# Cloud Computing For Supply Chain Management

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## *Abstract*

Cloud computing can give the ability of flexibly outsourcing software for supply chain collaboration and infrastructure needs in a better way. Instead of maintaining and paying for maximum use this technology puts forward the method that provides flexibility to add on the way, depending upon the overall business process and network model of supply chain. Ahead of the usual technology publicity, the worth of cloud computing is that it can be a right technology for supporting and managing a constantly changing and dynamic network and thus for supply chain management. Because now a day these are the exact visibility and supply chain collaboration needs. Efficient supply chains are a vital necessity for many companies. Supply chain management acts on operational processes, divergent and consolidated information flows and interaction processes with a variety of business partners. Efforts of recent years are usually facing this diversity by creating and organizing central information system solutions. Taking in account all the well-known problems of these central information systems, the question arises, whether cloud-based information systems represent a better alternative to establish an IT support for supply chain management.

**General Terms**

Green Technology, Environmental Science

**Keywords**

Supply chain management, Cloud computing, SaaS, PasS, IasS SCM Cloud.

## *Introduction*

### *Cloud computing*

Vivek Kundra, The first CIO of the USA, appointed by President Obama, Summarized cloud computing services offering as: "There was a time when every household, town, farm or village had its own water well.Today, shared public utilities give us access to clean water by simply turning on the top; cloud computing works in a similar fashion. Just like water from the tap in your kitchen, cloud computing services can be turned on or off quickly as needed. Like at the water company, there is a team of dedicated professionals making sure the service provided is safe, secure and available on a 24/4 basis. When the tap isn't on, not only are you saving water, but you aren't paying for resources you don't currently need." Cloud computing is a computing paradigm in which tasks are assigned to a combination of connections, software and services accessed over a network. This network of servers and connections is collectively known as "the cloud". Computing at the scale of the cloud allows users to access supercomputer-level power. Users can access resources as they need them [. The underlying cloud architecture includes a pool of virtualized computers, storage and networking resources that get aggregated and launched as platforms to run workloads and satisfy their Service-Level Agreement (SLA). Cloud architectures also include provisions to best guarantee service delivery for clients and at the same time optimize the efficiency of resources for providers. "Cloud" is a virtualized pool of computing resources. It can: Manage a variety of different workloads, including the batch of back-end operations and user oriented interactive applications.

Rapidly deploy and increase workload by speedy providing physical machines or virtual machines.

Support for redundancy, self-healing and highly scalable programming model, so that workload can be recover from a variety of inevitable hardware/software failure Real-time monitor resources usage, rebalance the allocation of resources when needed. The core concept of cloud computing is reducing the processing burden on the users' terminal by constantly improving the handling ability of the "cloud", eventually simplify the users' terminal to a simple input and output devices, and providing the powerful computing capacity of the cloud on-demand. All of this is available through a simple Internet connection using a standard browser or other connection.

## Cloud services

The service provider provides the following main services to the service user. These are as follows:
Software as a Service [SaaS]
Platform as a Service [PaaS]
Infrastructure as a Service [IaaS]

### (i) SaaS (Software as a service)

It features a complete application offered as a service on demand. A single instance of the software runs on the cloud and services multiple end users or client organizations. The most widely known example of SaaS is salesforce.com, Google Apps

### (ii) PaaS (Platform as a service)

It encapsulates a layer of software and provides it as a service that can be used to build higher-level services. There are at least two perspectives on PaaS depending on the perspective of the producer or consumer of the services: Someone producing PaaS might produce a platform by integrating an OS, middleware, application software, and even a development environment that is then provided to a customer as a service. Someone using PaaS would see an encapsulated service that is presented to them through an API.

### (iii) IaaS (Infrastructure as a service)

It provides basic storage and compute capabilities as standardized services over the network. Servers, storage systems, switches, routers, and other systems are pooled and made available to handle workloads that range from application components to high-performance computing applications.

## Characteristics of Cloud Computing

Cloud computing   has    following    essential characteristics:

### (i) On demand service

Cloud computing can automatically provide computing capabilities as needed. The main purpose of cloud computing is that the public can use computing power just like the way they use water, electricity, gas and telephone. Cloud will be available in a pay-as-you-go model that users can pay for only what they use.

### (ii) Elastic Scalability

Cloud computing solutions give clients the ability to choose the IT resources they need in a way that can grow over time or instantaneously as needs change.

### (iii) Sharing information and group collaboration

Data and applications are easily accessible from the cloud, and information can be shared to the maximum, which facilitates group collaboration on projects. The main feature of cloud computing is reliable services delivered through data centers and built on servers. Cloud often appears as a single point of access for all consumers' computing needs

## Virtualization technique:

Using virtualization technique, several operating systems can run at the same time on a single physical system. A user can pick the operating system and hardware configuration of his own choice to run his application. This selected combination is known as virtual machine (VM). In this approach the user share the underlying hardware resources. To centrally manage several virtual machines on a particular physical system, software is used known as "virtual infrastructure management software (VIMS)". According to user's point of view each virtual machine is a single, logical group of resources. Virtualization technique offers efficient and cost effective utilization of IT infrastructure. Xen and VMWare are the examples of virtualization technology provider.

## B.SCM (Supply Chain Management):

Hand field & Nichols define supply chain as: a supply chain includes all the activities relevant to the flow of goods and information from the raw material stage to that in which the goods are delivered to the end user. Supply chain management (SCM) is the oversight of materials, information, and finances as they move in a process from supplier to manufacturer to wholesaler to retailer to consumer. Supply chain management involves coordinating and integrating these flows both within and among companies. It is said that the ultimate goal of any effective supply chain management system is to reduce inventory as a solution for successful supply chain management, sophisticated software systems with Web interfaces are available, and who promise to provide part or all of the SCM service for companies who rent their service. Supply chain management flows can be divided into three main flows: The product flow includes the movement of goods from a supplier to customer, as well as any customer returns or service needs. The information flow involves transmitting orders and updating the status of delivery. The financial flow consists of credit terms, payment schedules, and consignment and title ownership arrangements.
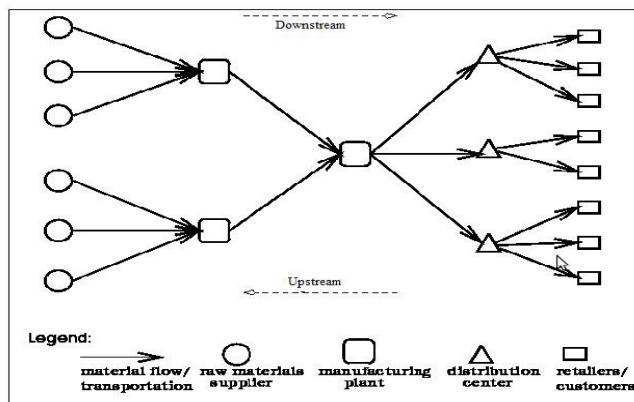


**Fig. 1**

*Goal of installing supply chain management software*

Before the Internet came along, the aspirations of supply chain software devotees were limited to improving their ability to predict demand from customers and make their own supply chains run more smoothly. But the cheap, ubiquitous nature of the Internet, along with its simple, universally accepted communication standards, has thrown things wide open. Now, companies can connect their supply chain with the supply chains of their suppliers and customers together in a single vast network that optimizes costs and opportunities for everyone involved. This was the reason for the idea that everyone a company does business with could be connected together into one big happy, cooperative family. Of course, reality isn't quite that happy and cooperative. But today most companies share at least some data with their supply chain partners. The goal of these projects is

greater supply chain visibility. The payoff of timely and accurate supply chain information is the ability to make or ship only as much of a product as there is a market for. This is the practice known as just-in-time manufacturing, and it allows companies to reduce the amount of inventory that theykeep. This can cut costs substantially, since you no longer need to pay to produce and store excess goods. But many companies and their supply chain partners have a long way to go before that level of supply chain flexibility can be achieved.

## Cloud computing in Supply Chain

### 1. SCM CLOUD

SCM Cloud offers - "a set of services that provide SCM functions to any cloud user in an efficient, scalable, reliable and secure way". That is, Cloud masks all the heterogeneities involved in implementing various SCM functions and the tiers within each function and provides a purely functional view rather than having to deal with the inherent technologies. The view of the cloud makes us, the service providers the best ones to take the cudgel to implement the CLOUD. We must therefore prepare a pool of requirements and a pool of plausible technologies and create a layer of abstraction to free the user from choosing packages, best-of-breed solutions, databases, integration middleware, and infrastructure and think only about the required functionality and how much he can/should pay for it. Here is a simplified tiered-illustration of SCM cloud components.
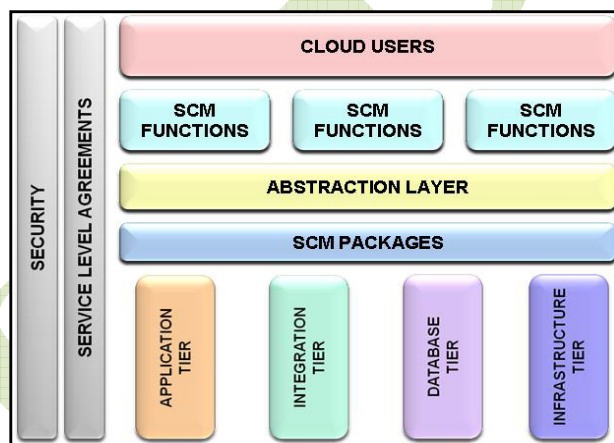


Fig. 2

### 2. CLOUD COMPUTING TRANSFORM SCM

Cloud computing evolution will affect companies (and their supply chain operations) in several fundamental ways: New competitors: cloud computing has the potential to enable start-up companies to establish themselves in a short period of time, without significant investment in infrastructure. This could have a remarkably disruptive impact on the competitive landscape of many established market leaders. Speed to market for new products and services: the pace at which new revenue-generating products and services are introduced has put constant pressure on supply chains in recent years. Cloud computing will speed up that pace even more. Large-scale transformation: the threat from new competition and the increased pace of new product and service introduction could force companies with traditional, infrastructure-intensive supply chains to reinvent themselves. Supply chains will likely become more dynamic, more scalable and more capable of supporting the financial objectives of boards and shareholders

### 3. CLOUDS IN SCM

Cloud computing is already making a significant impact on the supply chain management application market, and adoption is expected to continue to grow. Companies that provide SCM software applications – including e-

procurement, warehouse management systems, transportation management systems, supply chain planning, and business intelligence & analytics – are either already offering 'software as a service' (cloud-based) solutions or are articulating a clear strategy to move to such solutions as more customers demand it. As this happens, look for the following supply chain processes to become particularly prominent venues for cloud computing:

### Planning and forecasting:-

Cloud-based tools are available for capturing itemized spend data, performing basic analytics, planning manufacturing runs and executing statistical demand forecasts. Applications focused solely on retail are also prevalent, with capabilities that include planning & allocation, assortment & space, pricing & promotion, and forecasting & replenishment. A primary reason is that planning and forecasting are rarely core components of companies' ERP systems. Clients therefore canrunonmanufacturer'sERP application, but leverage another's best-of-breed planning/ forecasting application via the Internet.

### Logistics:-

Cloud computing applications for functions such as network strategy, inventory management, warehousing and transportation will appear with increasing regularity in the near future. Processes such as global trade compliance, replenishment planning, order processing, and transportation load building, fleet management and transportation route planning are likely candidates. Some basic warehouse- and transportation-management applications are already available online.

### Sourcing and Procurement:-

Cloud computing represents a great opportunity to reduce 'total cost of ownership': the most commonly cited success metric in sourcing and procurement. A key reason is that cloud-based tools are inherently collaborative and accessible – a significant boon to companies that may deal routinely with thousands of suppliers. Take contract management: cloud-based collaboration allows multiple parties to jointly develop supplier contracts. Myriad sourcing and procurement capabilities are rapidly coming online, including procurement report generation, database centralization and supply chain visibility.

### The future:-

Cloud computing in supply chain management is a paradigm that is still in its early stages. Thus it is likely to develop at different paces in different process areas, industry sectors, and markets: Process areas: supply chains 'in the cloud' are likely to initially take hold in those areas that are on the fringe of what many people consider core capabilities. Processes like global trade compliance, transportation route planning, freight bill audit and payment, and even basic product design engineering are all likely candidates. Industry sectors: early adopters will likely be industries with products Markets: since supply chains in the cloud will be characterized by a more efficient way to use services, the most likely early services could emerge in countries with less developed infrastructures. This could be a big boon to companies in Asia as well as to developing economies in areas such as the Arabian Peninsula and parts of Africa, where companies look for ways to leapfrog development cycles and have minimal access to capital.
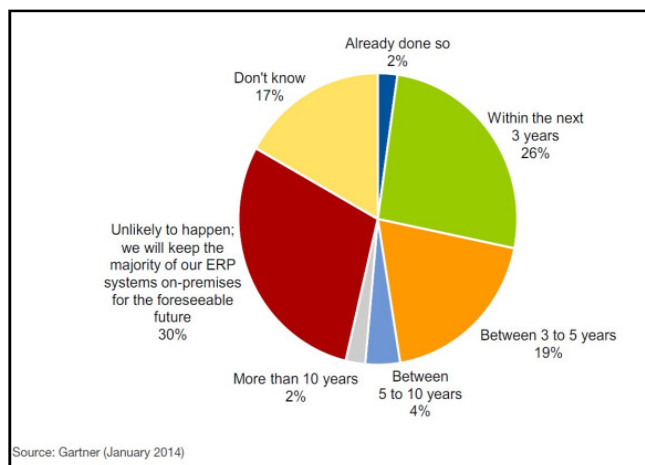
Fig 3 shows the cloud ERP adoption Plan

### *Impact of cloud computing Services on SCM*

Generally, supply chain planning; warehouse management and manufacturing applications have lower SaaS adoption rates, especially in large enterprises. Applications within supply chain execution, such as transportation management systems and global trade management, have higher adoption rates, but on-premises still remains the more common deployment model, especially for large enterprises with complex requirements. Procurement applications have a high adoption rate, but we have observed differences between the applications used to support direct materials versus those used to support indirect materials. There is a higher rate of cloud usage for indirect materials sourcing and procurement.SaaS for SCMis suitable for followingreasons:

### Cost
It can provide a low cost way to acquire SCM functionality.
Works around IT resource and budget constraints.
Supports highly distributed operational processes at a low cost if the SaaS provider has already built the integrations with supply chain partners.
Lower upfront costs.

### Speed
Typically achieves faster time to deployment.
May recognize or demonstrate ROI faster.
Avoids delays associated with long IT project queues.
 Quicker time to market for simple to moderate requirements.
Faster release of new features.

### Business value
Enables SCM in small and midsize businesses.
Builds competencies prior to investing.
Tests the vendor application in a proof of concept or pilot.
Enables companies to try innovations at a lower cost, without any long-term commitment.
Improves agility to respond to user requirements on an ongoing basis.
Often improves usability.

**Other cloud services impacting SCM**

Two other areas having an impact on SCM, but to a much lesser degree are Platform as a Service (PaaS) and Infrastructure as a Service (IaaS). PaaS helps users extend and customize a cloud-based business application that is offered as a service, or ecosystem partners can build solutions that extend the functional footprint of a vendor's SaaS applications. Using PaaS for SCM has the potential to reduce the cost of development and integration. At this stage, it is too soon to say whether PaaS will enable enterprises to innovate their SCM processes faster than in the past. We do however rate the business value of PaaS as high in terms of enabling new ways of performing horizontal or vertical processes that will result in significantly increased revenue or cost savings for an enterprise. IaaS or infrastructure utility services (IUS), on the other hand, are the provision of outsourced, industrialized, asset-based IT infrastructure managed services (below the business application functional layer). It is attractive because it enables a vendor or user organization to better align compute load and costs, avoiding the issue of over investing in data center capacity. Although user adoption has been low so far, we anticipate that this will grow in the future as users look to realize some of the benefits of cloud through applications that were not initially designed for SaaS deployment. Having said that, we rate the business value of IaaS as low as it only slightly improves processes (for example, improved user experience) that will be difficult to translate into increased revenue or cost savings. Current SaaS SCM applications in the market provide enough functionality at an economical subscription rate, offering little justification for users to buy an on-premises application and run it on an IaaS. A recent study authored by SCM world titled supply chain and the future of applications provides several interesting insights into how cloud computing applications and platforms are improving supply chain performance. The methodology is based on a combination of qualitative interviews and data analysis to break the question of cloud applications down with an eye to simplifying the issue for operational leaders. The sampling frame is SCM World members globally.

## *HISTORY AND FUTURE PROSPECTIVE OF SCM IN CLOUD COMPUTING*

Thomas Schramm, Jonathan Wright, Dirk Seng and Derk Jones divide the era of SCM in cloud computing in three parts

**Table 1: Implementation process of SCM on cloud platforms**

| 2010-2011 | 2011-2013 | 2013-2015 |
|---|---|---|
| Processes & providers characteristics & examples | Processes & providers characteristics & examples | Processes & providers characteristics & examples |

| | | |
|---|---|---|
| In early pilots SCM using cloud needs innovation and continuous Improvement. Testing attitude also needed. Support & administrative Processes. These can easily be abstracted and isolated, and do not require Complex integration. Examples:<br>• Capability development/training delivery<br>• Simple analytics | 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. Examples:<br>• Pricing optimization<br>• Replenishment planning<br>• Order processing<br>• Transportation load building | 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. Also complex process covered in cloud e.g. requiring collaboration between many entities and tighter integration with other processes and perhaps involving physical capacity Constraints. Examples:<br>• Collaborative engineering<br>• Warehousing and distribution of physical product<br>• Reverse logistics/returns processing<br>• Fleet management |
| User group interests | User group interests | User group interests |
| Companies with highest pressure for operational excellence and through competition, e.g. Products / Consumer Goods, High-Tech | Broader industry scope, companies with higher integration needs will start using cloud based services as part of their operating model | All industries applied cloud based processes |

## Conclusion

This paper explains how cloud computing services, SaaS, PaaS and IaaS impacting the SCM functionality.
Cloud computing can give the ability of flexibly outsourcing software for supply chain collaboration and infrastructure needs in a better way. Cloud computing is a computing paradigm in which tasks are assigned to a combination of connections, software and services accessed over a network. This network of servers and connections is collectively known as the cloud. The demand for cloud computing services has grown tremendously over the past 2 year. SCM Cloud offers a set of services that provide SCM functions to any cloud user in an efficient, scalable, reliable and secure way.

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