

## CLOUD LOGISTICS

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**Abstract:** The development of ITC technologies and the appearance of cloud computing led to the virtualisation of logistics services. There are in the literature three different types of cloud computing models: software as service, platform as service and infrastructure as service. Within the frame of this paper the author describes a new cloud computing model, the service as service model, which can be determined as cloud logistics. After a careful literature review this paper introduces an approach, which uses Internet based technologies to support virtual logistic networks. This work considers the requirements of design and operation and focuses on the capabilities of optimisation framework. The present paper contributes to the knowledge of design and control of logistic networks and supply chain and offers new insights in theory and modelling, paving the way for further research works on this topic.

**Keywords:** design, logistics, networking, supply chain, system

### 1. Introduction

Today's competitive global market, production and service enterprises and supply chains must be available, efficient, flexible, adaptable and responsive to the changes of market demands and customers' requirements. One of the most important factors of the cost efficiency is based on the utilisation of the available technological, logistic and human resources. The dynamically changing market demands results stochastic processes and the permanent utilisation of resources are not ensured. In facing up to these problems, enterprises explored new internal and external cooperation forms. These cooperation forms are based on either vertical or horizontal integration of the supply chain members. The virtuality, as a new business strategy for SMEs and multinational companies, makes it possible to improve their competitive position. The sustainability of this competitive position is based on the increased flexibility, decreased stocks, increased availability, decreased through-put time, increased utilisation of resources and decreased costs.

The most important tasks of the corporate logistics IT system are to plan, organise, manage, and inspect the material flow, energy flow, value flow and associated information flow among the members of the procurement market and the company; the company and the sales market; and inside the company. Important external interface points are the distribution warehouses and centres, banks, logistic service hubs, customs, tax, and social security organisations as well as users. Corporate management is in close relationship with the elements of the production system, and the corporate logistics system. The most important internal points are the followings: production system, production planning and management system, finance, and accounting, wages and payroll, HR that relate closely to the horizontal structural elements of the corporate logistic system (procurement-production-, distributional-, and recycling logistics). Procurement and distribution logistics maintains contact with the market through marketing logistics and/or the related warehousing systems. The tasks in the corporate logistics system require that a dedicated organisational unit should be created within the company to operate, maintain, and inspect

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the corporate logistic system. In the event of industrial companies that logistic system can be centralised or decentralised. In the event of a centralised organisation logistic tasks are being looked after by a central organisation segmented along logistic areas or logistic functions. In the event of segmentation along logistic areas, the tasks of the centralised logistic organisation are divided into 4 groups matching the 4 major logistic sub-systems (procurement, production, distribution, and waste management logistics). The advantage of this organisational form is that the objectives of the individual logistic areas are given more emphasis, and its disadvantage is that the unique needs of several decentralised production units are much harder to take into account.

## 2. Literature overview

Companies are forced to improve their business processes and take part in special cooperative networking processes. There are various forms of cooperation, but not all forms of them are applicable to any company [1]. The most important aim of the cooperation is to increase the customer's satisfaction and decrease the costs by the aid of shared problem solving. There are two main types of cooperation forms: vertical and horizontal cooperation. In the case of vertical cooperation the production and service companies of different levels of supply chain are working together [2]. This cooperation is usually limited in time. The vertical cooperation can be realised either close to the customers (forward vertical integration) or close to the purchasing (backward vertical integration).

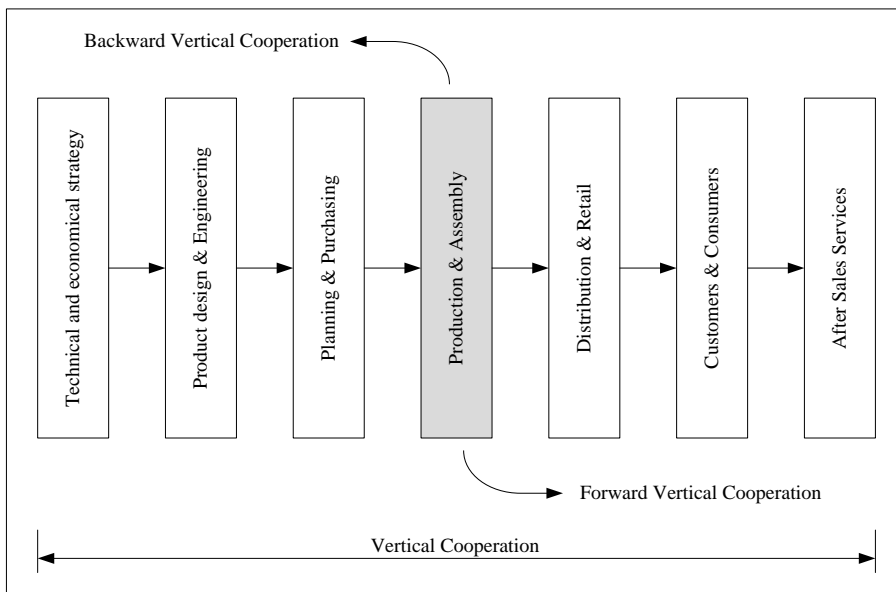


Figure 1. Vertical cooperation

In the case of horizontal cooperation production or service companies of the same branch and the same level of supply chain are working together [3, 4].

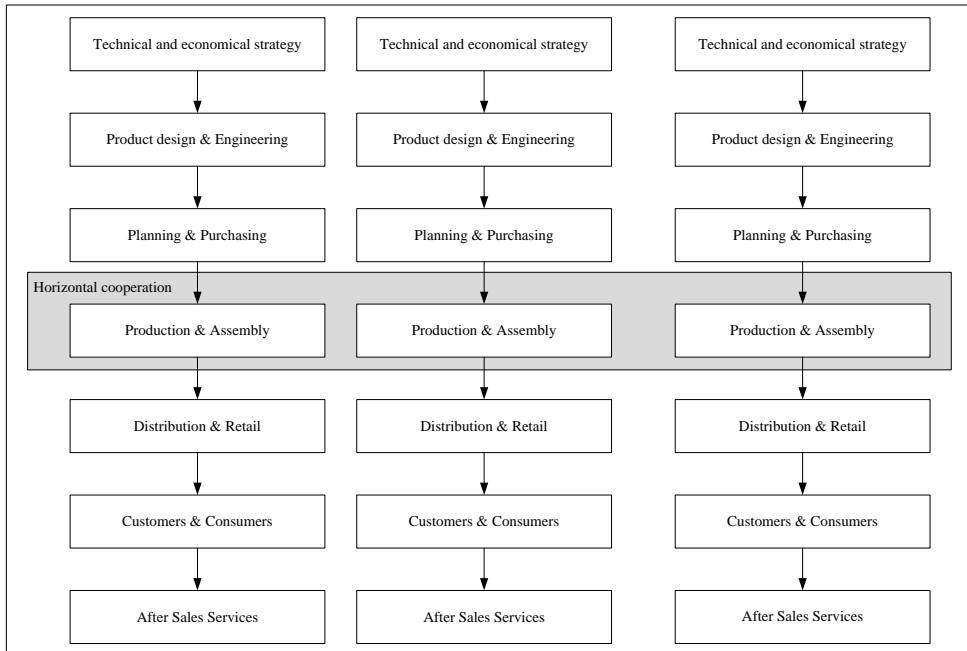


Figure 2. Horizontal cooperation

The cloud computing based autonomous logistics applications offers a new IT-based logistics service for cooperating companies, the cloud logistics [5]. The trust plays a crucial role in the supply chain processes, especially among suppliers, production or service companies and customers [6]. There is a huge number of methods, by the aid of which it is possible to optimise the cooperative processes of supply chain, such as cooperative game theory [7], EPM and alternative cost-avoided allocation method [8], data envelopment analysis [9], adaptive large neighbourhood search [10], social behaviour based heuristic algorithms [11, 12], neuro-fuzzy modelling [13].

In the case of horizontal cooperation forms the most important task of the cloud logistics is to increase the advantages (reduced costs, increased market influence, managed rivalry, cross-selling opportunities) and decrease the problems (high up-front costs, low level of resource merging, cultural differences). In the case of vertical cooperation, the cloud logistics services have the same tasks. The automated multi-objective construction logistics optimisation system is one of the best cloud computing systems for logistic problems, which was developed for construction planners to optimise material supply and storage [14]. This application includes construction planners, logistics planning module, user interface module, data retrieval module and database. Within the frame of the next chapter a new concept for service as service logistics will be described, especially from the point of view optimisation, integration with enterprise resource planning and ITC technologies.

### 3. Cloud logistics

The task of the cloud logistics is to support decisions of virtual supply chain design and operation. In the case of virtual networks and processes, the core enterprise resource software is not able to coordinate all activities of members. The cloud computing technology makes it possible to develop IT solutions, which makes it possible to support the design and operation of the wide range virtual supply chain members.

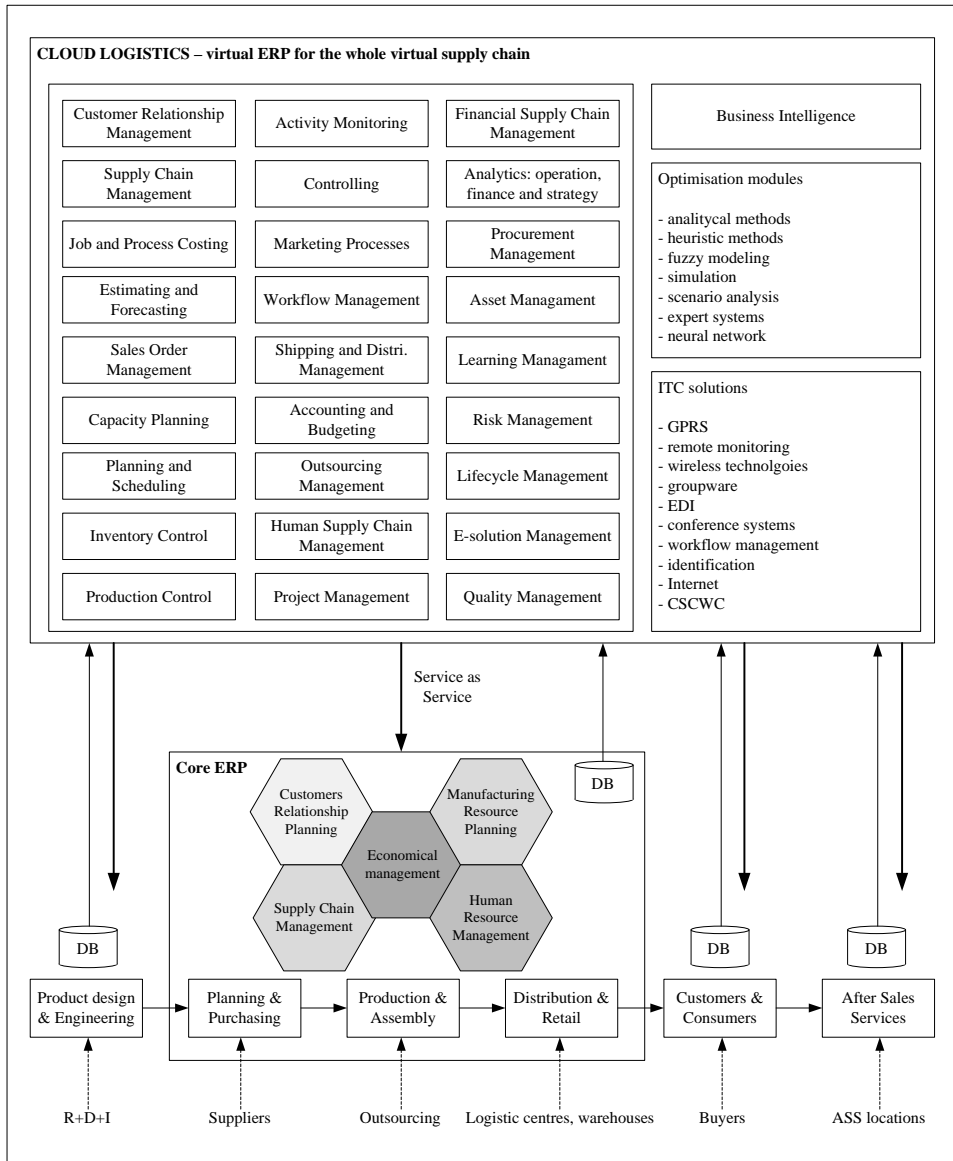


Figure 3. Core ERP and Cloud logistics for virtual supply chain

The core ERP focuses on five important areas: economic management and budgeting; manufacturing resource planning, supply chain management near to production, human resource planning and customers relationship management. The members of the supply chain belong to the purchasing, production, distribution or inverse processes, but the core ERP supervises not all of them. The product development and production engineering is realised with R&D institutions or in-house product development departments. The procurement process is based a wide range supplier set, and the production activities are partly outsourced. The distribution and retail process is based on logistics centres and distribution stores. Customers do not have a direct connection to the core ERP. After sales services are usually not parts of the core ERP, so the core ERP does not assure the management of the whole virtual supply chain. The cloud logistics solution makes it possible to offer service as service; the members of the virtual supply chain can be supported by decisions based on a shared database, business intelligence, ITC solutions and optimisation tools. The most important functions of the cloud logistics are the followings: customer relationship management; management of the entire virtual supply chain; job and process monitoring; forecasting, statistics and estimating; sales order management; capacity planning for purchasing, production and distribution; capacity planning for after sales services; inventory control; production control; project management; human supply chain management; outsourcing management for horizontal functions of the SC; choosing cooperation partners; cooperation strategy management; accounting, budgeting and business processes; shipping and distribution planning and scheduling; workflow management; marketing; logistics controlling; activity monitoring; financial supply chain management; analytics for operations, finance and strategy; asset management; learning and education management; risk management; lifecycle management for products, processes, human and technological resources; e-solutions; quality assurance and total quality management. The cloud computing can be based on different modelling and optimisation methods and tools: analytical methods, heuristic methods, fuzzy systems, simulation, scenario analysis, expert systems and artificial intelligence based tools and methods. The up-to-date ITC solutions make it possible to realise a wide range interconnection of the members of the virtual supply chain [15] and technological, financial and logistic efficiency can be achieved.

#### **4. Summary**

The globalisation of the market shows which industrial enterprises and service companies have to change their organisation structure. The establishment of cooperation of service or production companies needs specific processes to support their activities. Resources become more and more expensive. The virtuality of supply chains appears more often, but traditional ERP solutions are not always able to support virtual networks. Within the frames of this paper the author describes a cloud computing based virtual ERP solution concept, by the aid of which not only the core enterprise activities and members, but also wide range virtual members of the supply chain can be supported.

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