CRITICAL OVERVIEW OF SUPPLY CHAIN MANAGEMENT VIRTUALISATION

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Abstract

Qualities, which are expected from an organization are greater flexibility in responding to customers' immediate needs. Awareness of the necessity to use integrated information systems is already widespread and its virtualization is considered as a new trend.

There are two main driving forces pushing companies to invest in IT systems, which are seeking to gain a technological advantage on SCM and promoting the development of IT technology in the chain. These include changes in business environment and technological progress. Changes in a business environment require an increase of space needed for data and information management in SCM, which entails investing in IT systems in order to improve an organization. The evolution of technology provides tools and systems to facilitate the demand for processing and transmission of information, as well as provides enterprises with innovative technologies such as Cloud Computing.

In the paper, the author presents the topic of virtual solutions in the area of Supply Chain Management. The first part is devoted to theoretical background of Cloud Computing and Supply Chain Management. In the second part, the author focuses on a critical environmental analysis in order to formulate guidance, which may be helpful for any manager considering an implementation of cloud-based solutions into their supply chains. In conclusion, readers can find a summary of authors findings as well as a discussion on importance of modernization of information systems in management of a company.

Keywords: Cloud computing, supply chain management, process management

1. INTRODUCTION

The paper treats on the possibilities of use of the Cloud Computing concept in the supply chain management processes. Some argue that supply chain management is the last bastion of Cloud Computing. Thus, the author of the paper wants to demystify it and create a practical tips for entrepreneurs, who want to modernize supply chain management by implementing Cloud Computing solutions.

Paper is divided into two main parts. Author based on the literature, scientific journals and Internet sources researches the topic of supply chain management and Cloud Computing. It is crucial to explain the objective background of those two concepts to readers. Therefore, the view on the supply chain management in being reviewed. Next, the subject of supply chain is concluded with the role of information in it. It should be emphasized that, undoubtedly, information flow is a base for the concept of the Cloud Computing.

As the concept of Cloud Computing is relatively new, the inspection in the subchapter is concentrated on an accurate explanation of it. The review is based on the knowledge of authors who are authorities in the area.

Advantages and disadvantages of Cloud Computing services are explored. Conclusions consists of author's findings summary, and as of a discussion on importance of information systems modernization in company management. In the paper a methodology of explaining concepts from more general to specific ones is used. It gives a better overview and understanding of the problem to the readers. Owing to that, the work concludes with individual and independent results. The goal is to answer questions concerning, if it is beneficial to implement solutions based on the Cloud Computing, when and in what circumstances this process should take place.

2. THEORETICAL BACKGROUND

2.1. Supply chain

Supply chain management is a relatively new concept. The first time the term "supply chain management" was used by the consultants in the early eighties [1] and since then this concept has appeared more frequently in scientific studies related to logistics and management. Previously, companies used terms such as logistics and operational management instead. The article of prof. Rutkowski [2] shows various perspectives related to supply chain management. These are: functional awareness of the supply chain, represented by J. Houlihan; management contact points, J. Turner; the flow of information, L. Johansson; integration, formulated by The Global Supply Chain Forum.

However, for further analysis the definition of supply chain management by M.Christopher was accepted, i.e. *"The management of upstream and downstream relationships with suppliers and customers in order to deliver superior customer value at lower cost to the supply chain as a whole."* [3]

A supply chain can be divided into four different streams [4]: information about the demand from the buyer to the seller, which causes all other activity; movement of goods from sellers to buyers; transfer of ownership from a seller to a buyer; ash flows from a buyer to a seller. Although, according to K. Ficon [5], the prevailing opinion in the literature is that the flow of capital and cash are not formally part of the sphere of interest, however, in the framework of the logistics supply chain concept they are an integral part of the described concept.

2.1.1. Information in the supply chain

A proper flow of information and its synchronization are fundamental issues for most companies. Departments of manufacturing, commercial and service companies, which are involved in storage, transport, planning, purchasing and customer service, deal with a very large flow of information and data.

Data management needs to be well-organised, which means that it has to be clearly identified, efficiently taken from outside environment and effectively processed within the system. These are the conditions necessary for a proper operation of the system in terms of management. The main functions of information flows are to support the creation of coherent supply chains in order to enable effective management of resources and support efficient process control of transport, storage and preparation. The widest range of data use is at the level of executive staff, who work directly with transactional documents (e.g. inventory documents, sales documents, time and attendance, etc.). Databases, which in the processing are converted into information, are presented in a synthetic form.

Ability and willingness to exchange information in the supply chain with a customer is considered in three dimensions. [6] First, the tangible dimension concerns an access to all relevant information related to both logistics processes and to significant indicators. A customer decides which information they need and have a direct access to. As a result, there is a possibility to control and correct the assumed level of customer satisfaction and quality of logistics services in a supply chain. The resulting feedback is the basis for creation of active management mechanisms of a supply chain - Supply Chain Event Management (SCEM). Secondly, the time dimension is based on the provision of information on a status of supplies, the implementation phase of a contract, available inventory, etc., in real time. Finaly, the spatial dimension is availability of information in the supply chain from different locations and markets. Monitoring information of strategic importance affects logistic processes, e.g.: transport route planning, locating the whereabouts of a particular commodity or a group of commodities (European Satellite Navigation System Galileo, GPS) [7], monitoring the status of loading, etc. The implementation of this dimension is done using mobile technology and online connection of all parts of a logistics network.

Closer cooperation with suppliers requires companies to undertake activities aimed at levelling the barriers of free movement in the information distribution. Access to the information should be simple, cheap, fast and reliable. It should also be characterized by [8]: possibility of acquiring information at any desired location along the flow of the logistics chain; availability of information for all cooperating partners; accuracy of the information; satisfactory rate of flow of information and its actuality; ability to process information to support decision-making procedural; possibility of automating the processes associated with the production, obtaining and processing information and making decisions.

2.1.2. Information technology in supply chain management processes

Data, information and knowledge are assets of a company needed to carry out the logistics and supply chain management (SCM).

Information technology (IT) is one of the factors responsible for effective supply chain management [9]. Supply chain management involves an entire company, its surroundings, combining suppliers from one end of the chain to the other. Therefore, the discussion on IT systems for the supply chain should take into account two types of systems, namely those that are used internally in a company and external systems that facilitate the flow of information between various clients and companies.

From a point of view of information management, IT systems are SCM-oriented therefore, commonly ensure productivity and reduce operating costs [10]. IT systems are in particular used to obtain and collect data about products and services for specific logistics activities such as shopping so as to allow an access to accurate and reliable information in real time. Next, special IT systems are used to store information in pre-defined categories and formats, as in the case of database management systems for customers. Another aspect is to analyze the stored data in order to generate information for the decision-making process as a reaction to an event or an assessment of efficiency of an SCM system in terms of reducing costs and increasing productivity. The collaboration and communication between the participants of the chain reduce delays and misunderstandings in the flow of information. IT system are also used to standardize logistics operations and procedures for data acquisition and development of general and specific policies, rules, regulations and control measures. Consequently, IT systems are created to be used in the areas of SCM efficiency oriented applications, increasing the competitiveness of the supply chain, value adding and streamlining global operations.

The problem of information management in the supply chain as a strategic resource is inseparably connected with the implementation of modern IT solutions. Currently, the spotlight solutions dedicated to logistics supply chain systems are advanced planning and scheduling APS (Advanced Planning & Scheduling) systems and support of customer relationship management - CRM (Customer Relationship Management) [11].

APS and CRM systems implementation in supply chain management leads to the creation of integrated systems with modular design of SCM. This systems' feature is extensive functional structure and hardware, which controls the flow of products and information in separate key business processes for all partners. SCM systems support the implementation of processes responsible for synchronization and automation of operations related to finance, human resources, production and inventory [12]. The method of data handling depends on the specific operations that support a given system. Chopra and Meindl define several types of systems that provide the operations of the supply chain: Enterprise Resource Planning, supply systems, advanced planning and scheduling, transport planning systems, demand planning, Customer Relationship Management and Sales Force Automation, inventory management systems, Manufacturing Execution Systems, transport scheduling systems, Warehouse Management Systems [13].

2.2. Overview of Cloud Computing

Recently, Cloud Computing has become a subject of disputes not only for information technology specialists, but also for economists, lawyers and managers of small and medium-sized enterprises. Economists would focus on the stimulation of country development [14] and lawyers would consider this issue as a new way to provide services through the Internet and legal aspects connected to it. On the other hand, a manager of a company would examine all opportunities it could involve. This paper will be focused on the possibilities that Cloud Computing can offer to the supply chain in an enterprise.

Cloud Computing is a model for enabling a ubiquitous, convenient and possible on-demand network access via a shared computing resource (i.e. network, servers, storage, applications, and services) that can be quickly secured and released with minimal vendor management or intervention. This model is characterized by five basic features, and mixes up the three models of delivery and four exploitation models. At this point, main drivers mentioned in the definition should be emphasized. These are: on-demand self-service (customers can secure a new computing resources whenever they need without having to contact a service provider), unlimited access to the network (an access to all the facilities is possible by devices with Internet connection), pool resources (collecting and sharing data between multiple users at the same time - multitenancy), rapid elasticity (flexibility resources provided and released as needed), measurement services (the scope and intensity of service used must be constantly monitored). [15]

The essence of Cloud Computing can be concluded by the simple fact that a third party manages the application, which previously had to be installed on the hard drive from CD or DVD and update in the same way. [16] Other authors, Arthur Mateos and Jothy Rosenberg, explain that Cloud Computing is "*the computing service offered by external entities and is available on request at any time by scaling dynamically in response to demand*". [17] Renzo Marchini explains that Cloud Computing means delivering possibilities, remote computer capabilities, by service provider without the need to install additional software (SaaS) or infrastructure (IaaS) in the customer's network. According to him, creating a strict definition is difficult. Therefore, he distinguishes a set of features to explain the essence of this concept. Among them, there are: no requirements to install the software in the network; use of the software managed by the provider on servers controlled by them or on behalf of the supplier; charging only for the specific use; the liability of the supplier for updates; data security and equipment management. [18]

Four main components of the Cloud Computing were found: scalability on demand (adaptation to the needs of computing resources across the organization), simplification of data centers (client can simplify the operation of his data centers by taking advantage of cloud technologies within the organization, or by making the transfer of data outside without purchasing hardware and software), business process improvement (those who resorted to the cloud make it possible to devote more attention to the operation of the organization rather than organizational issues), minimization of initial costs (a choice of Cloud Computing allows to save money on the purchase of the entire infrastructure necessary to start activity). [19]

There are three main ways to implement Cloud Computing solutions: Cloud Computing (cloud compute), stored in the cloud (cloud storage) and applications in the cloud (cloud applications). [16] Leading among these is the service, which involves the provision of data storage. The client uses a shared external space, wherein data are moving. The biggest advantage of this service, and at the same time, the feature that most definitively distinguish this service in the cloud from other similar ones, is a method of accounting. The recipient does not have to pay for use of the entire infrastructure, but only for data transfer and storage. Cloud application is a service allowing for an on-demand access to its their own applications maintained by the provider on a platform, using a special code. This service is appropriate for the IaaS (Infrastructure as a Service) model. Software as a Service (SaaS) would be an offer that defines the concept of Cloud Computing. It is worth noting that, in any model of delivery, different characteristics may be present. SaaS provider can offer both services - use application that at the same time allows to store data.

The presented definitions create a picture of Cloud Computing as a model for the provision of IT services, which gives a user an ability to use computing resources anytime anywhere. Thanks to the possibilities offered by scaling and multitenancy, services in the Cloud Computing are flexible and adaptable to the changing needs of customers. Customers do not need to invest in hardware and software, which are guaranteed by the provider, who is responsible for the maintenance and safe operation of the entire infrastructure. Therefore, Cloud Computing differs from other models of IT outsourcing. Cloud Computing may be located anywhere, by using the virtual platform, while a "client - server" option is possible for a single device only. Another thing to be mentioned, is utility computing, which differs from Cloud Computing. It can use the split of virtualized platforms instead of centralized computing resources. [20]

There are also views that Cloud Computing can provide competition for traditional outsourcing. The authors emphasize that the essence of outsourcing is to provide a specific business process for a longer period of time. Cloud Computing assumes, however a frequent settlement - mostly on the monthly bases.[21] Due to the desirable attributes, Cloud Computing can be considered as a new solution of different data management.

3. CONDITIONS OF SCM VIRTUALISATION FOR A BUSINESS

3.1. Use of SCM applications in a SaaS model for a business

When choosing a supply chain management application, it can be noticed that it is a set of applications, which includes ERP, SRM, CRM and MRP. Basically, an offer of this kind of applications in the SaaS model is of interest to primarily small and medium sized enterprises, which due to their limited financial resources are not always able (or willing) to use advanced information systems. Moreover, this form of use of virtually integrated management of information systems may be of a particular interest to newly created or restructured undertakings in which the number of users, information needs and scope of IT support for business processes, may be subject to dynamic changes. For the newly emerging entities, operating on a highly competitive market, the decision to use, for example, an ERP system in a SaaS model helps it to avoid an initial investment (and at the same time supports its current operations of IT solutions) and allocate financial resources, which can be used for an implementation of other important business projects. The SaaS model can also be considered in the case of enterprises, which do not have an extensive IT department and are not interested in implementing and maintaining a separate ERP system. ERP systems in the service model can also be an interesting alternative for companies, whose already present system is at the end of its life cycle and the company officials consider its replacement. Such a solution can also be of a particular interest to companies characterized by a geographically distributed organizational structure, for organizations actively carrying on their activities in the virtual space (e-business) and stakeholders using only the most basic functionality of ERP systems.

3.2. Benefits and threats of SCM application based on SaaS

The use of SCM applications in a SaaS model involves both benefits and risks, which should be thoroughly considered in companies by managers responsible for the implementation of integrated management information systems. A set of potential benefits relating to the use of SaaS model (prospect customer) can be considered in economic, organizational, technological and social aspects. It should be emphasized that not every type of presented benefits will be noticeable or measurable. Specific features, in relation to the recipient of the system implementation process - an approach and providers' professionalism determine an occurrence and measurability of presented benefits. Nevertheless, some risks and problems, which should be carefully examined by senior management, are also associated with the use of SCM solutions in the SaaS model. These include mainly: the Internet failures that prevent access to and usage of the system; probability of a temporary performance slow-down, due to a momentary reduction in the bandwidth of the Internet; high costs of the required broadband Internet connections; a lack of system's full customization to the needs of a recipient; potential difficulties in data migration (e.g. from a previous system); significant functional differences between

the system offered in SaaS and in an on-premise model; concerns and problems of the management with safety data, collected in the systems, which are managed by an external supplier; possibility of legal problems (different rules in different countries, unfavorable provisions in the agreements, a lack of practices, etc.); difficulty to distinguish oneselves from rival firms by applying such a system by oneself; a partial dependence on external supplier recipient's system, resulting in, among others, weakening the ability to manage an IT area; market risk of co-operating with unprofessional supplier of the systems (e.g. the possibility of sudden cessation of activities by the IT supplier); possibility of integration difficulties.

As the first economic benefit, which can be mentioned, when implementing a cloud-based system, is that there is no need to purchase and to develop IT equipment (servers, data storage equipment, UPS) and software (system and database). Secondly, there is no need to incur the costs associated with planning, organization, implementation and maintenance of specialized storage (server) necessary for a safe operation of the ERP system. What is more, a low cost of acquisition and ownership of the system (monthly subscription) as well as including the above-mentioned advantages can replace CAPEX investment costs spread over time resulting in OPEX costs of “system living”. The IT specialists, who were in charge of maintenance and development of administrators, can be redundant from the company.

There are also relatively lower costs of modernization, renovation and development of the system, which is a next great advantage, likewise improved predictability of costs associated with the use of a cloud-based system.

A faster and easier way of obtaining and implementing a SCM system (along with a package of specialized services) is one of the organizational benefits of implementation of this mentioned solution. It is necessary for current activities of a company (rapid "time to market"). Next, the use of a system is independent regardless of the geographical location of a company and its employees. It means that there is a support for mobile workers and telecommuting. It should also be emphasized that another great advantage is both an ability to easily share information and knowledge stored in ERP systems with enterprise partners and a support for an implementation and coordination of shared business processes.

When a company outsources its IT infrastructure using Cloud Computing solution, it means that it can concentrate on its core competencies and further development of its business activities. Furthermore, owing to a collaboration with a provider, there is an ability to dynamically add / subtract a required functionality of the system depending on the current needs of an enterprise. It is also an opportunity to unify and simplify the organizational procedures related to the use of the SCM systems, e.g. an ERP.

When considering technological benefits of implementing systems based on cloud computing solution, one has to remember that it is characterized by a high level of security in the collection, processing, transmission and archiving of collected data. What is more, a provider of the cloud service offers a possibility of a professional and flexible technical support for an ERP system. A company is instantly provided with an access to the most current version of the system (taking into account legal changes and noted errors, etc.).

What is more, small and medium size enterprises can also take advantage of advanced in terms of functional SCM systems, previously available primarily for large enterprises.

One of the main social benefits is protection of the environment by reducing energy consumption and emissions. Secondly, an implementation of cloud-based systems reduces the amount of business travel by allowing free, mobile and effective communication between employees and partners.

4. CONCLUSIONS

Modern companies, regardless of their size and industry, use various types of information systems. The progressive computerization integrates and streamlines business processes in enterprises, mainly due to the increasing role and importance of information needed to make appropriate decisions in managing. As a result,

without a proper application of information systems, it is difficult to obtain or maintain a competitive advantage on today's demanding market. Special roles in helping companies are now played by integrated ERP, MRP, SRM and CRM systems, which have a direct influence on the effectiveness of SCM in a company. This class of systems has the capacity to support and integrate almost all areas of company's activity and offer significant management support of governance in reporting, monitoring and analysis of business processes.

Finally, specialists understood that companies cannot focus only on their own profit, but through a proper policy of cooperation and coexistence with the environment, it is possible to enable the development and existence of contractors, without whom, it is difficult to speak about the existence of one's own business. Currently, the main idea of SCM is based on the customer satisfaction.

The model of Cloud Computing is the catalyst of centralizing the pieces of information, which connect dots in processes, create a real-time opportunity to effectively implement service for increasingly demanding customers in a globalized economy. Enabling integration of data for the implementation of dynamic cooperation within the transparent and flexible supply chain affects the structure of the total cost of ownership. In a recent study conducted by M. Christopher [22], it was stated that the solutions available in the Cloud Computing model meet challenges of the problems of preserving transparency of the supply chain.

Cloud Computing is the provision of IT services over the network infrastructure. Cloud Computing is the model for enabling access via the Internet to a shared pool of computing resources (e.g. network, servers, storage, applications and service), they are configurable, available "on demand", can be quickly allocated and released with a minimal user interaction by allowing services by flexibly increasing or decreasing resources depending on the current demand.

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