiple branches of the same organization or between different organizations. All the developments process shared over secure network between different organizations. These processes include specific information, marketing firm, test results and design changes as well as customer feedback (Tiwari & Jain, 2013).

1.5.2 Cloud Computing Benefits in SCM

The replacement of traditional solutions with the cloud computing model has potential for delivering several benefits to involved companies as follows:

- **Cost efficiency:** Since cloud services are offered by external providers (public clouds), they do not require any investment for software or computer power ownership. However, in traditional models, common in-house Enterprise Resource Planning (ERP) systems require other additional ownership. Therefore, in cloud services, capital costs are converted to the operational costs in SCM (Schramm et al, 2010). User companies have to pay an activation fee at first to acquire cloud system and then, they have to pay only the usage fee according to cloud service usage (pay-as-you-go) which is different from traditional electronic document interchange (EDI) and web-based applications which require high upfront technology costs (Toka et al., 2013). Cloud systems decrease the upfront costs of installation of hardware and software and also keeping upgrade costs to minimum (Zhou et al., 2012). Therefore, it significantly reduces maintenance costs of data centers, which is approximately 80% of total IT expenditures. Moreover, cloud computing allows companies to pay for information sharing capability in a similar manner as to how utilities such as water and electricity are paid. This benefit allows companies to add resources during high volume seasons and growth periods and reduce expenditures during downtimes (Gray, 2015).
- **Simplification:** Cloud services provide customers to access through the same platform to the all supply chain functions, which decrease the compatibility problems, provide easy connection and enable the information collaboration between partners in one system (Chen & Mayan, 2011). In this collaborative community, the user can be added anytime and anywhere only having a set of password and surname (Pires & Camargo, 2010) which can be used to share real-time overviews of inventory and sales information resulting in closer integration between channels and more efficient supply chain and customer analytics (Maziliauskaite, 2015).

- **Flexibility:** There is one single platform that can be hosted variety of applications for entire supply chain which gives partner to have access to this platform from their own environment or company regardless the location by using common devices (Zhou et al., 2012). This network opportunity offers more agility to the whole SCM process from demand forecasting to warehouse or transportation management. Furthermore, it reduces the response time of one partner to another's decisions by the help of operating process and application in simple platforms (Schramm et al., 2010). For example, inventory information is updated instantly without users having to wait for central servers to populate information across a supply network (Gray, 2015).
- **Visibility:** It provides connections across multiple supply chain participants instantly. Visibility is an important issue for the third-party logistics companies since it does not only coordinate their operations and manage many different customers but also, allows the customer network to have a transparent view of the entire system (Gillis, 2011). Logistics tracking can be improved by implementing cloud-based system because it provides visibility of inventory and shipment by real time (Toka et al., 2013).
- **Scalability:** By using cloud computing, companies can reach scalable services and payment arrangements. The scalable services give opportunity to reduce the cost structure. Thus, information sharing becomes more cost efficient. The different service offering such as SaaS, PaaS or IaaS can be tailored according to the needs of user companies. Moreover, the payment arrangement such as one-time flat fee, pay-per-use or hybrid approach allows users to scale services with respect to their business strategy goals and competitive priorities (Benlian & Hess, 2011; Iyer & Henderson, 2010; Marston et al., 2011). By the implementation of cloud solutions, system capacities can be controlled more accurately; for example, increasing demand in rush periods. Cloud platforms provide users to adjust their capacity automatically according to their needs and give possibility to scale their computing power depending on demand fluctuations (Zhou et al., 2012).
- **Sustainability:** Cloud-based services, which contribute companies to improve their operational efficiency, usage amount of energy and environmental impact can be considered as a "green" trend (Scott & Watson, 2012). There is substantial improvement in energy efficiency by leveraging the economies of scale which connects large number of organizations to share the same cloud infrastructure (Garg & Buyya, 2012). According to Abood, Murdoch, N'Diaye, Albano, Kofmehl and Tung, ...

Whitney (2010), by using cloud-based platforms, emission of CO_2 per user will decrease since multiple companies can share the same infrastructure. In addition, by the help of visibility advantage of implementation of cloud-based solutions, companies can optimize their inventory routes, and this will reduce emissions that are harmful for the environment (Toka et al., 2013).

- **Resource pooling:** Resources are pooled by the cloud service providers in order to fulfill the consumers demand from multiple consumers. The physical or virtual resources are assigned dynamically by providers to the customers who have no information about the resource location which is assigned to their business (Zhou et al., 2012).

1.5.3 Cloud Computing Risks in SCM

It is necessary to identify and assess the risks of implementation of cloud computing solutions in SCM. Potential risks are explained below:

- **Data security and privacy:** Cloud solutions as software cannot always ensure confidentiality. This will increase the risk of being infiltrated by hacking systems (Zhou et al., 2012). However, data in the cloud should have been accessed only by authorized members, namely trustworthy partners of supply chain, otherwise, policy and organizational risks will appear such as lock-in, loss of governance and social engineering attacks (Haeberlen & Dupré, 2012).
- **Availability:** There is a concern about system crash down which creates problem to the provider company while delivering services. Since the supply chain operations are crucial for company's financial welfare, any delay due to cloud system's malfunction can be considered fatal. User companies have doubts about to have access to cloud services in case of poor internet connection while working in different geographic regions (Zhou et al., 2012).
- **Lack of customization and technical issues:** Cloud computing offers in generally standardized services which could not fit the specific supply chain operations. As an example of manufacturing, which is composed of unique individualized processes depending on each company's products, it can be difficult to be boosted with cloud services because of requisition of higher-level customization (Schrödl & Turowski, 2011). This concern will create lower market response than the traditional solutions (Schramm et al., 2010). Moreover, there is always risk of having technical issues within cloud solutions such as cloud provider malicious insider, management interface

compromise, loss of cryptographic keys and loss of backups (Haeberlen & Dupré, 2012).

- **Outdated Mindset:** Shift from traditional solutions to the cloud-based systems can be seen as a cultural business issue (Zhou et al., 2012). Sharing every piece of information regarding production processes or supply chain networks can create concerns about being liable to lose their competitive advantages. Temporarily, implementation of cloud-based solutions in the whole supply chain network brings significant changes in business model of supply chain management (Schramm et al., 2010). All the partners have to learn how to use new cloud-based systems in order to manage their operations effectively. These kinds of adaptations need period of time, since the transition to a more open way of business strategy needs slow pace to carry out (Toka et al., 2013).

CHAPTER 2: OBJECTIVES AND METHODOLOGY

In this chapter, the objectives of the research and the methodology that is implemented in order to conduct analysis in detail is explained.

2.1 Objectives

This research is conducted as a graduation study at Management Engineering department of Politecnico Di Milano. The research study is about applications of cloud platforms in the supply chain management and prepared for research team of Digital Innovation Observatories of the School of Management, which found in 1999 to raise cultural awareness in all the principle areas of digital innovation.

The main goals of this study are:

- To understand and spread knowledge about cloud platforms in the management of supply chain processes and examine which supply chain functions cloud platforms support.
- To collect and analyze data about cloud-based solutions in supply chain management processes developed and used in various locations in the world, mapping them regarding different parameters and filling out a census;
- To understand in which areas (industries, functions, location, clusters etc.) the cloud platforms are used in SCM;
- To assess the level of adoption of cloud-based solutions
- To identify the impacts of cloud platforms in supply chain functions.

At the end of this paper, cloud platforms in SCM processes will be well examined and understood.

2.2 Research Methodology

Demonstration of methodology illustrates the main steps of this research study (shown in Figure 24).

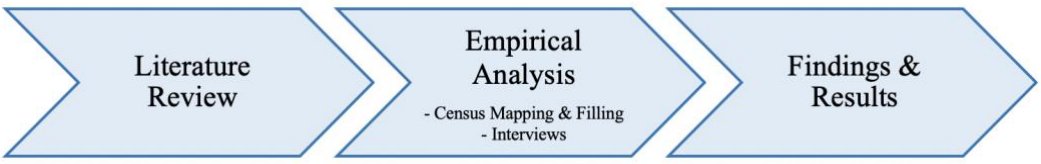


Figure 24: Methodology Phases

2.2.1 Literature Review

In order to have complete knowledge about the research subject and better assess the findings and results, academic literature review is conducted. Top-down approach has been implemented in the literature review part. In the beginning, supply chain and supply chain management are explained in detail with their academic definitions, significance, benefits and criticalities. As new enhancements in technologies of supply chain management has been introduced, new definitions are evolved; therefore, e-supply chain management has been explained after SCM. e-SCM section has been explained in three main categories as e-Supply Chain Execution, e-Supply Chain Collaboration and e-Procurement and e-Document Management. In the next section, definition of cloud computing has been given and deployment models, service models and the impacts of cloud-based solutions have been examined in detail. This part continues with the introduction of cloud computing in SCM and its benefits and criticalities have been explored.

Throughout the literature review, the following resources have been taken as references:

- Academic publications and articles, focusing on the important editors in the field of supply chain management and cloud computing such as "*Supply Chain Management: An International Journal", "International Journal of Production Research", "International Journal of Operations & Productions Management", "Logistic Information Management", "Information Technology & Management", "Cloud Computing" and more.*
- Non-academic publications, such as related company reports.

The materials have been searched through websites (Capterra, Softwareadvice), search engines (Google Scholar, Scopus, Emerald, etc.), bibliographic databases and institutional archives.

2.2.2 Empirical Analysis

Two different approaches have been adopted during the empirical analysis so as to attain the goals of the study.

- **Census mapping and filling:** In this approach, secondary sources have been used to meet the objectives of the research. Census mapping began with the database from the previous census where database was collected from the previous studies of Advanced Supply Chain Planning Lab of 2015/2016 academic year lecture in the department of Management Engineering. However, since the database is outdated, it should be revised and cleaned. Therefore, after putting all data together in one complete database, cleaning of database has been conducted. In this phase, duplicate data were removed.

After data cleaning, census filling has been done by using websites of cloud platform provider companies and internet research (websites such as Capterra and Softwareadvice) to extend the number of cloud platforms in the database and recent information of cloud platforms were collected. In total, 298 cloud platforms were analyzed according to different parameters which are shown in Table 16.

- **Interviews:** Direct interviews have been conducted both companies which provide cloud platforms and companies which use cloud platforms. The main aim of the interviews with provider companies is to better understand the role of the cloud platforms and their functionalities. On the other hand, the objective of the interviews with user companies is to observe the impacts of cloud solutions on their supply chain management processes. It is important to analyze the implementations of cloud platforms in real work environment so as to make conclusions more precisely.

Consequently, both approaches cannot be considered separately since interviews have been used in census filling and in order to conduct interviews, census mapping is completed as a first step.

Figure 25: Relation between Census Mapping & Filling and Direct Interviews

2.2.3 Census Mapping and Filling

Secondary resources are mainly used for census mapping and filling as follows: database from previous census, internet researches, websites of cloud platform providers and interviews. In order to better analyze the cloud platform provider companies, following information have been collected throughout research study:

- General information about cloud platform provider company (number of employees, year of foundation, location of foundation, website link, description);
- Information about customers of cloud platforms (number, locations, business size (small, small medium, medium, large enterprises), names);
- Information about partners of cloud platform provider company (number and names);
- Classification and functionalities of cloud-based solution (clusters in SCM process, sub-clusters in SCM and clusters in e-SCM and sub-clusters in e-SCM);

- Information about main industries that use corresponding cloud platform;
- Pricing models;
- Service models of cloud platforms,
- Extra services offered by provider company;
- Benefits and obstacles about the solution received from user and provider companies.

More than 500 cloud platforms have been determined; however, 298 of them were selected for deep analysis according to the objectives of the study.

Table 16: Census Analysis Structure

Platform	Name
	Description
	Cluster
	Sub-Cluster
	Delivery Model
	Pricing Model
	Main Functionalities
Developer Company	Employee
	Release Data
	Location
	Partners
	Customers
User Company	Business Size
	Location
	Industry

2.2.4 Interviews

In order to understand the functionalities of cloud-based solutions, interviews have been conducted with cloud platform provider companies. In addition, companies that are using these cloud platforms have been interviewed so as to examine the impacts of cloud platforms in SCM. During both interviews, the following steps have been conducted:

Figure 26: Phases of Interviews

2.2.4.1 Definition of selection criteria

The following selection criteria for cloud platform provider and user companies have been applied to understand main benefits, criticalities and implementation obstacles of platforms as well as the main services they are providing for their clients:

- Priority to big companies;
- Priority companies which are located in Italy;
- Priority to companies which were examined in the previous census;
- Priority to companies which have willing to participate and are easily contacted.

Table 17: Interviewed Companies

Company Name	Provider Company	User Company
Kraft-Heinz		x
Beko-Arcelik		x
Prysmian Group		x
Infor	x	
Logiwa	x	
DXC Technology	x	
Relex	x	

2.2.4.2 Definition of questionnaire structure

In order to obtain information in a more structured way, a set of lists of questions have been created separately for user and provider companies.

User Companies

1. General information about company
2. Cloud computing solutions in supply chain projects
3. Identification of risks and benefits of cloud platforms in supply chain projects
4. Further improvements and future projects related with cloud platforms

Provider Companies

1. General information about company
2. Cloud computing solutions in SCM
3. Identification of risks and benefits of cloud platforms in SCM
4. Further improvements of cloud platforms

2.2.4.2.1 General information about company

User Companies

The objective of questionnaire is to gather general information about the company such as number of employees, revenue, industry which company operates in, its business size and its

relationship with other actors. Moreover, information about the participant of interview was obtained in this section such as functional department he/she works in and his/her job title.

Provider Companies

In order to provide general information about provider company, information referred to business size, number of employees, number of customers, geographical location, number of partners, service models of cloud platforms that offered, pricing models and industry served.

2.2.4.2.2 Cloud computing solutions in supply chain projects

User Companies

During the interviews, cloud-based solutions which are used in SCM were analyzed. In particular, which functions in SCM that are supported by cloud platform solutions were examined. The question in this part were investigating the purposes of cloud-based solutions and the activities that these cloud platforms are used for. Moreover, these questions gave an answer to the time period that these platforms are used.

Provider Companies

The aim of this section is to understand main services that the cloud platform provider companies offer and the functions they are supported. In addition, the necessary requirements for the implementation and usage of the platform such as time and any particular hardware or software were investigated.

2.2.4.2.3 Identification of risks and benefits

In this section of the interview, the aim is to examine the benefits and criticalities of the cloud platforms. It is fundamental to understand the benefits of the solution in terms of privacy, speed, costs and security. On the other hand, criticalities were questioned in order to understand the possible implementation and usage barriers. Questions were asked to both provider and user companies so that analysis has become more complete by providing different perspectives.

2.2.4.2.3 Further improvements and future plans

The purpose of this section is to understand the further needs of user companies and future implementations of cloud platforms in their SCM. Furthermore, to have better understanding of perspective of provider companies, improvements in current technologies that they offered and future plans of the company were analyzed.

2.2.4.3 Arrangement of interviews

Before interview arrangement, contact details of related people have been researched through online platforms such as LinkedIn, company websites and database of the university. After having contact information of people in related department, interviews were arranged through e-mail.

2.2.4.4 Conduction of interviews

The interviews lasted for 30 minutes. Interviews were made via Skype call, phone call and e-mail. Throughout the interviews, the questionnaire has guided the flow; however, there was no strict direct guideline and participants freely added other aspects.

2.2.4.5 Case study writing

After interviews have been conducted so as to understand obtained information in a better way, pre-defined structure has been established. In particular, the structure is explained as follows:

- General information;
    - Summary table;
    - Company overview;
- Cloud based solution inside SCM;
- Benefits and criticalities;
- Future improvements.

2.2.5 Findings and Results

After collecting all the empirical information by the implementation of two different research methodologies, census filling and interviews, data have been analyzed in detail in order to make accurate conclusions for attaining the research goals. Detailed analysis from the database of census have been conducted and various results have been obtained. With the interviews, main benefits and obstacles of cloud platforms in SCM have been observed from the point of view of cloud platform user and provider companies.

CHAPTER 3: FINDINGS AND RESULTS

3.1 Census

During the activities of census, more than 500 cloud platforms have been determined and 298 solutions were selected to be examined in detail regarding to the objectives of the work. According to three main aspects, 202 platforms were eliminated. These removed platforms are; platforms that offer services which are not related with SCM, platforms that operate in industries which are not related with manufacturing and operational activities and platforms that operate in SCM but support different activities which is not in the scope of this study. In order to better analyze the cloud platforms, following information have been collected and it is represented in Table 18.

Table 18: Census Analysis Structure

Platform	Name
	Description
	Cluster
	Sub-Cluster
	Delivery Model
	Pricing Model
	Main Functionalities
Developer Company	Employee
	Release Date
	Location
	Partners
	Customers
User Company	Business Size
	Location
	Industry

According to the literature review, observed cloud platforms are categorized into two main groups as SCM process and e-SCM process. Platforms can perform in both management processes and after this classification, from 298 cloud platforms, 284 of them are serving for SCM and 248 platforms are grouped in e-SCM. Within these two main groups, there are different main clusters separately. In SCM, there are Execution, Extended Enterprise and Supply Chain Planning clusters whereas there are 4 main clusters in e-SCM processes; e-Supply Chain Execution, e-Procurement, e-Supply Chain Collaboration and e-Document Management. Regarding the academic literature review, it is concluded that each cluster has key functions, and in order to have complete understanding of all functionalities that platforms

have, these main clusters are divided into sub-clusters (shown in Table 19 and Table 20). In this respect, cloud platforms are categorized according to main clusters and their sub-clusters as well. Furthermore, analysis of geographical distribution for both user and provider companies, Italian market analysis, business sizes of user companies, deployment models of platforms, pricing models of platforms and industries that platforms performed in are conducted throughout the research.

Table 19: Supply Chain Management Processes

Cluster Type	**Supply Chain Processes**		
Cluster	**Supply Chain Planning**	**Extended Enterprise**	**Execution**
Sub-cluster	Production Planning	Supplier Relationship Management	Production
	Inventory Planning	Customer Relationship Management	Logistics
	Transportation Planning	Product Lifecycle Management	Maintenance
	Demand Planning	Others	Quality
	Others		Others

Table 20: e-Supply Chain Management Processes

Cluster Type	**e-Supply Chain Management Processes**			
Cluster	**e- SC Execution**	**e-Procurement**	**e-SC Collaboration**	**e-Document Management**
Sub-cluster	Pre-sales Support	Need analysis	Monitoring & Control	Record Management
	Order Issuing	e-Sourcing	Planning Activities	
	Delivery	Contract Management	Communication & Marketing	
	e-Invoicing	Catalog management	New Product Development	
	After-sales Support	Others	Others	
	Others			

3.1.1 General Analysis

The analysis is conducted including 298 cloud platforms, without categorizing them as SCM and e-SCM.

- **Geographical distribution of cloud platform provider companies**

According to the analysis, it is shown that America is the main provider of cloud-based solutions with 73%. There is no provider located in Middle East and there is only one provider in Africa (shown in Figure 27).

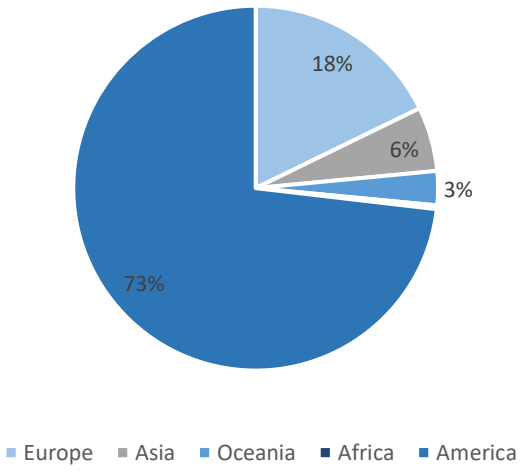


Figure 27: Geographical Distribution of Cloud Platform Providers

- **Geographical distribution of cloud platform user companies**

The number of missing values is 9 (3%) and after excluding them from the analysis, 289 platform are remained. 33% of companies which are using cloud platforms have worldwide presence. Platform user companies are mostly located in America (90%). Europe (63%) is the second destination where cloud platforms serve in. Besides, Asia, Middle East, Oceania and Africa are the locations which cloud platform users are less in number compared to other destinations (44%, 40%, 37%, 37% respectively).

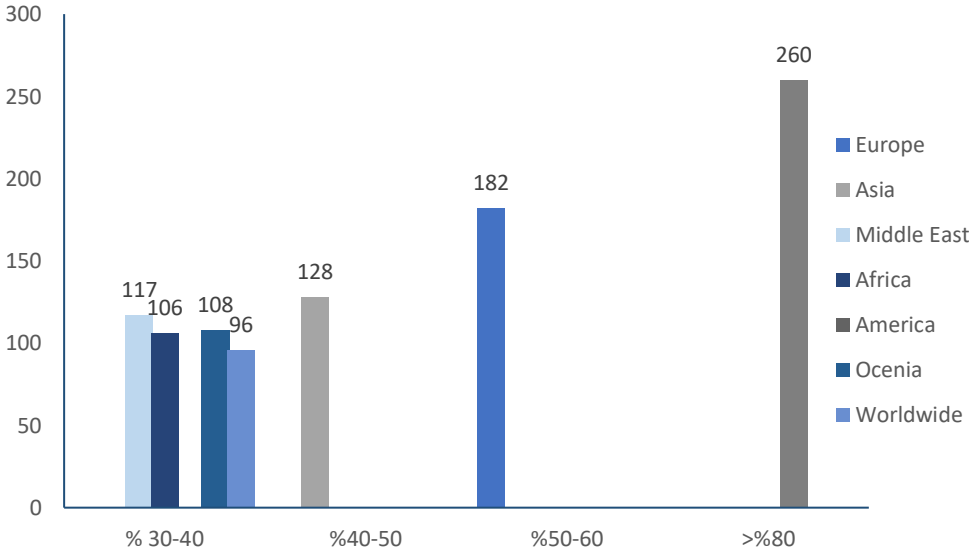


Figure 28: Geographical Distribution of Cloud Platform Users

- **Italian market analysis for user and developer companies**

In order to see the position of Italian market in Europe, the detailed analysis focused on Italian cloud platform provider and user companies is conducted. According to the analysis, there are 53 platforms are developed in European countries. Among them 13% (7) are released by Italian firms such as Zucchetti, iUngo, TesiSquare, Axioma, CIEItalia, Mainsim, Relex. In Table 22, these provider companies and their customers in Italian market can be seen. To illustrate, Infinity CRM provided by Zucchetti allows customer to analyze their clients and business needs in an easy and accurate way. In addition, this platform gives opportunity to examine all the activities related with their clients and establish strong customer relationship by enabling the use of platform from anywhere and anytime according to their needs. Infinity CRM is used by big players in Italian market such as Pirelli, Toyota, Bialetti, Eataly, Kneipp and so on.

Table 21: Cloud Platforms Developed by Italian Companies and User Companies

Provider Company	Platform Name	User Company
Zucchetti	Infinity CRM	Toyota, Pirelli, Morellato, Bialetti, Poltrona Frau, Port Mobility, Eataly, Alnatura, Kneipp, Pompea
iUngo	iUngo	Amer SpA, Arkimat, Caprari Group, Aermec, Bertelli SRL, Bonfiglioli Riduttori, Calzedonia, ABS Acciai, Camozzi Group, Datalogic
Tesisquare	Tesisquare	Costa, Fater, Bayer, Sorgenia, Gruppo Sogegross, Comau, Samsung, Manital, United Colors of Benetton, Permasteelisa Group, Pirelli, Flexilog, Epson
Axioma	Axioma ERP Cloud	Dayco, Ellena, FAAC, Modecor, Parigi, Polieco Group, Ravasi, Rinaldi, Sambeplast, Sireg, SMI, Technovaa, WAM Group, BLM Group
CIEItalia	IPS Cloud	MAN Truck
Mainsim	Mainsim	Pirelli, Roche, Axa, Campari and Barilla, Engie, Duferco, Contarina, Saint-Gobain, Forte Village
Relex	Relex	Douglas, Auchan, Coop

- **Business size analysis**

Business size analysis is conducted in order to understand the distribution of the user companies and cloud platforms are classified in more than one category in business size. The number of missing values in this analysis are 32 (11%); therefore, 266 platforms are used to analyze distribution of business size. As a result, user companies are categorized as small enterprise (79, 30%), medium enterprise (240, 90%), SME (164, 62%), large enterprise (162, 61%). In addition, platforms that are used by all enterprises (33,12%) also presented in Figure 29. As a consequence, medium enterprise is the leading category. In parallel, the number of SME and large enterprises is significantly high compared to small enterprises.

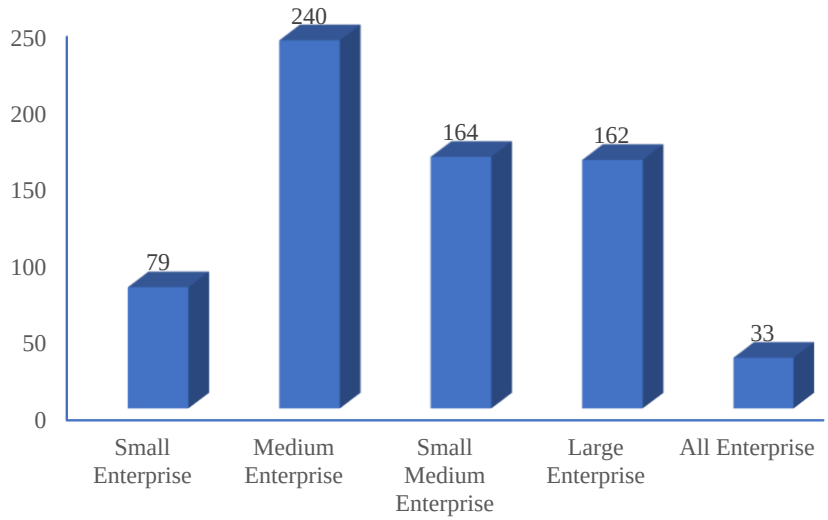


Figure 29: Distribution of Business Size of Cloud Platform Users

- **Geographical distribution of user companies according to business sizes**

Considering the analysis of business size and geographical distribution of user companies, the sequence of business size categories is accordingly as follows (in descending order): Medium enterprise, SME, large enterprise, small enterprise, all enterprise in all locations (shown in Figure 30). Furthermore, it can be observed that the amount of medium enterprises (212) is significantly high in America due to the high number of companies using cloud platforms in that locations which is shown in Figure 28.

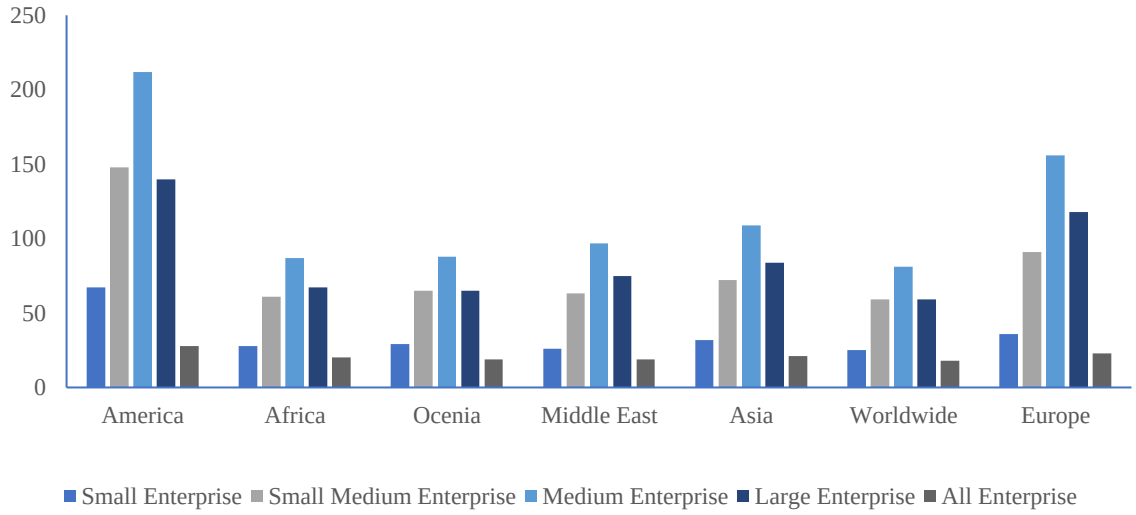


Figure 30: Distribution of Business Size of User Companies among Different Locations

- **Distribution of service models**

After analyzing service models, it is categorized as six different groups as SaaS, PaaS, IaaS, On-premise, Mobile and Web-based. One platform can have different service model options. SaaS solutions (100%) are offered in all platforms since cloud-based solutions have accessibility through client interface either web or program. Web-based service models are substantially implemented in cloud-based solutions (99%) compared to mobile (44%) and on-premise (33%). According to the analysis, PaaS (2%) and IaaS (1%) are less demanded in SCM and e-SCM processes.

Table 22: Distribution of Service Models

	Number of Platform	Percentage
SaaS	298	100%
PaaS	6	2%
IaaS	4	1%
On-premise	98	33%
Mobile	131	44%
Web-based	294	99%

Cloud-based solutions are offered in various combinations of service models. Representation of different combinations with the example of cloud platforms names are given in Table 24. For example, Pronto Xi ERP offers all service models. There are other platforms such as Infinity CRM and Gainsight which offer SaaS model, but they have different interface accessibility according to business needs of clients (Web-based, on-premise or mobile).

Table 23: Cloud Platform Examples

Platform Name	SaaS	PaaS	IaaS	Web based	On premise	Mobile
Infinity CRM	x			x	x	x
IFS Cloud	x		x	x	x	x
S2K Enterprise	x	x		x	x	x
Pronto Xi ERP	x	x	x	x	x	x
Moga4	x			x	x	
Gainsight	x			x		

- **Distribution of pricing models**

Pricing models are divided into two groups as pay per time and pay per time/user. Number of missing values are 158 (53%) in pricing model data. After excluding missing values, 140 platforms (47%) are used to analyzed for pricing model. According to result, 41% of platforms offer pay per time pricing model and 59% offer pay per time/user model. It can be concluded that pay per time/user is slightly more preferred than pay per time pricing model (shown in Figure 32).

Table 24: Examples of Cloud platforms with Pricing Models

Price/time	Price/time/user
Contractworks	Iptor ERP
FlexRFP	Infor CloudSuite
IQMS ERP	Leadcommerce
ERP-ONE	Sourceit
IFS Cloud Solution	NeoGrid
JDA	Datacor Chempex
Kinaxis	PLM 360
ShippersEdge TMS	Promena
UltraShipTMS	PTC PLM Cloud
Aim Vision	Tradogram
Brightpearl	Zoro CRM

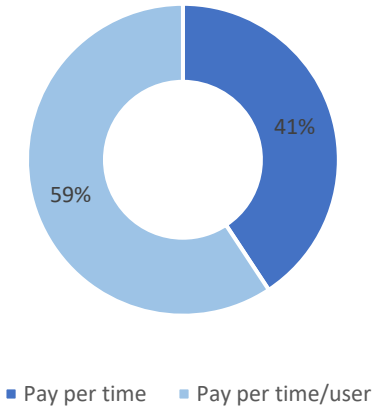


Figure 31: Pricing Models Distribution

- **Distribution of number of employees working in provider companies**

The number of missing values is 31 (10%) and analysis is conducted with remaining 267 platforms. Number of employees of cloud platform provider companies are categorized into different ranges. It is observed that the number of employees is mainly in the range of 11-50 (33%), 51-200 (22%) and 201-500 (14%). It can be concluded that cloud platform provider companies are small and medium enterprises.

Table 25: Number of Employees Working in Cloud Platform Provider Companies

Employee Number	Percentage
1-11	2%
11-50	33%
51-200	22%
201-500	14%
501-1000	4%
1001-2000	7%
2001-5000	9%
5001-10000	1%
10001-20000	5%
10000+	1%
100000+	1%

- **Distribution of number of partners of cloud platform provider companies**

There are 121(41%) missing values. After excluding them from the analysis, 177 platforms are remained. According to this, it is found that 49% of companies have partnerships within the range of 11-50 partners, and 27% of the companies have partners within the range of 1-10 which is shown in Figure 33. As a result, it can be concluded that more than 75% of cloud platform providers have partnerships between 1 to 50 partners. In the analysis of

partnership, the salient technology companies are Oracle, SAP, Avalara, IBM, Salesforce.com, Microsoft, Aptean, Amazon web services, Infor, Quickbook, Shopify, Sage.

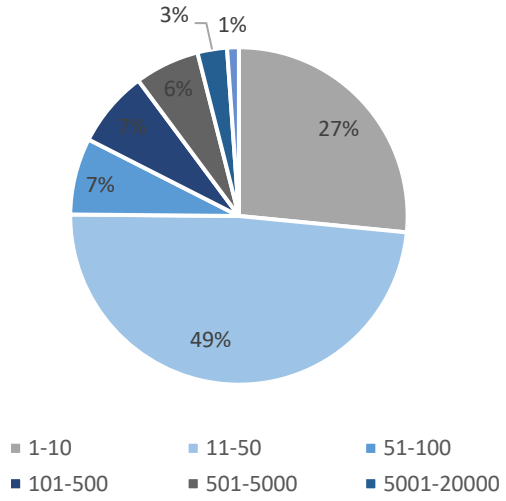


Figure 32: Distribution of Number of Partners

3.1.2 Analysis of Cloud Platforms in SCM

Considering SCM process cluster, after removing the platforms that are performing only in e-SCM, there are 284 platforms remained. These platforms are analyzed as regards to three main clusters, sub-clusters, main functionalities and industry distribution. The platforms that are serving for more than one cluster is called multi cluster.

3.1.2.1 Cluster Analysis

According to cluster analysis, it is found that 120 (42%) platforms served for only in Supply Chain Planning such as BlueLink, Lead Commerce, Delmia Quintiq, Arkieva; 186 (65%) only in Execution for example, Dispatch MAX, Blujay, Logiwa WMS, Deltek Costpoint; and 145 (51%) only in Extended Enterprise such as Procuware, Zoro CRM, Coupa, QuickBase. For multi cluster categorization, there are four group of platforms serving for different clusters together which are Supply Chain Planning & Execution, Extended Enterprise & Execution, Supply Chain Planning & Extended Enterprise and all three clusters. According to the analysis, 48 platforms serve for all three clusters. Total number of platforms that serve as multi cluster is 119 and all other combinations are given in Figure 34. From the results, it can be observed that Execution is the leading cluster in cloud-based solutions in SCM, following that Extended Enterprise and Supply Chain Planning.

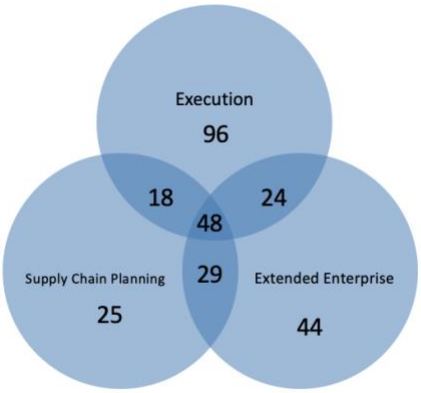


Figure 33: Number of Platforms in Different Clusters

To illustrate cloud platform which belong both Supply Chain Planning and Execution clusters, Relex can be given as an example. Relex is a software that gives possibility to optimize forecasting according to pricing, policy, space allocation and promotional activities in order to maximize revenue. Moreover, considering Execution, it provides solution to improve workforce efficiency and reduce costs for ensuring accuracy of the orders and deliveries.

- **Cluster analysis according to different locations**

In order to observe distribution of clusters among different locations, further analysis is done which is shown in Figure 35. According to analysis, it is observed that Execution is the leading cluster in all locations; the cluster is followed by Extended Enterprise and then Supply Chain Planning. Moreover, since the number of cloud platforms in America is higher than other locations, America has great presence in Figure 35.

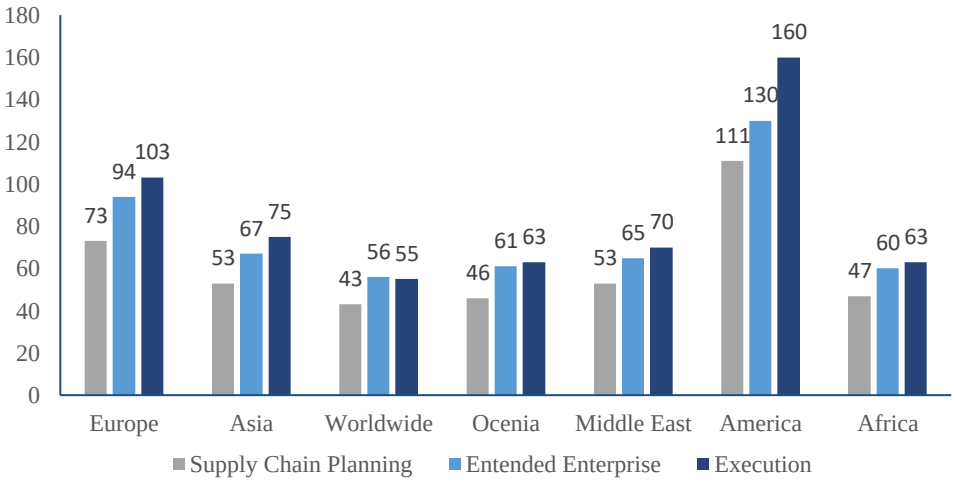


Figure 34: Distribution of Clusters among Different Locations

3.1.2.2 Sub-cluster Analysis

In order to have better understanding of various functionalities in clusters, sub-cluster analysis is conducted. Examples of some cloud platforms according to their sub-clusters are given Table 27.

Table 26: Examples of Cloud Platforms according to Clusters and Sub-clusters

Cluster	Sub-cluster	Cloud Platform Name		
Supply Chain Planning	Demand Planning	NetSuite ERP	Kinaxis	Epicor ERP
	Distribution Planning	Tesisquare	iUngo	ERP One
	Production Planning	JobBoss	Royal4	Halo
	Inventory Planning	JDA	Relex	JustFood ERP
Execution	Production	Simio	Opus Capita	SOLIDIFY
	Logistic	Synapse	Rio	Descartes
	Maintenance	Direct Line	iMaint	MEX
	Quality	eOCM-XD	HQMS	MyeasyISO
Extended Enterprise	SRM	Iptor ERP	Promena	Tradogram
	CRM	DRC ERP	Xledger	Insightly CRM
	PLM	Bluecherry	Aptean Apprise	Quality Data Assurance

- **Supply Chain Planning:** SC Planning includes 120 platforms. It is composed of five different sub-clusters; production planning (50, 42%), inventory planning (27, 23%), transportation planning (60, 50%), demand planning (70, 58%) and others which includes mainly materials requirement planning (38, 32%). As a result, cloud-based solutions in SC planning are used in mainly demand planning (58%) such as NetSuite ERP, Epicor ERP, Kinaxis, Logility. In addition, transportation planning (50%) is the other significant sub-cluster and iUngo, ERP One, OpenPro, TesiSquare are some examples of cloud-based solutions which are used in this sub-cluster. Besides, a considerable number of platforms perform in production planning (42%) such as JobBoss, Royal4, Halo, Avercast. There are 13 (11%) platforms which belong to all sub-clusters; for instance, Rapid Response, Settle Point Cloud, Real Time Value Network, NeoGrid.

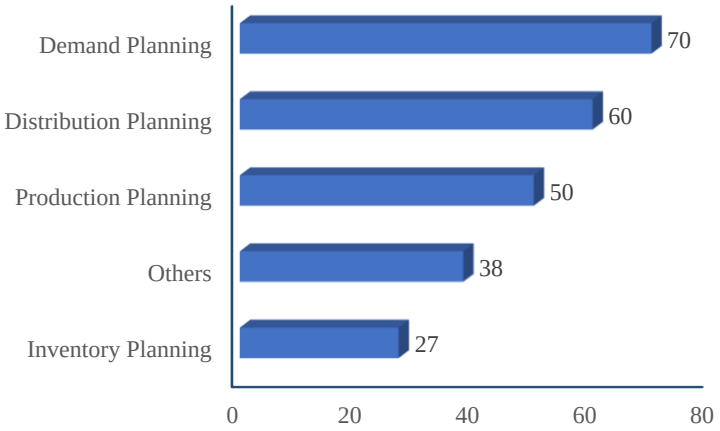


Figure 35: Number of Platforms in Supply Chain Planning

- **Extended Enterprise:** Extended enterprise includes 145 platforms. It is composed of three different sub-clusters; product life cycle management (11, 8%), CRM (74, 51%) and SRM (90, 62%). It can be concluded that cloud platforms in Extended Enterprise cluster are mainly used for CRM and SRM which is shown in Figure X. According to analysis, it is found that Iptor ERP, Promena, Tradogram, E2Open can be used in SRM sub-cluster. For CRM sub-cluster, Freshdesk, Xledger, Insightly CRM, DRC ERP can be implemented as a solution. Considering product lifecycle management, some cloud solution examples are Arena, BlueCherry Suite and Aptean Aprise ERP.

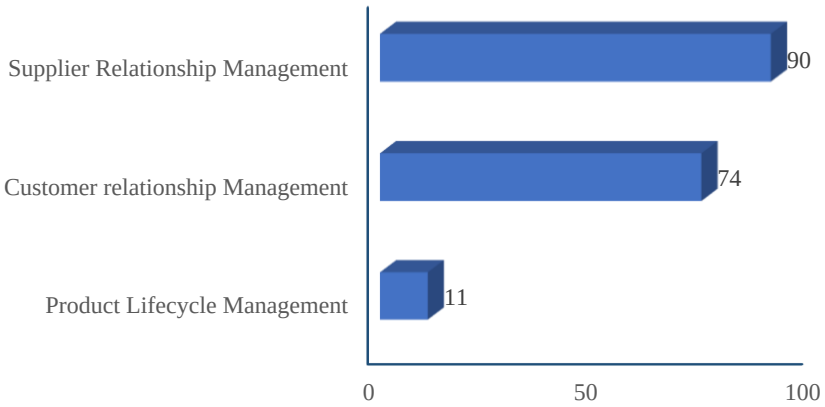


Figure 36: Number of Platforms in Extended Enterprise

- **Execution:** Execution includes 186 platforms. It is composed of five different sub-clusters; logistics (117, 63%), quality (54, 29%), maintenance (46, 25%), production (38, 20%). As a consequence, cloud platforms are substantially performed in transportation and logistics sub-cluster (63%). Therefore, the number of platforms in this sub-cluster is two times more than each sub-cluster as presented in Figure 38. To

illustrate cloud platforms in Production sub-cluster, Simio, Cormsquare, Solidify and Opus Capita can be given. Regarding transportation and logistics, Apptricity WMS, Sage Intacct, Relex and Synapse are shown as examples. For quality sub-cluster, some examples are Q-pulse QMS, HQMS, eOCM-XD and QIT QMS. For maintenance, Deside, Gemini, OpenPro and 4Site platforms can be used.

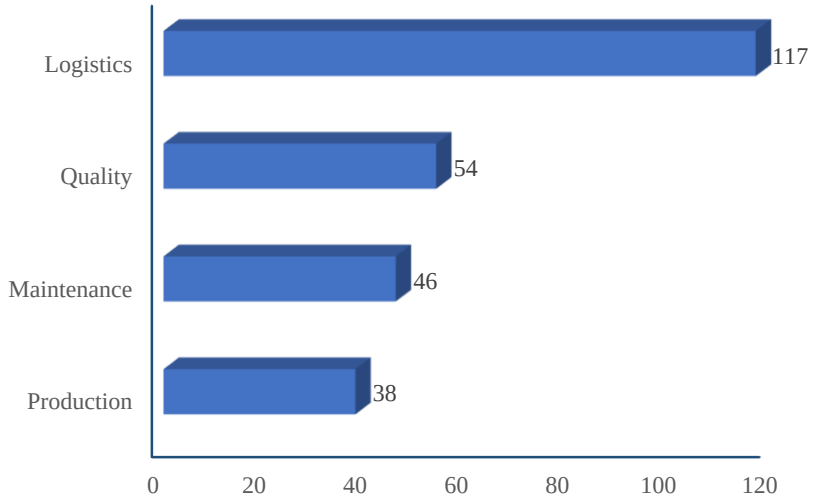


Figure 37: Number of Platforms in Execution

3.1.2.3 Main Functionality Analysis

In order to have better understanding how the cloud platforms are serving in each cluster, 32 functionalities are analyzed. Since each cluster performs in various roles in SCM, they have different main features and cloud platform can perform more than one functionality. In order to present main functionalities of each sub-cluster precisely, only most related features are selected for the analysis below.

- **Supply Chain Planning:** There are 120 platforms serving for this cluster. Main functionalities are divided as production scheduling and planning (53, 44%), transport management (45, 38%), planning and control (112, 93%), order management (78, 65%), financial analysis (65, 54%), stock management (76, 63%), inventory management (85, 71%), warehouse management (74,62%) and reporting and analytics (95, 79%).

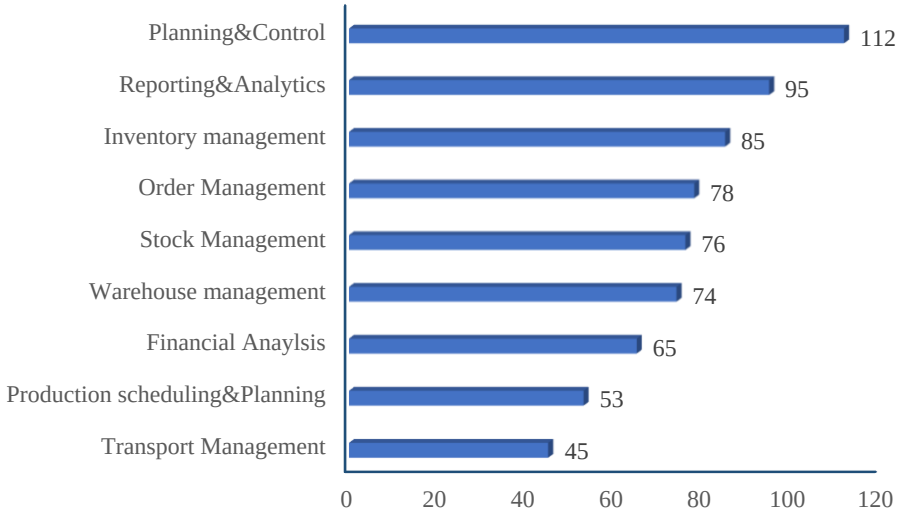


Figure 38: Main application of Supply Chain Planning Cluster

According to results, almost all of the platforms have planning and control function (93%) and reporting and analytics function is used by 79% of the platforms. In SC Planning cluster, transportation planning are main sub-clusters in Figure 36 therefore, inventory, order, stock and warehouse management applications have significant presence in Figure 39.

Table 27: Examples of Cloud Platforms with their Main Functionalities

Main Functionalities	Moga4	iUngo	GCS A2000	Abas ERP	AX4	Aptean WMS	JDA
Transport Management		x	x		x	x	x
Production Scheduling & Planning	x			x			
Financial Analysis	x		x	x			x
Warehouse management	x		x	x		x	x
Stock Management	x		x			x	x
Order Management	x	x		x			x
Inventory management	x		x	x			x
Reporting &Analytics	x	x	x	x			
Planning & Control	x	x	x	x	x	x	x

As an example, Moga4 is one of the cloud platforms belonging to SC Planning cluster which provide companies to solutions regarding resource planning and management in order to meet their operational, development and business needs. This platform gives opportunity to rationalize stock, track all the entry and verify their position in an easy and efficient way. Mago4 and its functionalities mainly support planning and control in

order to optimize efficiency of organization processes. Other examples of SC Planning cluster are tabulated in Table 28.

- **Extended Enterprise:** There are 145 platforms serving for this cluster. Main functionalities are divided as reporting and analytics (34, 77%), SRM (31, 70%), supplier management (28, 64%), sourcing (26, 59%), contract management (26, 59%), spend analysis (21, 48%), purchasing (21, 48%), RFx (18, 41%), CRM (12, 27%), financial analysis (7, 16%), sales force analysis (5, 11%) and project management (5, 11%).

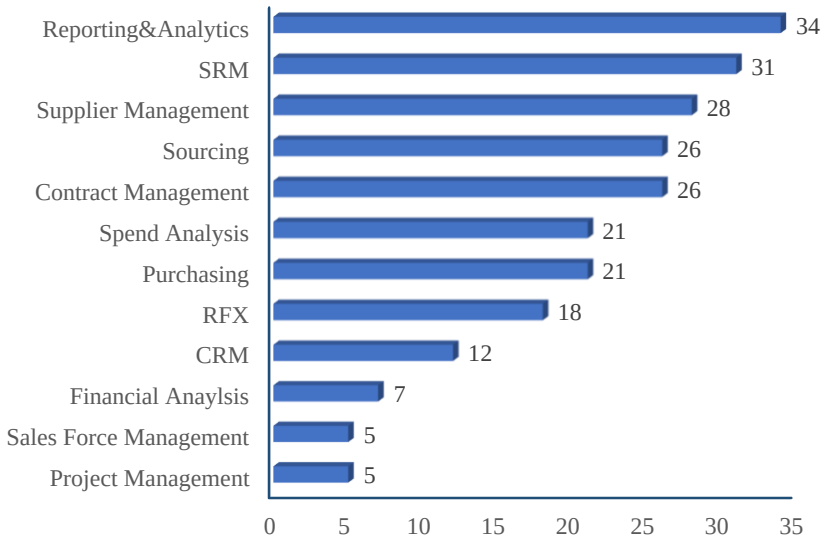


Figure 39: Main Functionalities of Extended Enterprise Cluster

From the results, it can be realized that SRM, sourcing, contract management are the key functionalities of Extended Enterprise cluster. Result of main functionality analysis justifies the high number of platforms in SRM and CRM sub-clusters.

Table 28: Examples of Cloud Platforms with their main Functionalities

Main Functionalities	Procureware	Insightly	Vroozi	Procurify	Xledger
Project Management		x			x
Sales Force Management		x			x
Financial Analysis			x	x	x
CRM		x			
RFx	x		x		
Purchasing			x	x	x
Spend Analysis			x	x	x
Contract Management	x		x		
Sourcing	x			x	x
Supplier Management	x		x	x	

SRM	x		x	x	
Reporting & Analytics		x	x	x	x

For instance, Procureware is an e-Procurement, which provide solution mainly for supplier management, sourcing and contract management, belonging in SRM sub-cluster within Extended Enterprise. This platform allows customers to standardize supplier qualification by reducing costs, ensure visibility of key suppliers and support risk management and procurement decision. Besides, some examples of Extended Enterprise cloud-based solutions are represented in Table 29.

- **Execution:** There are 186 platforms serving for this cluster. Main functionalities are divided as production scheduling and planning (7, 6%), transport management (47, 41%), planning and control (23, 20%), order management (24, 21%), financial analysis (10, 9%), stock management (26, 23%), inventory management (32, 28%), warehouse management (31, 27%), reporting and analytics (39, 34%), maintenance (26, 23%), quality management (17, 15%), work definition (13, 11%).

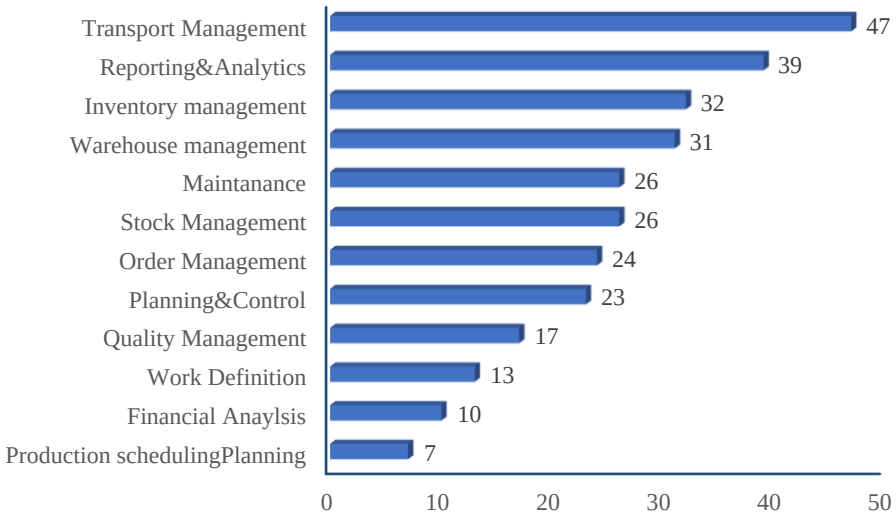


Figure 40: Main Functionalities of Execution Cluster

From the results, it can be concluded that transportation, inventory and warehouse management are the main functions that serve for Execution cluster since the number of platforms in transportation and logistics sub-cluster is high. In parallel, substantial number of platforms in maintenance and quality management functionalities are observed and shown in Figure 41.

Table 29: Examples of Cloud Platforms with their Main Functionalities

Main Functionalities	OpenPro	bcFood ERP	Simio	Magaya	Apptricity	IQMS ERP
Production Scheduling & Planning	x		x			x
Financial Analysis	x					
Work Definition			x			x
Quality Management		x				x
Planning & Control			x			
Order Management	x					
Stock Management	x	x		x	x	x
Maintenance	x					
Warehouse management	x	x		x	x	x
Inventory management	x	x		x	x	x
Reporting & Analytics	x					x
Transport Management	x	x		x		

For example, OpenPro is a cloud platform in Execution cluster which accelerates operation work flows by improving data reliability and offers visibility of services to better and faster decision making for customers, suppliers and partners. Functionalities of this platform support distribution management, inventory control management, document management, accounts and BOM. Besides, other examples of cloud platforms in Execution cluster are given in Table 30.

3.1.2.4 Industry Distribution

The missing values are 4 (1%) in this analysis which is conducted according to remaining 280 platforms. For 280 platforms, industries which implement cloud platforms in SCM are analyzed. There are 13 different categories in industry analysis and cloud platforms can serve for more than one industry. There are some industries (business services, architecture, non-profit) that are categorized as Others (30%) since cloud platforms relatively less in these industries. According to analysis, the companies operating in manufacturing (73%), logistics (68%), food and beverage (51%) and healthcare (47%) are the main users of cloud-based supply chain solutions. On the contrary, fashion (17%), aerospace and defense (13%) and chemicals (13%) industries are the less preferred ones to use cloud solutions in their supply chain management. Apart from these, other industries are used cloud-based solution in the range of 21%-45% which is shown in Figure 42.

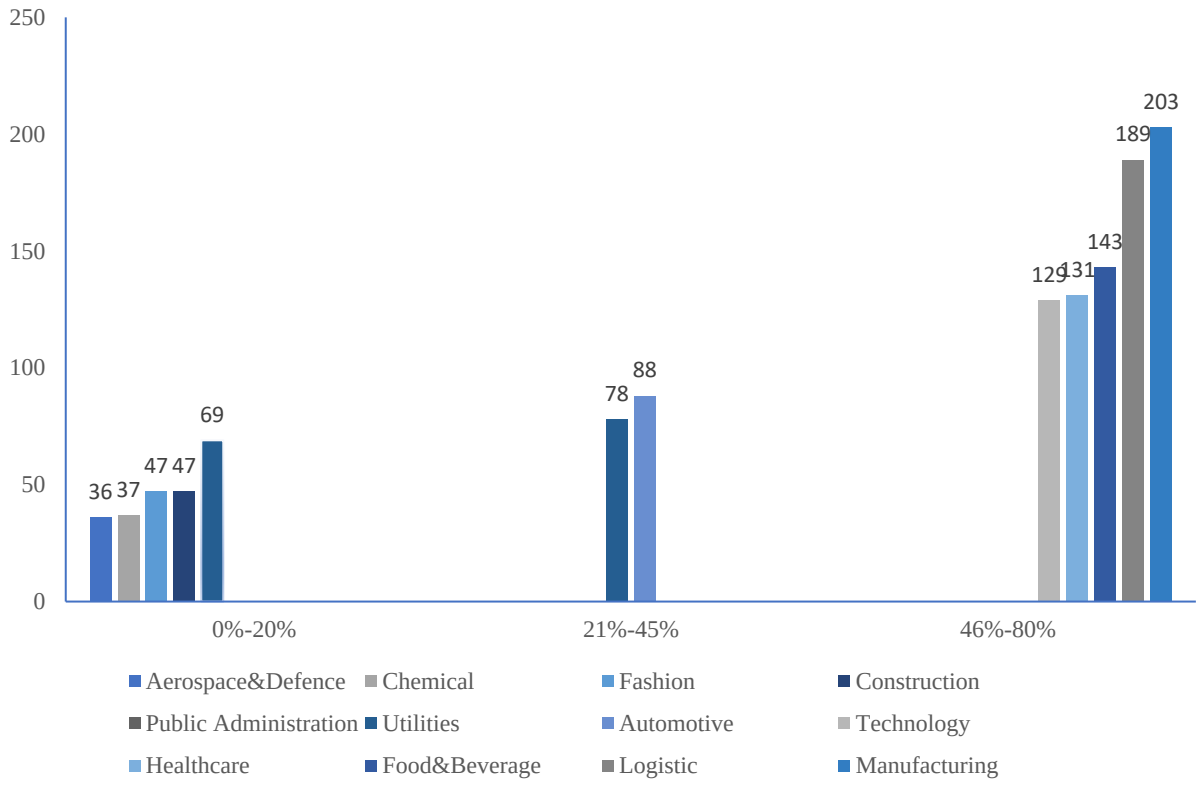


Figure 41: Industry Distribution

- **Cluster analysis according to industries**

As a result of the detailed analysis of industries in sub-cluster, it is found that supply chain planning and execution clusters have same trend in the distribution of industries (shown in Table 31). Thus, food and beverage, logistics, manufacturing and healthcare are the leading industries in these clusters. However, in extended enterprise cluster, technology (61%) and healthcare (55%) have substantial presence with the manufacturing (76%) and logistics (65%) industries.

Table 30: Cluster Analysis According to Industries

Industries	SC planning	Extended Enterprise	Execution
Food & Beverage	62%	52%	52%
Chemical	9%	10%	14%
Other	30%	37%	17%
Logistics	63%	65%	71%
Public Administration	17%	28%	22%
Automotive	36%	33%	32%
Fashion	22%	19%	19%
Manufacturing	76%	76%	75%
Construction	20%	20%	16%
Healthcare	48%	55%	47%

Utilities	23%	32%	27%
Aerospace & Defense	11%	12%	16%
Technology	47%	61%	41%

3.1.2.5 Business Size Analysis

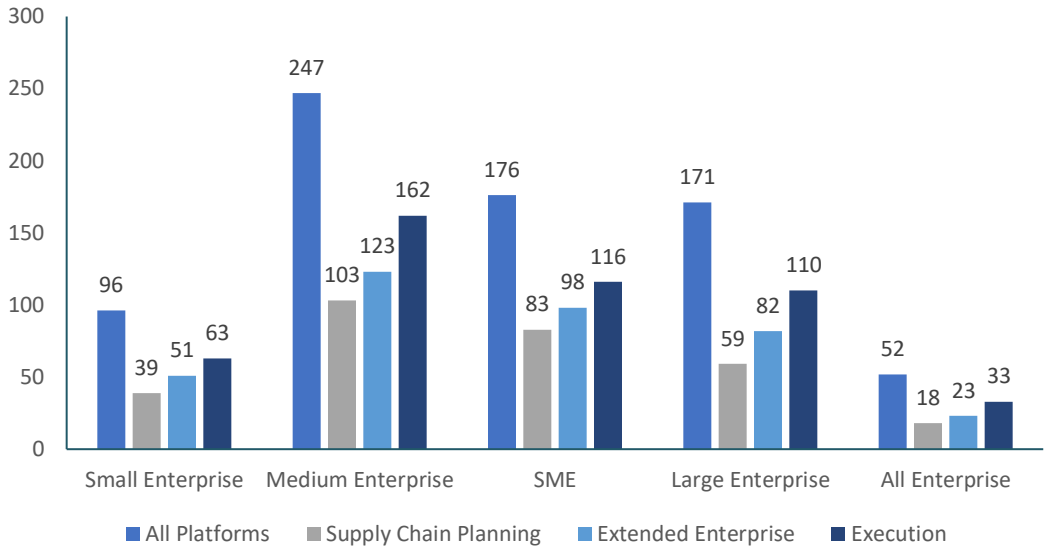


Figure 42: Distribution of Business Size According to Users

Business size analysis is conducted in order to understand distribution of the users and cloud platforms are classified in more than one category in business sizes. The number of missing values in this analysis are 30 (11%); therefore, 254 platforms are used to analyze distribution of business size. As a result, user companies are categorized as small enterprise (96, 38%), medium enterprise (247, 97%), SME (176, 69%), large enterprise (171, 67%). In addition, platforms that are used by all enterprises (51, 20%) also presented in Figure 43. Regarding the relation between business size and clusters, it is realized that number of platforms in execution cluster (162) is substantially higher than other clusters in all categories.

3.1.3 Analysis of Cloud Platforms in e-SCM

3.1.3.1 Cluster Analysis

Considering e-SCM category, after excluding the platforms that are performing only in SCM, there are 248 platforms are remained for further analysis. These platforms are examined according to four main clusters, sub-clusters, main functionalities and industry distribution. The platforms that are serving for more than one cluster is called multi-cluster.

Table 31: Cluster Analysis of e-SCM

Name of the Cluster	Number of Platforms
e-Supply Chain Execution	91
e-Procurement	9
e-Supply Chain Collaboration	18
e-Document Management	12
Multi Cluster (applied for 4 clusters)	9
Multi Cluster (applied for 2&3 clusters)	109

According to analysis of results, it is realized that 91 (37%) of cloud platforms serve only in e-Supply Chain Execution such as Moga4, Freshdesk, Epicor ERP; 9 (4%) in e-Procurement such as Procureware, Sourceit, Conga; 18 (7%) in e-Supply Chain Collaboration such as Vorex, Rootstock, Omono and 12 (5%) in e-Document Management such as Gimmal, Dokmee, Oxcyon. For multi cluster analysis, it is found that 9 (4%) platforms serve for all four clusters and 109 (44%) platforms for 2 or 3 clusters together (shown in Table 32).

The total number of platforms performing in e-Supply Chain Execution, e-Procurement, e-Supply Chain Collaboration and e-Document Management including the multi clusters are 189 (76%), 101 (41%), 98 (40%) and 40 (16%) respectively and shown in Table 33.

Table 32: Cluster Analysis of e-SCM (Total Number)

Name of the Cluster	Number of Platforms
e-Supply Chain Execution	189
e-Procurement	101
e-Supply Chain Collaboration	98
e-Document Management	40

To give an example of cloud platform serving for both e-SC Collaboration and e-SC Execution, Softeon can be examined. Softeon is a software which has capability to optimize distribution, inventory management and planning. In addition, it provides companies to have possibility to decrease gap between their suppliers and business processes.

- **Cluster analysis according to different locations**

  In order to observe distribution of clusters among different locations, further analysis is done which is shown in Figure 44. According to analysis, it is observed that e-SC Execution is the leading cluster in all locations; the cluster is followed by e-Procurement, e-SC Collaboration and then e-Document Management. Moreover, since the number of cloud platforms in America is higher than other locations, America has great presence in Figure 44.

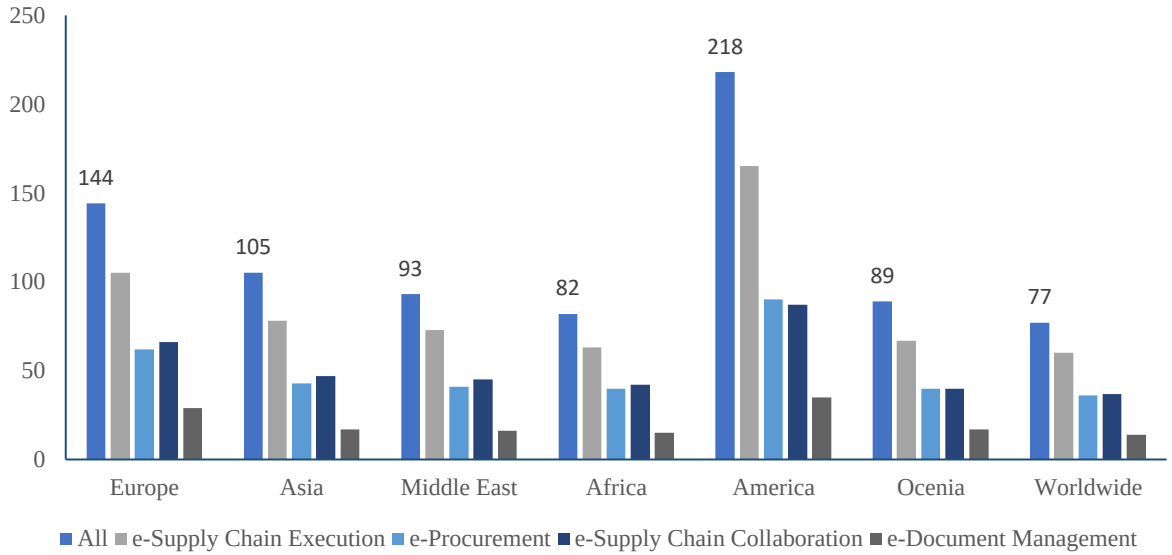


Figure 43: Distribution of Clusters According to Locations

3.1.3.2 Sub-cluster Analysis

In order to analyze clusters in detail, sub-cluster analysis is done and to illustrate examples of cloud-based solutions in each sub-cluster, names of the platforms are given in Table 34.

Table 33: Examples of Cloud Platforms with Corresponding Clusters and Sub-clusters

Cluster	Sub-cluster	Cloud Platform Names		
e-Supply Chain Execution	Pre-sales Support	Delmia Quintiq	Aptean Apprise ERP	Brightpearl
	Order Issuing	Keyedin	GMPro	Add One
	Delivery	AX4	Apptricity	Logiwa
	e-Invoicing	Dispactch MAX	Epicor Prophet 21	Ecomdash
	After-sales Support	Five9	Coupa	Freshdesk
e-Procurement	e-Sourcing	Procureware	FlexRFP	SourceIT
	Need Analysis	4site	QLM Sourcing	Sourcedog
	Contract Management	Contractworks	Datacor Chempex	SAP ERP
	Catalog Management	Pronto Xi ERP	Process Pro	Dear
e-Supply Chain Collaboration	Monitoring & Control	Zoro CRM	Demand Foresight	QuickBase
	Planning Activities	Kinaxis	Atlas Planning Suite	Netlog
	Communication & Marketing	Gainsight	IFS Cloud Solution	Accolent ERP
	New Product Development	iUngo	PTC PLM Cloud	GCS A2000

e-Document Management	Record Management	Eloquent System	One System ERP	View Centre

As it is shown in the Table 20, main e-SCM clusters are divided into sub-clusters. One cluster can function in multiple sub-clusters.

- **e-Supply Chain Execution:** The total number of platforms performing in e-Supply Chain Execution is 189 and it is divided into five main sub-clusters as pre-sales support (49, 26%), order issuing (69, 37%), delivery (157, 83%), e-invoicing (86, 46%) and after-sales support (29, 15%) shown in Figure 45. According to results, in transactional cycle, delivery is the leading sub-cluster and the number of platforms in e-invoicing sub -cluster is substantially high which is followed by order issuing. For instance, AX4, Apptricity, Logiwa and Maxoptra can be given as examples of cloud solutions in delivery sub-cluster. Besides, Dispactch MAX, Epicor Prophet 21**,** Ecomdash, Moga4 are some examples which are used in e-Invoicing and Keyedin, GMPro, Add One, Bluecherry Suite are some platforms in order issuing sub-cluster. Examples for other sub-cluster in e-Supply Chain Execution is tabulated in Table 34.

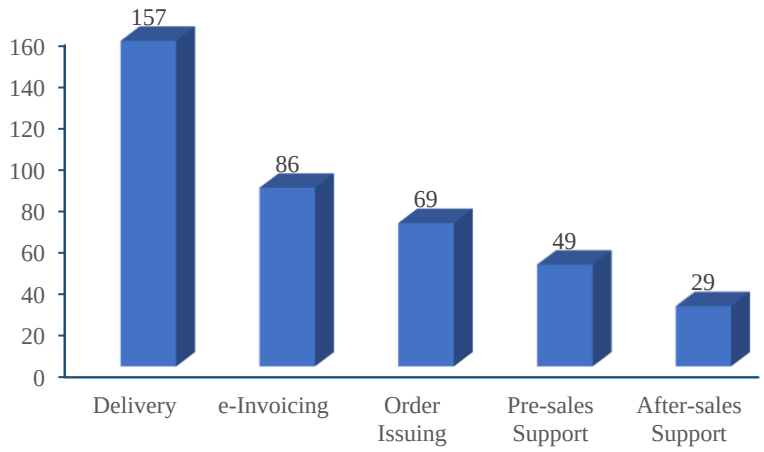


Figure 44: Number of Platforms in Sub-clusters of e-Supply Chain Execution

- **e-Procurement:** The total number of the platforms is 101 and it is categorized into four main groups as need analysis (78, 77%), e-sourcing (79, 78%), contract management (58, 57%) and e-catalog management (39, 39%) shown in Figure 46. It can be concluded that e-sourcing and need analysis are the two main sub-clusters, and there are significant number of platforms in contract management. To illustrate, in e-sourcing, there are some examples of cloud platforms such as Procuware, FlexRFP,

SourceIt, Relex; in need analysis, 4site, QLM Sourcing, Source Dogg, Orderbot; in contract management Contractworks, Datacor, Chempex, SAP-ERP.

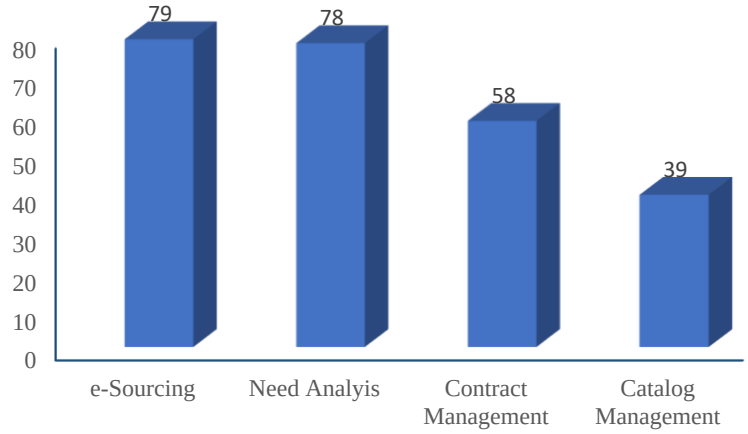


Figure 45: Number of Platforms in Sub-clusters of e-Procurement

- **e-Supply Chain Collaboration:** The total number of the platforms is 98 and it is classified into four main groups as new product development (3, 3%), communication and marketing (7, 7%), planning activities (47, 48%) and monitoring and control (90, 92%) shown in Figure 47. From the results, monitoring and control is the leading sub-cluster in e-Supply Chain Collaboration and the number of platforms in planning activities sub-cluster is significant. For example, Zoro CRM, demand foresight, QuickBase, Visibility are the cloud platforms in monitoring and control sub-cluster. In planning and control sub-cluster, Kinaxis, Netlog, Anaplan, Atlas planning suite can be given as examples of cloud platforms.

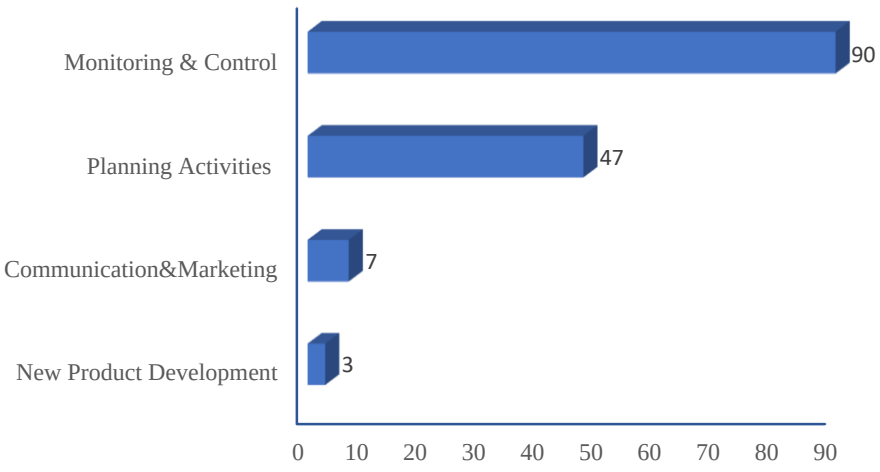


Figure 46: Number of Platforms in Sub-clusters of e-Supply Chain Collaboration

- **e-Document Management:** It has only one sub-cluster which is record management. Since there are 40 cloud platforms in this cluster, all of them are placed in record

management. Some examples of platforms are Eloquent System, One System ERP, View Centre and FireHold.

3.1.3.3 Main Functionality Analysis

- **e-Supply Chain Execution:** There are 189 platforms serving for this cluster and main functionalities are divided as pre-sales support (49, 26%), e-Invoicing (86, 46%), after-sales support (29, 15%), transport management (91, 48%), order management (106, 56%), financial analysis (72, 38%), stock management (100, 53%), inventory management (110, 58%), warehouse management (108, 57%) and reporting (120, 63%).

  Reporting and analytics is one of the major features of e-Supply Chain Execution cluster with 63%. Besides, inventory, warehouse, order, stock and transport management are in the range of 48%-58% as the number of platforms in e-Supply Chain Execution is significantly high in delivery sub-cluster compared to others.

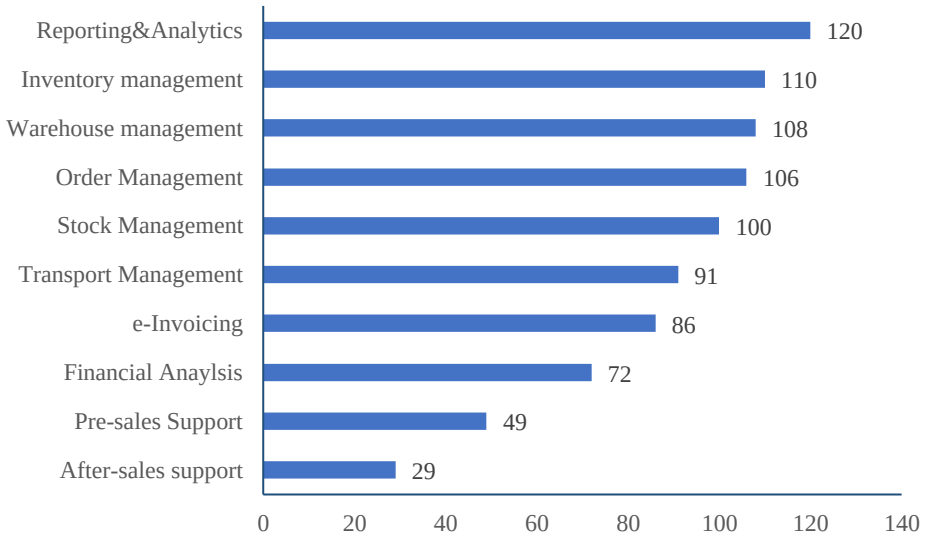


Figure 47: Distribution of Main Functionalities of e-Supply Chain Execution

Table 34: Examples of Cloud Platforms with their main Functionalities

Main Functionalities	Abas ERP	Biz Automation	Blue Link ERP	Oracle Cloud SCM	IQMS ERP	JDA
After-sales support		x				
Pre-sales Support		x	x		x	
Financial Analysis	x	x	x		x	x
e-Invoicing		x	x	x	x	x
Transport Management			x			
Stock Management		x	x	x	x	x

Order Management	x	x	x	x	x	
Warehouse management	x	x	x	x	x	x
Inventory management	x	x	x	x	x	x
Reporting & Analytics	x	x	x	x	x	

For example, Abas ERP is a software for production companies which develop and control features related with the delivery, storage, e-invoicing and sales support. This platform gives opportunity to synchronize, combine and configure different modules according to business needs of customers.

- **e-Procurement:** There are 101 platforms serving for this cluster and main functionalities can be classified as reporting and analytics (81, 80%), sourcing (67, 66%), supplier management (67, 66%), SRM (66, 65%), purchasing (61, 60%), order management (59, 58%), planning and control (55, 54%), spend analysis (47, 47%), contract management (47, 47%), RFx (46, 46%) and demand planning (37, 37%) shown in Figure 49.

  As regards to results, it can be concluded that reporting and analytics tool is one of the key features of e-Procurement with 80%. On the other hand, since e-Procurement depends on the suppliers and their relationship with companies, supplier management and SRM are significant functions for this cluster. As one of the main sub-clusters of the e-Procurement is sourcing, number of applications related with this cluster (Sourcing, RFx and purchasing) is high.

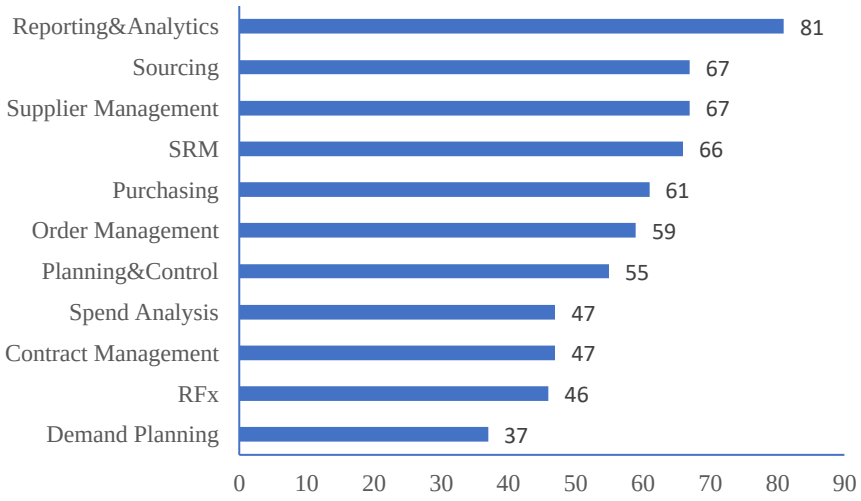


Figure 48: Distribution of Main Functionalities of e-Procurement

For instance, SourceDogg is a cloud-based solution in e-Procurement cluster which connects organizations with their suppliers. This platform offers supplier management tools in order to control organizations' spending, provide solutions for savings and create effective supplier relationships.

Table 35: Examples of cloud platforms with their main functionalities

Main Functionalities	Sourcedogg	Relex	SourceIT	QLM Sourcing	4Site	Procure ware
Demand Planning		x				
RFx	x		x	x		x
Contract Management	x					
Spend Analysis			x			
Planning & Control		x				
Order Management						
Purchasing	x		x	x	x	
SRM	x			x		x
Supplier Management	x			x	x	x
Sourcing	x		x		x	x
Reporting&Analytics	x	x	x			

- **e-Supply Chain Collaboration:** There are 98 platforms serving for this cluster and main functionalities can be classified as supplier management (76, 78%), SRM (75, 77%), inventory management (53, 54%), order management (51, 52%), warehouse management (48, 49%), planning activities (47, 48%), stock management (47, 48%), demand planning (36, 37%) and CRM (29, 30%) shown in Figure 50.

  Regarding the analysis of chart, supplier management and SRM have substantial presence (78% and 77% respectively) because in e-Supply Chain Collaboration, user companies mainly collaborate with suppliers and thus, the key features are management of suppliers and their relationship with them. In parallel, since the sub-cluster of planning activities such as VMI, CRP and CPFR is high in number (shown in Figure 50), the number of platforms having inventory, order and warehouse management functions are higher than other applications in this cluster.

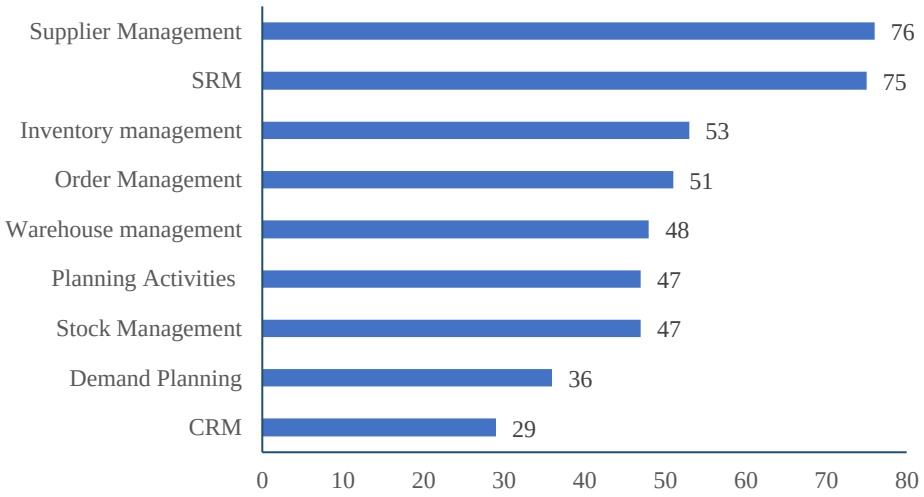


Figure 49 : Distribution of Main Functionalities of e-Supply Chain Collaboration

Table 36: Examples of Cloud Platforms with their Main Functionalities

Main Functionalities	Geneva Systems	GCS A2000	Gain sight	Accolent ERP	Jaggear One	E2Open
CRM	x		x	x		
Demand Planning	x			x	x	x
Stock Management	x	x				x
Planning Activities	x	x		x	x	x
Warehouse management	x	x		x	x	x
Order Management	x			x	x	x
Inventory management	x	x		x	x	x
SRM	x	x		x	x	x
Supplier Management	x	x		x	x	x

To illustrate, Geneva Systems is a cloud platform which belongs to e-Supply Chain Collaboration cluster. It streamlines the process of supplier relationship management to have an increase in business capabilities by the help of collaboration. This platform provides suppliers to have full visibility on operations; and hence, it leads to an effective collaboration which creates flexibility and efficiency in the management of supply chain processes.

- **e-Document Management:** Main features are reporting and document management. All the platforms which are performing in e-Document Management cluster have functions of document management and reporting and analytics. M-Files document management is a software that allows customers to store data, keep track all changes

and support business processes quickly and efficiently. It provides easy access to documents according to needs at the right time.

3.1.3.4 Industry Analysis

The missing values are 3 (1%) and after removing them, 245 platforms are remained for the analysis of industries which implement cloud platforms in e-SCM. These platforms are categorized into 25 different groups and cloud platforms can perform more than one industry. Companies operating in logistics (171, 70%), manufacturing (166, 68%) and food and beverage (120, 49%) are the main users of these cloud platforms. On the other hand, aerospace and defense (24, 10%), chemical (31, 13%) and construction (41, 17%) industries are used significantly less than other industries. Apart from these industries, others are used in the range of 21%-45% and shown in Figure 51.

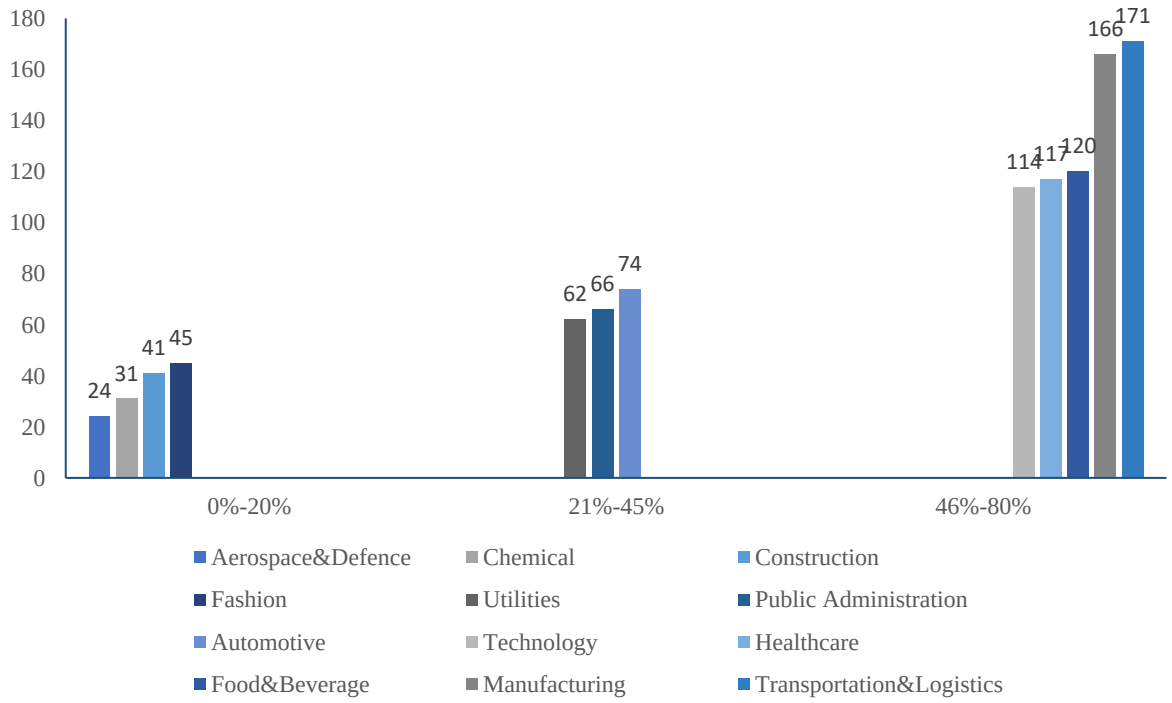


Figure 50: Industry Analysis

According to results, in all clusters, logistics and manufacturing are the leading industries. In fact, in e-SC Execution food and beverage is the third main industry whereas the third industry is technology in e-SC Collaboration and e-Procurement. In addition, food and beverage industry as a third sector is substituted by healthcare in e-Document management (shown in Table 38).

Table 37: Cluster Analysis According to Industries in e-SCM

Industries	e-SC Execution	e-Procurement	e-SC Collaboration	e-Document Management
Logistics	76%	62%	70%	64%
Manufacturing	69%	75%	77%	74%
Fashion	21%	18%	18%	15%
Construction	16%	23%	18%	31%
Automotive	29%	32%	41%	15%
Food & Beverage	53%	46%	55%	41%
Healthcare	47%	52%	54%	69%
Utilities	21%	33%	32%	38%
Aerospace & Defense	8%	9%	14%	15%
Chemical	11%	14%	13%	15%
Technology	42%	58%	63%	51%
Public Administration	22%	29%	26%	49%
Other	24%	32%	33%	31%

3.1.3.5 Business Size Analysis

Analysis is conducted to understand the distribution of user companies regarding their business sizes and cloud platforms are classified in more than one category of business sizes. According to analysis of results, the user companies of cloud platforms are categorized as small enterprises (70, 28%), SMEs (144, 58%), medium enterprises (197, 79%) and large enterprises (128, 52%). Some cloud platforms are used by all enterprises (29, 10%). It is realized that the number of platforms performing in e-SC Execution cluster is substantially high in all categories.

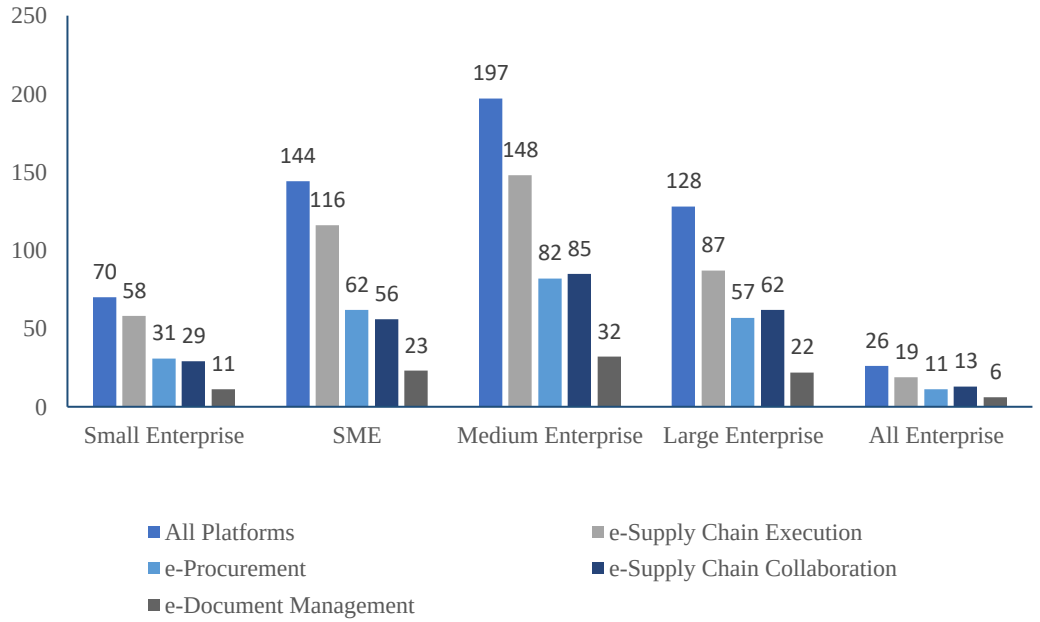


Figure 51: Business Size Analysis

3.2 Interviews

3.2.1 Platform User Companies

3.2.1.1 Kraft-Heinz

General Information

Table 38: Kraft-Heinz General Information

Company	Kraft-Heinz
Address	Via S. Bovio, 3, 20090 Milano San Felice, Milano
Link	http://www.kraftheinzcompany.com/
Business Segment	Food & Beverage
Revenue	26,232 billion €
Number of Employees	40,000
Contact	Enrico Asteggiano – Supply Chain Controller

Kraft-Heinz is an American food and beverage company formed by merger of Kraft Food and Heinz in 2015. Currently, Kraft-Heinz is the third largest food and beverage company in North America and fifth in the world with the 26,2 billion € turnover and approximately 40,000 employees.

The interview is conducted with supply chain controller in Milan office of Kraft-Heinz company. Team of supply chain in Milan office are divided into logistics and demand planning functions. Logistics team is structured for inbound and outbound operations separately. Inbound operations (from production site to warehouse) are carried out by the team of logistics. For outbound operations (from warehouse to customers), third-party logistics provider is responsible. Logistics team has only traceability and control on the third-party operations.

In SCM, Kraft-Heinz supply chain team are using two cloud platforms: SILOG and SharePoint. SILOG has been used for 3-4 years whereas SharePoint has been used for 3 years.

SharePoint – Microsoft Office 365:

It is an environment to share and collaborate on content and offers users a place in which they can organize common resources, save and store files, and share them with entire organization.

SILOG:

It is an accounting program that takes the data from warehouse management system and calculates costs of the transactions. SILOG provides all the transactions in one program and applies the cost values to transactions so that the firm can get information about how much they should pay every month for their transportation services. In order to use SILOG, internet

(requires company network) or company provided VPN are needed. SILOG is managed by another company called Europe Consulting SRL which is an IT consulting company.

SILOG is connected to the management system which called BPCS and it is not a cloud platform. It is a platform that includes all information related with production data and its transactions. In order to find costs of transactions, BPCS and SILOG have to be connected to each other. For example, inbound shipments are paid by Kraft-Heinz and could include the transportation from other European countries, or it could be the transportation within Italy both on freight to warehouse or freight to customer side, and also warehouse costs (handling costs for pallets, etc.). From this data, SILOG applies costs and gives the cost of each transaction.

Benefits, Criticalities and Future Improvements

SharePoint:

Considering benefits, it is easier to share and manage files on a local network. Employees can access required documents from anywhere with their connected devices. In general, SharePoint is easier to use, faster and safer. It is safer because of the difficulty to hack the system and reach the documents in terms of external perspective. From an internal perspective, if user deletes files on SharePoint, it can be recovered easily.

Considering criticalities, in some cases, employees cannot use the same files at the same time. For example, with Microsoft Excel, user cannot work on the same file while other user is working at the same time. However, for Microsoft Power Point, user can change and modify simultaneously even if other colleagues are working on the same file.

Regarding the future improvements, for every kind of file, it should be editable simultaneously by multiple users. In online version of SharePoint, links could be lost; thus, employees do not prefer to use it. Improvements can be done in online version by extending functions and connection enhancements.

SILOG:

Considering benefits, it is safer and without SILOG, information about costs of transactions would not be calculated automatically. Therefore, it is an important platform for company to reach the costs of transactions in a fast, accurate and secure way.

As regards to criticalities, it does not have user-friendly interface since there are several manual steps that the user should do. However, it can be learned quickly and hence, it does not require technical knowledge. For general understanding, personal skills could be important to adapt the system quickly. As a result, complexity and fragmentation of system are obstacles for the employees. Complexity has created some risks; for example, if some data are not correctly transferred from BPCS, it would create some problems because it is difficult to understand and

verify the accuracy of information. In addition, for any change in the system of SILOG, Kraft-Heinz needs to go to the intermediary firm (Europe Consulting SRL) for the management of change. Therefore, the company itself has a dependency for the third party.

For future improvements for SILOG, mentioned barriers could be improved. In general, it would be better for employees to have one single platform that store all the needed data such as data of production, costs of transactions, etc.

3.2.1.2 Beko – Arcelik

General Information

Table 39: Beko – Arcelik General Information

Company	Beko
Address	Şifa Mahallesi, Arçelik Fabrika, 34950, Istanbul
Link	http://www.arcelikas.com/
Business Segment	Domestic Appliances and Consumer Electronics
Revenue	2,59 million €
Number of Employees	20,000
Contact	Burcu Ozgur – Global Supply Chain System Development & Project Manager

Beko is a household appliances manufacturer based in Turkey, founded in 1954. Having operations in durable consumer goods industry with production, marketing and after-sales services, Beko offers products and services around the world with its 30,000 employees, 18 different production facilities in 7 countries (Turkey, Romania, Russia, China, South Africa and Pakistan), its 34 sales and marketing companies in 32 countries all over the world and its 11 brands (Arcelik, Beko, Grundig, Blomberg, ElektraBregenz, Arctic, Leisure, Flavel, Defy , Dawlance and Altus) serving products and services in more than 145 countries. Beko is using SAP Cloud ERP, Qlik Sense Cloud and Microsoft SharePoint for various operations within SCM. Cloud platforms are used to support import and export operation management, warehousing activities, demand planning and data mining and storing. SAP Cloud ERP consists of several modules in order to support material management, production planning and distribution. Qlik Sense Cloud is used for understanding complex supply chain analytics in a better way from forecasting, planning, transportation, production; all aspects. Cloud-based solutions have been used for many years because structure of supply chain of Beko includes many branches all around the world. This brings a need of structured way of communication in order to manage information exchange in a fast, secure and accurate way.

Benefits, Criticalities and Future Improvements

Considering benefits of cloud platforms used by the company, each platform enables the organizations to be on the same platform even if they operate in different locations. Therefore, cloud platforms allow employees to manage demands, operational business flows and reporting and also, all data can be visible and accessible anytime and anywhere.

Regarding criticalities, in some exceptional cases, activities need flexibility; however, platforms requires standardization of data (in terms of hardware, software and technical skills) and it causes some limitations in standardization which can be considered as an obstacle. Limit of access is another obstacle of the cloud-based solutions since each platform requires Internet access to be effectively used and there could be interruptions of Internet access due to maintenance, low connection, etc. In addition, since it is a global company, training difficulties are another barrier of cloud platform because the adoption level of each organization could be different and required time for training can vary from location to location.

Considering future improvements, Beko would like to increase maturity level of digitalization. Forecasting tools can be implemented in the future for each supply chain processes such as customer demand, vehicle or costs of transactions to decrease the uncertainty. Tools for training programs and standardization for new merger or acquisitions could be beneficial for the company.

3.2.1.3 Prysmian Group

General Information

Table 40: Prysmian Group General Information

Company	Prysmian Group
Address	Via Cenisio 6, Milano
Link	https://tr.prysmiangroup.com/
Business Segment	Cable Technology and Manufacturing
Revenue	711 million €
Number of Employees	30,000
Contact	Cyrine Sahli – Supply Chain Manager

Prysmian Group, which headquartered in Milan, manufactures electric power transmission and telecommunication cables and systems. It is the largest manufacturer of cables in the world with the 711 million € turnover and approximately 30,000 employees. Prysmian Group has 112 production plants and 25 research and development center all around the word. The interview is conducted with Supply Chain Manager in Milano office of Prysmian Group. Project

management team of supply chain is divided into portfolio planning and operation planning in Milan office.

In SCM, Prysmian Group uses five cloud platforms. For all businesses, SharePoint and Salesforce are used but according to the different clients and different projects, they also use other platforms such as ThinkProject, Asite and Aconex in order to manage documentation.

SharePoint – Microsoft Office 365:

It is an environment to share and collaborate on tenders and documents. It offers users a place in which they can organize common resources, save and store files, and share them with entire organization. Moreover, Prysmian Group has also permission to reach clients local networks. For the weekly and monthly update of each project, company interact with the client through client's local SharePoint which is provided by STNEXT (IT consultancy company) and Prysmian Group has been using this solution for more than 3 years.

Salesforce:

Salesforce is a SaaS solution that specializes in CRM. It allows customers to have better connection with their potential client and partners. It gives opportunity to track customer activities and arrange market according to customers business needs. Platform is provided by Accenture and has been used for more than 1 year.

ThinkProject, Asite & Aconex:

These are the document management platforms that facilitate cross-enterprise collaboration and overall information management. These platforms also offer process management solutions for building information modelling and interfaces to general business applications like ERP.

Benefits, Criticalities and Future Improvements

SharePoint:

Considering benefits, it is easier to share and manage files on a local network. Since team of project management in Prysmian Group deals with the different long-term projects, it is important to share all related document about project to the different teams such as installation, system design and also R&D. Each member has possibility to reach required documents from anywhere with their connected devices. As a result, SharePoint is easier to use, faster and safer. Considering criticalities, it requires a permit to access all files in the network. If company does not have a structured IT department, it may cause delays to reach that documents and files easily. Moreover, having a stable internet connection is a must to use SharePoint.

Salesforce:

CRM is used by sales manager to keep track of all opportunities which are coming from current or possible customers. In addition, business process management is also completed in Salesforce which is the work flow of the offer. In Prysmian Group, Salesforce is integrated with their local SharePoint. Therefore, if client or sales responsible upload any files about tender or documentation, other functions can reach these documents through SharePoint. It streamlines the project communication. In terms of obstacles, it requires time to implement (approximately 8 months and then training of each user because it requires time to adapt).

ThinkProject, Asite & Aconex

These platforms connect Prysmian Group to the client for document management. They include different and divided segments for each team. Inside of platforms, clients can create a comment and Prysmian Group can reply. Moreover, through these platforms, client can accept or reject any document which is not related with the scope of the project. Then, teams of Prysmian Group which is responsible for that documents or files directly review the files and reupload to the system.

3.2.2 Platform Provider Companies

3.2.2.1 Infor

General Information

Table 41: Infor General Information

Company	Infor
Address	Via Torri Bianche 24, 20871 Vimercate MB, Italy
Link	https://www.infor.com/it-it
Business Segment	Software products and services
Revenue	2.8 billion $
Number of Employees	15,000
Contact	Luca Pagliochini - Business Development

Infor is a global enterprise software company which has headquarter in New York City, USA. Infor has 168 offices worldwide. They have 68,000 customers and over 15,000 employees all over the world and they are offering 176 new products to their clients. Infor mainly focuses on business applications for organizations delivered via cloud computing as a service called CloudSuite. They provide their user applications which suitable for different sectors in cloud mode and effectively distribute technology around it. They also provide many services to their

customers, including consulting and support, as well as education and training. Infor has implementation and delivery partners in order to fulfill customer needs.

Benefits, Criticalities and Future Improvements

Cloud-based solutions provided by Infor bring several benefits to user companies. Users can feasibly deploy cloud-based solutions in 3 minutes with a good internet connection and proper devices. Additionally, benefits include low cost of total ownership, comprehensive services, flexibility of deployment, robust industry-specific and last-mile functionality.

Future trends are pointing toward end-user experiences, cloud deployments for flexibility and security on-the-go and lighter-weight applications that can all obtain one version of the truth from multiple data sources.

3.2.2.2 Logiwa

General Information

Table 42: Logiwa General Information

Company	Logiwa
Address	330 N Wabash Ave, Floor 23, Chicago, IL 60611
Link	https://www.logiwa.com/
Business Segment	Software products and services
Revenue	2.5 million $
Number of Employees	55
Contact	Cagdas Yildiz – Co-Founder

Logiwa is a Chicago based cloud platform provider company founded in 2004 which offers warehouse and inventory management software served in retail, e-commerce, wholesale and 3PL businesses. It has more than 5000 customers worldwide. Logiwa provides customers opportunity to synchronize their inventory and orders across sales channels, reducing operational costs, providing visibility and increasing margin. Warehouse management system (WMS) is designed to support and optimize warehouse efficiency and distribution management which gives possibility to have better planning, organizing and controlling of the available resources while supporting performance of material movements and storage in the warehouse.

Benefits, Criticalities and Future Improvements

Since Logiwa offers Cloud WMS solutions to their clients, their customers are divided mainly into two groups as retailers and third-party logistics companies. According to these two different groups, benefits of WMS differ. For online retailers, increase in sales by using the same resources and reduction in costs are two main focus of this customer side. By using Cloud

WMS, operations become easier and clients can increase sales of products or services in online channels since user can predict the demand better and manage the inventory more efficient way. For third-party logistics companies that are having customer profile as online retailers, the main benefit is flexibility. Customers can handle operations easily by using Cloud WMS. Besides, clients of Logiwa differ from each other in terms of business sizes. Some of the customers deliver small number of products whereas some of them deliver high number of batches. However, Logiwa ensures scalability during the operations. In addition, since Logiwa mainly focuses on SMEs, security and privacy issues are not concern for them as sensitive data (customer data, credit card information, social security number, etc.) are not collected by Cloud WMS and they offer services that are hosted on Amazon Web Services; therefore, it is reliable. On the other hand, the main criticality is difficulty in integration process. Both retailers and 3PL companies are using different platforms to sell their products and there are many different platforms (more than 1000) that clients are using; hence, integration is the main encountered obstacle for the customers. However, Logiwa offers more than 50 integration of these platforms through their sales channels.

Considering the future trends, usage of augmented reality in warehouses such as Google glasses, machine learning in operations in SCM to predict more accurately and Internet of Things and Artificial Intelligence has increased tremendously, and all these digital technologies will be increasingly implemented in various sectors and functions in SCM. Cloud solutions will be used more in different industries and more companies will adopt these solutions into their operational activities.

3.2.2.3 Relex

General Information

Table 43: Relex General Information

Company	Relex
Address	Via delle Industrie 15, 30175, Marghera – Venezia, Italy
Link	https://www.relexsolutions.com/
Business Segment	Software products and services
Revenue	~8.6 million $ (annually)
Number of Employees	650
Contact	Jarno Martikainen – Country Director Italy

Relex is a cloud platform provider company founded in 2005 and it is dedicated to help retail business by offering them various SaaS solutions. The company has offices in United States, UK, Germany, Italy, Spain, France, Finland, Sweden, Norway, Denmark and Hong Kong, with over 600 employees. The main customer base of the company is retailers and wholesalers and RELEX Solutions offer to their clients forecasting and replenishment solutions. Forecasting solution can optimize the planning activities as the solution allows customers to see the impacts of external events such as holidays, seasonal factors or weather forecasts and some other planned changes such as price changes, promotional activities, etc. Regarding the replenishment solution, the company offers automatic replenishment solution which enables the automatic distribution of forecasts to relevant sub-components in BOM to ensure efficient replenishment. Besides, promotion and price management, space optimization and workforce management are other main services the company offers to their clients. For promotion management, with accurate forecasting and planning, it allows analysis of promotions and markdowns and ease the decision-making process. Furthermore, by offering space optimization solution, clients have the right allocation of space in their stores and workforce management solution helps clients better plan the workforce. On the other hand, the company offers implementation services which includes training as well. In order to fully use solutions, it takes 3-4 months to 1 year depending on the business size of the customer.

Benefits, Criticalities and Future Improvements

Considering benefits, since RELEX Solutions offer clients demand planning, inventory planning, automatic replenishment and analytics tools, clients can better manage their inventory and hence, it leads to lower inventory level and decrease cost of inventory. In addition, they will have more accurate data for planning and control activities. Better forecasting and planning lead to decrease wastes as well. Besides, the workforce management and space optimization solutions decrease the costs related with workforce because of better management.

Regarding criticalities, the most important possible obstacle is having wrong calculations in terms of customer side. In order to have reliable output, customer should have accurate data as input and there might be some wrong input data and as a consequence, result could be wrong in this case.

For future trends, the company has been using artificial intelligence and machine learning technologies to give better solutions to their clients and those trends will be increasingly used in recent future as well. For example, solutions that use artificial intelligence technology help

clients decrease cannibalization and halo effect in their business. Machine learning tools help the company use external data to guide their statistical analysis more accurate way.

3.2.2.4 DXC Technology

General Information

Table 44: DXC Technology General Information

Company	DXC Technology
Address	Via Achille Grandi, 4, 20063 Milano
Link	https://www.dxc.technology/
Business Segment	Software products and services
Revenue	21 billion $
Number of Employees	200,000
Contact	Giuseppe Pietro Marengon – Manufacturing and Automotive Practice Leader

DXC Technology is an American multinational corporation that provides end-to-end IT services to businesses and was founded in 2017 by the merger of Computer Sciences Corporation and the Enterprise Services business of Hewlett Packard Enterprise. The company has 6,000 public and private clients in 70 countries. The main service that DXC Technology offers to their clients is system integration which the company is fully responsible for the implementation of the project that will address the specific needs of business needs of the customer. For instance, customers ask for a customizable solution to their existing software and DXC Technology proposes solutions according to their needs and writes additional codes to make capable the existing software as regards to clients' requests and integrates the new solution with the existing software. Besides, the company offers training activities (fixing bugs, how to use the new software, how to proceed, etc.) for the new solutions to support change management. Therefore, DXC Technology offers end-to-end IT services to their clients in which they are responsible from the beginning of the project until the completion. The implementation time depends on the complexity of the projects, but it takes minimum four months up to one year.

Benefits, Criticalities and Future Improvements

Benefits of the solutions that the company offers to their clients differ from industry to industry. Considering manufacturing industry, customers generally ask for solutions that optimize the processes and reduce internal costs. Therefore, the main benefits of manufacturing solutions are increase in production efficiency and reduction of costs which is achieved by reduction of

stocks, lead time, etc. Moreover, traceability is another benefit because customers ask for the company for traceability solutions where the clients can track all the activities related with production and final customer will not receive just the product itself but additional value which includes the certification of traceability (information about how the product is built or produce) as well. In addition, reduction to time to market can be considered as another benefit of offered solutions. The clients of the company want to be more competitive in the market and hence, they ask for solutions which reduce the time to market. Therefore, DXC Technology offers a system that is able to accelerate and optimize the activities such as design and evaluation of new products, etc. For instance, in pharmaceutical sector, the customers need to prepare several documents and fulfill a number of trials and tests to put new drugs into market. Thus, DXC Technology offers a new system for them to optimize these activities to reduce time to market. Regarding criticalities, main issue is the unwillingness of employees to change. Since employees got use to their way of work, they are reluctant to change their ongoing activities. Hence, management of change of work is the main barrier to adopt new solutions because even the company offers the best solution for them, employees need to be convinced in order to implement the solution.

For future trends, globalization is the most important change as regards to competition. In the future, more solutions which are not related to one company but address the cluster of companies will be encountered. These solutions may address all supply chain players such as from suppliers to end customers. Furthermore, some solutions such as autonomous vehicles require huge investments but nowadays, big players consider negotiating and establish partnerships for reduction R&D investments, time, etc. In the future, more partnerships will form between potential competitors in various sectors.

CHAPTER 4: CONCLUSION

As it is stated in the previous chapters, cloud computing is one of the trending technologies today, with broad-ranging effects on IT services, information systems architecture, business, software engineering and data storage. Moreover, cloud computing concept in SCM is an innovative practice and has created a significant impact in SCM applications and also the adoption of cloud platform is expected to continuously grow during the years. In order to collect and analyze data about cloud-based solutions in supply chain processes, the study has been divided in two main groups as SCM process and e-SCM process. More than 500 cloud platform provider companies have been determined and 298 solutions were selected to be examined in detail regarding the objectives of study for the analysis. From 298 cloud platforms, 284 of them are serving for SCM and 248 platforms are grouped in e-SCM. Within these two main groups, there are different main clusters separately. In SCM, there are Execution, Extended Enterprise and Supply Chain Planning clusters whereas there are four main clusters in e-SCM processes; e-Supply Chain Execution, e-Procurement, e-Supply Chain Collaboration and e-Document Management.

Table 45: Supply Chain Management Processes

Cluster Type	**Supply Chain Processes**		
Cluster	**Supply Chain Planning**	**Extended Enterprise**	**Execution**
Sub-cluster	Production Planning	Supplier Relationship Management	Production
	Inventory Planning	Customer Relationship Management	Logistics
	Transportation Planning	Product Lifecycle Management	Maintenance
	Demand Planning	Others	Quality
	Others		Others

Table 46: e-Supply Chain Management Processes

Cluster Type	e-Supply Chain Management Processes			
Cluster	**e- SC Execution**	**e-Procurement**	**e-SC Collaboration**	**e-Document Management**
Sub-cluster	Pre-sales Support	Need analysis	Monitoring & Control	Record Management
	Order Issuing	e-Sourcing	Planning Activities	
	Delivery	Contract Management	Communication & Marketing	
	e-Invoicing	Catalog management	New Product Development	
	After-sales Support	Others	Others	
	Others			

General analysis without categorizing them as SCM and e-SCM, is conducted including 298 cloud platforms. According to the analysis, America is the main provider of cloud-based solutions in supply chain management among other and there is no platform developed in the Middle East. Also, platform user companies are mostly located in America with a considerable portion. However, Europe is the second location where cloud platforms are used. According to number of employees of cloud platform provider companies, it can be concluded that cloud platform provider companies are small medium enterprises. Moreover, in terms of business sizes, cloud platform user companies are mainly medium enterprises, followed by SMEs and large enterprises. After analyzing service models, it is conducted that all cloud platforms have SaaS and web-based models. IaaS and PaaS service models are very less in number compared to others. Therefore, it can be concluded that cloud-based solutions in SCM is generally preferred by companies as a ready to use service when it is compared with other service models. In terms of pricing model, pay per time/user is the most preferred pricing model but the number of platforms which offer pay per time is also substantially high. In the analysis of partnership, it can be concluded that cloud platform providers mostly have partnerships between 1 to 50 in which the salient technology companies are Oracle, SAP, Avalara, IBM, Salesforce.com, Microsoft, Aptean, Amazon Web Services, Infor, Quickbook, Shopify and Sage.

Supply Chain Management

Considering SCM process cluster, after removing the platforms that are performing only in e-SCM, there are 284 platforms remained. These platforms are analyzed as regards to three main clusters and multi cluster in which platforms that are serving for more than one cluster. From

the results, it can be concluded that Execution is the leading cluster in cloud-based solutions in SCM, followed by Extended Enterprise and Supply Chain Planning. After analyzing relation of cluster analysis according to location, it is also observed that Execution is the leading cluster in all locations. In terms of sectors; manufacturing, logistics, food and beverage and healthcare industries are the main users of cloud platforms in SCM. On the contrary, fashion, aerospace and defense and chemicals industries are the less preferred ones to use cloud solutions in their SCM. From the analysis of sub-cluster, it is observed that demand planning is the most significant sub-cluster in supply chain planning; SRM and CRM sub-cluster in extended enterprise cluster; transportation and logistics in execution.

e-Supply Chain Management

Considering e-SCM category, after excluding the platforms that are performing only in SCM, there are 248 platforms are remained. These platforms are examined according to four main clusters and multi clusters. It is observed that e-Supply Chain Execution is the leading cluster in the cluster analysis and also in all locations; the cluster is followed by e-Procurement and e-Supply Chain Collaboration. According to the sector analysis, it is concluded that logistics, manufacturing and food and beverage industries are the main users of cloud platforms. On the other hand, aerospace and defense, chemicals and construction industries are used significantly less than others. In terms of sub-cluster analysis, it is concluded that delivery is the leading sub-cluster in e-Supply Chain Execution; e-Sourcing and need analysis in e-Procurement; monitoring and control in e-Supply Chain Collaboration; e-Document Management has only one sub-cluster which is record management.

According to literature review and interviews, benefits and criticalities of cloud platforms in the management of supply chain processes have been identified.

Benefits

First of all, cloud platforms give possibility to connect across multiple supply chain participants instantly. As it is supported from the interviews, visibility is an important issue in supply chain management in order to coordinate their operations and manage exchange of information through different locations both internally (different branches of the companies) and externally (customers and third-party providers). Traceability which is created by having visibility in the supply chain brings cost efficiency. In addition, since it provides easy connection and enables collaboration between partners in one single system, it will decrease the compatibility problem and it allows to simplify the processes and data exchange. Furthermore, in terms of costs, since the cloud platforms do not require any additional software, capital expenses are transferred to operational expenses. Scalability of cloud platforms in SCM give opportunity to reduce cost

structure. The payment arrangement can be done by the pay per use or hybrid approach which allows user to scale their services according to their business strategy. Since cloud-based supply chain ensures user to access platform from any location and anytime, it provides flexibility in operations. As it is extracted from interviews, it reduces the response time of one partner to another's decision by the help of application in single platform.

Criticalities

One of the main issues related with the cloud platforms is data security and privacy for the user enterprises. Because of the privacy issues and having possibility to be hacked, have cyber-attacks and lose data, it brings organizational risks to be considered for the user companies. Besides, during the interview phase, it is observed that big enterprises in the field of distribution and manufacturing sectors are not ready to implement cloud platforms due to their security and privacy concerns. There is another issue about accessibility of cloud platforms since they require good internet connection and proper devices. User companies have doubt about being interrupted because of the low quality of network while working different environments. Moreover, with new trends of digitalization in SCM, users of the cloud platforms have to learn how to use this new technology in their operations effectively. This adaption needs to be aligned with the organizational model and business strategy of the user companies.

In conclusion, adoption of the cloud platforms in SCM will be increasing during the years. Main functionalities that cloud computing support in SCM are forecasting and planning, sourcing and procurement, logistics, service and spare parts management and product development. Enterprises implement cloud-based solutions in their SCM because of the scalability of resources, cost efficiency, flexibility, simplification and visibility. Risks that cloud based solutions include such as security and privacy, will be solved by the help of collaboration with user and provider companies in the future.

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