

## New Approaches to Supply Chain Management Concept. Logistics Integration of "Hub and Spoke" Model

Gheorghe MINCULETE  
Polixenia OLAR

"Carol I" National Defense University, Romania  
minculetegh@yahoo.com

### Abstract

*In the current modern trade, the integration of economic affairs from design to completion is an important priority, which determines all economic options of companies to focus on satisfying the needs of consumers and users to their loyalty.*

*A supply chain consists of all parties involved, directly or indirectly, in fulfilling a customer's request. The supply chain not only includes the manufacturer and suppliers, but also transporters, warehouses, retailers, and customers themselves.*

*Within each organization, such as a manufacturer, the supply chain includes all functions involved in receiving and filling a customer's request. These functions include, but are not limited to, new product development, marketing, operations, distribution, finance, and customer service.*

*This article stresses the essential aspects of supply chain management in modern economics affairs, which are integrating under the functional aspect of the "hub and spoke" model.*

**Keywords:** *supply chain management, hub and spoke model, hub and spoke system, hub and spoke network, e-commerce*

**JEL Classification:** L11, L22

### 1. Introduction

The management of the supply-delivery chain aims to intensify the processes that take place from the level of the suppliers of raw materials to that of the end customers. The aim is to increase the added value and to improve the use of resources and the efficiency of costs by bringing the required product at the indicated time and place with minimum manipulations and without delays.

A supply chain means a flow of goods, services, money and information through different situations (Tan, 2001). These units are legally independent companies, factories or offices far from each other, geographically speaking, or organizational entities that have the autonomy to take decisions regarding the information systems.

The concept of management of the supply-delivery chain is closely connected to Michael Porter's idea (1985), which expresses it as a *chain of values* based on the processual vision on organizations. According to this idea, an organization can be seen as a

subsystem composed of sub-systems, each of them with inputs, transformation (conversion) processes and outputs.

Having in mind the logistic field, the management of the supply-delivery chain is very important, because it covers the aspects that study the flows of materials and information, the acquisitions and sales from an operative point of view, such as the transports, orders and packing, but also aspects of a strategic nature, such as the competition. Although there is a large number of definitions on the management of the supply chain, this concept is more comprehensive than the concept of logistics. Thus, the management of the supply-delivery chain emphasizes in essence the mechanism of planning and control of the various economic flows from the suppliers of raw materials to the end customers (Nurmilaakso, 2003).

More concretely, the concept of management of the supply-delivery chain is problematic because the supply corresponding to the demand implies specific managerial operations such as inventories or checks of the supply and delivery of goods and services. Comparatively speaking, the management of the demand chain reflects operations like orders or customer care. Thus, in these circumstances the management of operations is not independent of the general economic situation. During times of recession, the management of the demand is often used due to more intense competition. From another view point, low competition leads in times of economic boom to a management specific to the demand. It results that the management of the supply-delivery chain can be associated both to the concept of management adequate to the supply and also to the one specific to the demand.

Experts think that the especially important role of the management of the supply-demand chain is emphasized by the arguments presented below.

*Internationalization of companies:* globalization brought us to the situation where the companies, even the medium sized ones, have branches in many countries. Because operations are carried out over an extended geographical area, emerging needs require for the rationalization of storage spaces and transports.

*Complex products:* products have become complex and a single company does not own the necessary resources to achieve them. Because the development of resources from zero requires time and efforts, it could be an option to use the existing resources of other companies. Although a product is not complex, it often needs adjustment.

*Changes in the conditions of the market:* the rapid technological development had as a result the shortening of production cycles. Because opportunities to make profit come and go very quickly, the market is rapidly flooded and new products have to be brought on the market frequently. For this reason, the needs and abilities of various commercial partners must be rapidly identified. In these circumstances, the management of the supply-delivery chain has an impact at least on the following essential objectives:

- the *response time* is the time lapsed from the moment when the customer places the order until the moment when he receives it. Because a short response time increases the degree of satisfaction of the customer, this objective increases competitiveness;
- the *level of stockpiles* has an important effect on profitability because a small stockpile reduces costs. It also reduces the risk of products ending their shelf time.
- the *total time* is the sum between the time of conversion of raw materials into end products and the waiting time. In principle, competitiveness and profitability should not exclude one another. In practice, the growths of safety stockpiles may reduce the response time. Similarly, a longer response time leads to reduced stockpiles. Because a shorter total time produces more rapid reactions, this opens the way toward the improvement both of competitiveness and profitability.

The capacity to capitalize on / use the own production potential plays an important role. On the one hand, under usage erodes both competitiveness and also profitability because slow employees and obsolete equipment generate costs and not income. It is possible that these costs be balanced with the income, but the adjustment of capacities / potential may be costly in its turn. On the other hand, over usage rapidly erodes capacities. Although profitable on a short term, the deterioration of capacities can be very costly on a long term. In order to improve the use of capacities, the company must be capable of selling its own capacity when this thing is possible and of buying capacity when it is necessary (Nurmilaakso, 2003).

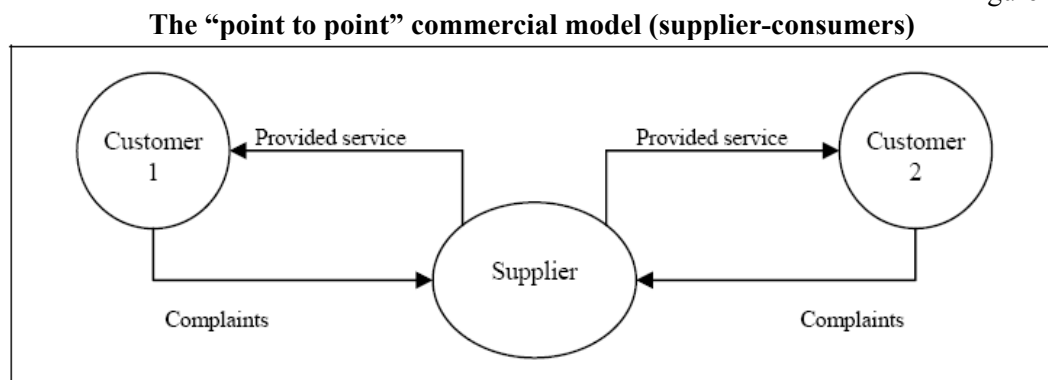
Specialty studies revealed the level of logistical costs between 10 and 35% of the gross income of companies. Out of these logistic costs, 60% are destined to the transportation of goods. A study conducted by the consultancy firm PRTM considers the companies with the best practices in moving products within the market as the organizations that enjoy an advantage of 45% from the point of view of the costs of the supply-delivery chain in comparison with the average of the competition (Abdinnour, 1999).

## 2. Functional aspects specific to the management of the supply-delivery chain

In the conditions of a complex and ever more dynamic modern market, the necessity arises to immediately identify and satisfy the requirements of current and potential consumers by using simple commercial systems (the "point to point" model) or within a network (the model of the supply-delivery chain), which will allow efficiency and profitability on a medium and long term.

If a solution of the point to point type is specific to a certain commercial partner, the implementation costs can be very high. In this case, a profitable solution requires a long term relationship and a high volume of transactions. Figure 1 presents the commercial relationship between supplier and customers, which later requires the integration in the supply-delivery chain, according to the domain of reference and specificity of the business.

Figure 1.



(Source: [http://www.ipsera.com/assets/documents/ancarani\\_cp.pdf](http://www.ipsera.com/assets/documents/ancarani_cp.pdf))

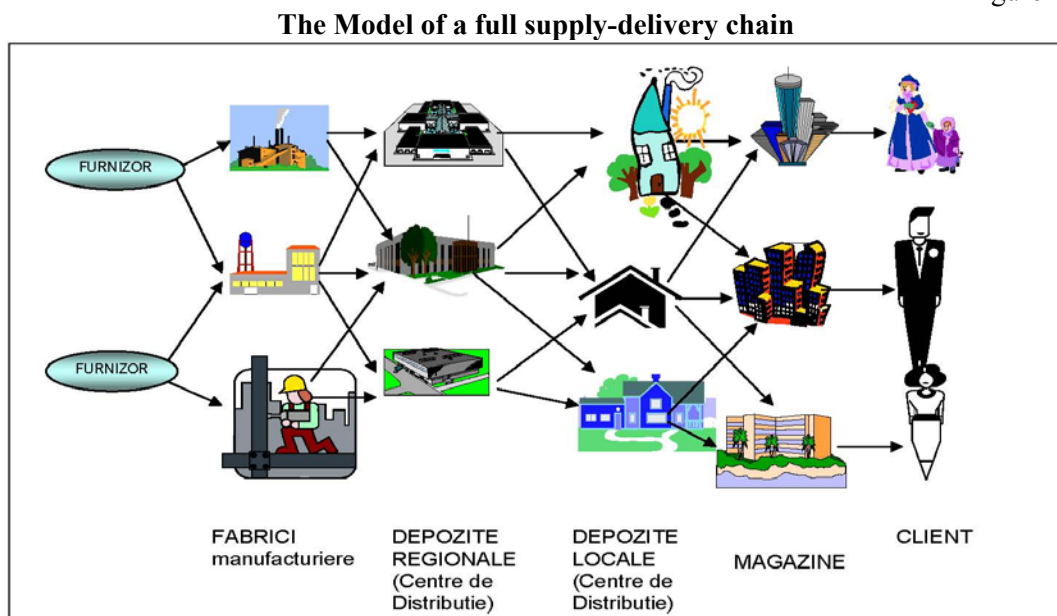
Because the commercial model previously presented is limited from the point of view of the engaged resources (human, material, informational) for the capitalization of the business potential of a company, the economic practice recommends as being extremely

efficient to integrate the producing, supplying and service providing companies in supply-delivery chains that are adequate to their field of activity.

In order to produce / provide the goods / services required by the market, companies need to integrate themselves in supply-delivery chains. Thus, they economically relate with "upriver" partners that is with suppliers of raw materials and providers of specialized services, as well as with "downriver" partners, meaning firms specialized in transport and distribution to customers (consumers and end users)(Kotler & Keller, 2008).

According to the economic theory and practice, for an adequate functioning of a supply-delivery chain, it must have, within its structure, the following types of firms and beneficiaries: suppliers; producers; storehouses/silos; transporters; distributors (wholesalers and retailers);\* consumers/end users. At the same time, within any supply-delivery chain a number of complex managerial processes take place, such as: the management of materials, the management of acquisitions; the management of demands; the management of storehouses, the management of transport, the management of distribution of materials etc. Figure 2 emphasizes the structures and relationships within a full supply-delivery chain.

Figure 2.



Within a supply-delivery chain specific processes of integration of the structures composing it take place. Thus, the integration can be internal or external and it requires a lot of communication.

The *internal integration* occurs within an organizational component. It refers to the integration of the applications from the various sales software and the systems of the individual users. Experts suggest five approaches internal integration. These are oriented toward data, toward the interface of the application, toward the method, toward the portal and solutions oriented toward the process of integration (Goldfarb & Prescod, 2002).

The *external integration* occurs between organizational components. These are components within the same company or they belong to different companies. The external integration includes the exchange of information with customers and suppliers at the same time, as well as activities carried out through intermediaries. In the traditional trade, each customer and each supplier can be automatized at an internal level, by connecting the systems using manual processes such as the mail, fax or telephone. Through the web page of the shop, the customer can see the supplier's catalogue of goods and services and can place orders directly in the system. Nothing is necessarily automatized in what the customer is concerned. In the case of an electronic commerce portal, the customers enter the portal in order to see the supplier's catalogue and to place orders. The suppliers enter the same website in order to see the orders and to honour them. Within the electronic integrated commerce, the systems of the various companies exchange information directly, which eliminates the manual processes (Goldfarb & Prescod, 2002).

In order to adequately correlate, relate and coordinate the firms integrated in a supply-delivery chain, an adequate management is applied, which ensures a precise distribution of resources and an exact synchronization of activities within a specific mechanism of functioning. In the best-case scenario, the management of the supply-delivery chain ensures a smooth specific functioning which reduces the response time, the total time, the level of the stockpiles and it improves the capacity of usage. In the worst case scenario, its failure leads to the redistribution of rewards and risks, which is costly and does not create added value.

The model of reference of the specific operations within the supply-delivery chain (according to the requirements of the Council of the Supply-Delivery Chain) emphasizes a description of the specific processes, which are the planning of business, supply, production, delivery, as follows:

- *The plan*: the planning of the demand/supply;
- *The source*: supply/acquisition of materials, the management of the supply infrastructure;
- *The production*: achievement/execution of the production, the management of the production infrastructure;
- *The delivery*: the management of orders, the management of stockpiles, the management of transports and installations, the management of delivery infrastructure (Nurmilaakso, 2003).

This model requires that participants in the creation and functioning of the supply-delivery chain achieve a continuous exchange of information.

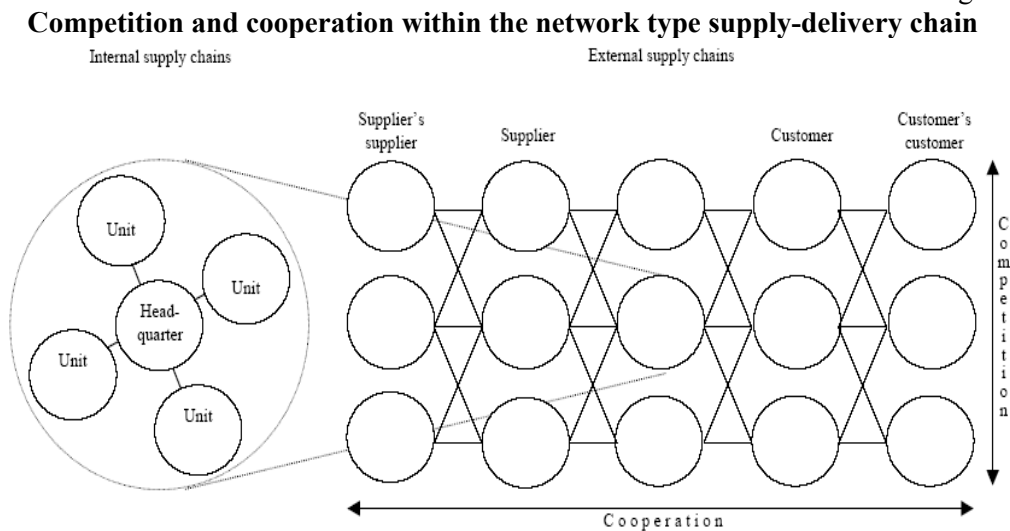
If we have in mind the supply sources (suppliers) necessary to a company that produces the products required by the various markets, we must have in mind the specific relationships within the supply-delivery chain related to the procurement of raw materials required by the production process of that company. Thus, within this functional mechanism, the suppliers within the supply-delivery chain get involved in the management of the stockpiles of the producing company, with which they have normal and legal business relations, by using the *stockpile managed by the supplier* system (Kotler & Jain & Maesincee, 2009). To this end, the producing company transmits to the mentioned suppliers information with regard to the planned demand, the current situation of its stockpiles, other logistical elements etc. The information obtained allows suppliers to intervene at the right moment to complete the stockpiles. Acting in this manner brings about the positive economic effects expected within the producing company, which make reference to the reduction of the length of the projected production cycle, of the number of

personnel employed, as well as the level of the total costs. At the same time, it increases the precision within the supply-delivery chain regarding the materialization of the economic flows: *inputs - conversion - outputs - distribution - full satisfaction of the requirements of the consumers / users* (Kotler & Jain & Maesincee, 2009).

According to the statements of the experts, there are four major decisions that need to be taken by the managers involved in the functioning of a supply-delivery chain: the way in which orders are processed (managed); the positioning and management of stockpiles; the delivery (transport) of the goods to customers (Kotler & Jain & Maesincee, 2009).

The company cooperates with its customers and suppliers, who in their turn are in competition with each other. Figure 3 illustrates the fact that a company can have several branches and can be involved in several supply chains at the same time. Similarly, these customers and suppliers can cooperate with the competitors of the company. There is an equilibrium between competition and cooperation. Because management refers to decision making, which requires information, the management of the supply chain requires integration, which requires an exchange of information between participants. For this reason, the basic challenges have their origins in the difficulties to achieve an equilibrium between competition and cooperation between the participants in the supply-delivery chains.

Figure 3.



(Source: Nurmilaakso, 2003)

Figure 3 emphasizes a functional mechanism in the supply-delivery chain, which reveals both its internal and its external side within the relational mechanism of the network. The mentioned participants are not only different units within the same company, because they often belong to different companies. The first case is linked to an internal supply-delivery chain, because a participant has authority over the others. The second case is linked to an external supply-delivery chain, because all participants have autonomy. This latter case is more difficult than the former from several points of view. According to experts, because the functionality of a supply-delivery chain is based rather on

cooperation, competition is not necessary between the participating companies, but between supply-delivery chains. However, the supply-delivery chains are not isolated, but they often form a supply network.

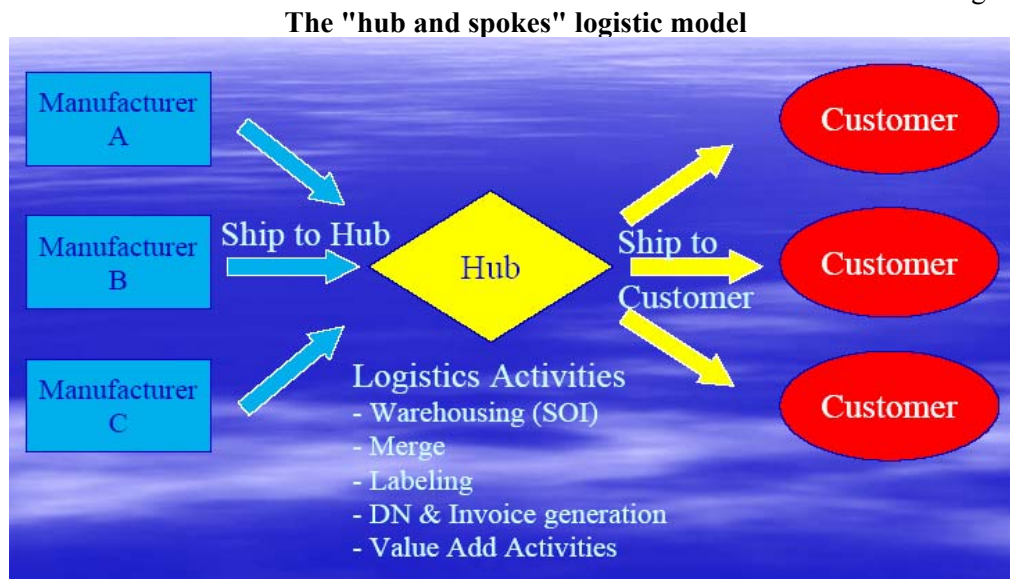
### 3. The integration of a "hub and spokes" model in the management of the supply-delivery chain

Companies that seek to expand their business but to preserve their advantage in relation to their competitors must overcome the discrepancies that might appear between the various components. In this context, the "hub and spokes" model facilitates a smooth integration of the processes, ensures a good hierarchy and reduces the operational and maintenance costs.

Within the "hub and spokes" model, all deliveries go through a central distribution hub, often strategically located. The resulting map looks like a bunch of spokes with a hub in the centre.

The hub is, almost literally, in the centre of attention. If the hub is too far from the geographical centre, the time and cost of distribution are negatively affected. If the hub is too far from the airport, port or railway station, this will lead to an increase of the operational costs. Figure 4 presents a "hub and spokes" logistic model that includes producers (spokes), intermediaries (wholesalers) and customers (spokes) (Lin & Lin & Lin &, 2003).

Figure 4.



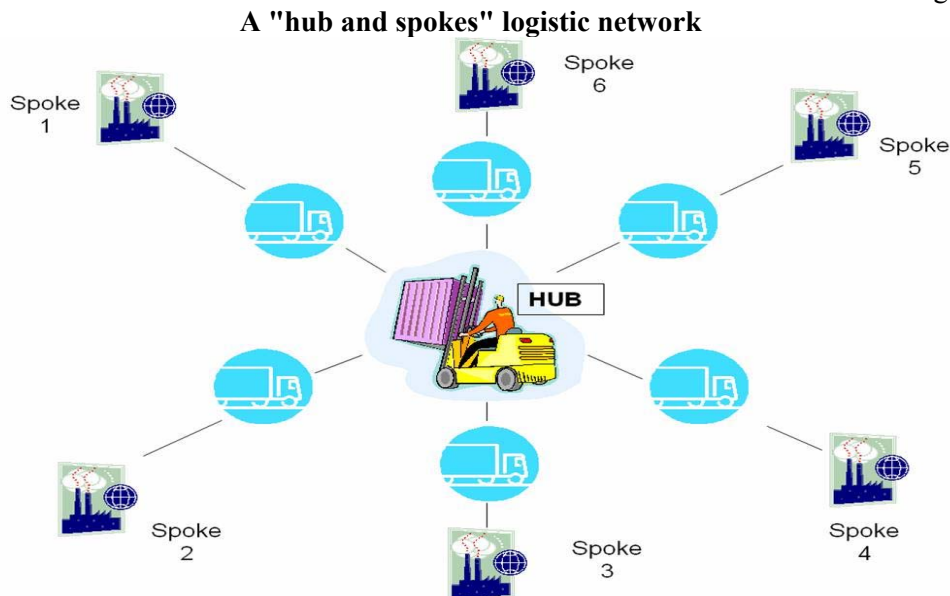
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The location of the hub is essential and the entrance and exit of goods must be done without blockages. Other factors are the storage costs, taxes, availability of alternative routes and so on. It could be recommendable for several hubs to exist, but this will lead to a more complicated functionality.

If deliveries are constantly late or lost in transit and the distribution logistics go out of control, it means that the time has come to take into consideration the hub and spokes model.

In the field of transports, a distinction is often made between the direct transport and the one conducted according to the "hub and spokes" model. The direct transport is a connection between two points, which means transports that go in a single direction. The characteristics of the "hub and spokes" systems refer to their organization under the shape of a star. The hub is the nodal centre from where transports are done toward all the spokes (Figure 5).

Figure 5



(Source: <http://sinaslogisticsblog.blogspot.ro/2010/04/hub-and-spoke-system.html>)

The "hub and spokes" model is applicable to the following forms of transport ([http://en.org/Spoke-hub\\_distribution\\_paradigm](http://en.org/Spoke-hub_distribution_paradigm)):

- *The road transports* imply heavy transport vehicles which require standardized loading equipment (freight cars, pallets, boxes, caterpillars etc). The routes of these transport means can be from "spoke" firms (suppliers, producers etc) to "hub" firms (wholesalers, retailers etc), which manage specialized commercial storehouses, and from here to consumers/users (companies or individuals);

- *The transport of goods on railway*, in which the loads are transported to a central terminal. At that terminal the containers are moved on other cars, and the railway yards are used to select the cars and compose the trains according to their destination;

- *The air transport* implies smaller airports as "spokes" from where the flows of transport are directed to airports with large traffic potential of the "hub" type. If we have in mind the flows of goods, we can consider (for example) that most of the flights of company A go through the International Airport B, and a significant part of the FedEx Express packages are processed in the "Super Hub" situated in the International Airport C. This already reveals a "hub and spokes" system that is adequate to this type of transport.



- *The maritime transport*, where small ships transport containers from various ports to a central terminal where the containers are loaded on larger ships.

- *The public transport of people* uses various hubs which allow passengers to make transfers between transport lines and transport means.

- For the *individual transport*, the "hub and spokes" model does not apply because drivers in general choose the shortest route between two points.

The "hub and spokes" model in the field of logistics (presented in figures 3 and 4) can be incorporated in the modern commerce. This model is usually based on a traditional and electronic market that connects the hub company to the spokes firms. In this way the commercial models are applied to businesses of the types B2B (Business-to-Business) and B2C (Business-to-Consumer). And here, through the "hub and spokes" model, the commercial partners are integrated through a hub. Thus, most electronic logistic networks of the "hub and spokes" have a single form of allocation, a single option, as well as a complex system of transport routes from the demand points toward the hubs.

The transactions within the supply chains which require businesses specific to the electronic commerce include flows of information, products and funds. For example, the following transactions can be carried out in the virtual space: providing information about the products to participants in the supply-delivery chain; placing orders with suppliers; permission given to customers to place orders; permission given to customers to monitor the progress of the order; filling out and transmission of orders to customers; reception of payments from customers (Chopra & Meindl, 2004).

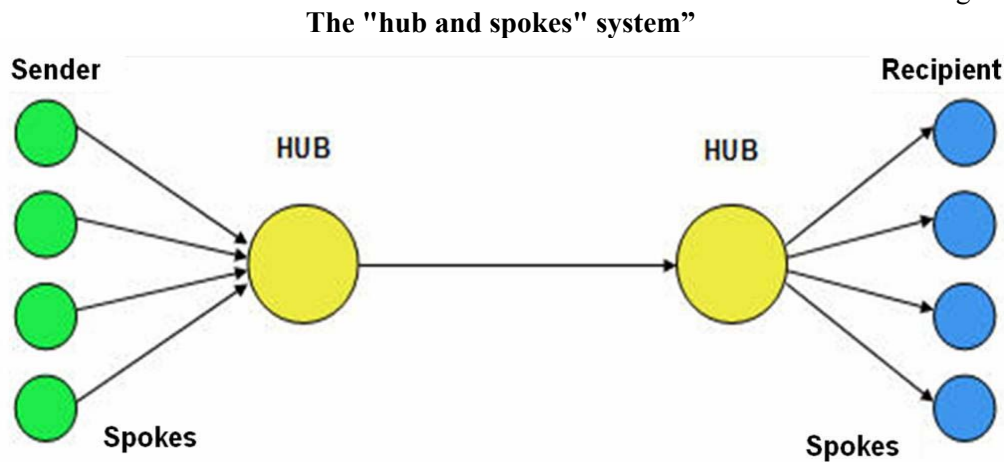
Thus, in the field of electronic commerce the network is not just a broker, but also an intermediary that creates demand for the suppliers and supply for the customers. The commercial accord is prepared manually between the intermediary and the commercial partner. The "hub and spokes" model is limited to interactions such as the search for products, the updating of catalogues, orders and auctions in the virtual space and operations of reading and writing within the portals. In order to reach a critical mass of commercial partners, specific standards with maximum applicability are necessary.

The initial growth in the electronic commerce was recorded in the B2C supply chains. The best known example is Amazon.com, which started to sell books on the internet and extended to music, toys, electronic products, software and others. However, most businesses in the virtual space are conducted between companies. At General Electric, the employees order office supplies on the internet from already selected retailers. Ford Motor uses the internet to facilitate the cooperation between the engineers in the entire world in order to collaborate on various projects with the aim to create basic components that can be used (Chopra & Meindl, 2004).

The "**hub and spokes**" system is the best known network system. The spokes in the network constitute transport services between regional terminals and hubs. The hubs are terminals or, in the case of railway systems, they can be railway nodes. Within the hub, the transports are conducted from one line to another that connects the hub with the terminals of destination. Ideally, the hubs are located as close as possible to the gravity centre of the transport demand. This way the distances to be covered and the duration of the transports between the terminal of origin and those of destination are minimized. The total time of transport from terminal to terminal grows due to the supplementary distance necessary for the transport to the hub and to the time spent in the hub. A "hub and spokes" system is created in order to combine the small flows that come and depart for different directions (Chopra & Meindl, 2004).

Within the "hub and spokes" system there are pre-established transfer/re-loading points that are usually situated near important transport routes and that are used for the transfer of goods to regional distributors (Figure 6). The hubs describe the re-loading points, while the spokes mark the flow of goods from and to the hubs.

Figure 6.



(Source: <http://sinaslogisticsblog.blogspot.ro/2010/04/hub-and-spoke-system.html>)

A hub and spokes network is a centralized and integrated logistic system created in order to keep the costs at a low level. The hub and spokes distribution centres receive products from many different directions, they consolidate them and send them directly to their destination.

A "hub and spokes" logistic network is composed of hubs that have the role to carry out transfer operations (like, for example, to re-assemble and re-direct loads composed of smaller units) and of spokes or storehouses that have the role to connect the end customers with the hubs (Zapfel & Wasner, 2002).

The mother companies and their subsidiaries or divisions have different needs and that is why they need different business systems. The data within these different business systems must, however, be integrated so that the organization functions as a whole. A system that is suited to this end makes possible for the organization to develop effectively as a business unit, within which the mother company acts like the hub of a wheel, and the subsidiaries like its spokes.

While the "hub and spokes" model is currently predominant in organizations, it is followed by the centralized model within which a single company maintains a constant in the field of social and media efforts. We can observe this in fields like medical assistance, finances, pharmaceuticals and in the case of a number of car manufacturers in order to preserve a sensation of control in a coordinated manner.

Most often, companies launch a centralized multifunctional group (often known as Centre of Excellence) in order to serve the various components through a common set of services, models, software and knowledge. Within the "hub and spokes" model the strategic decisions are mostly taken inside the hub, the results being later directed to the components that form the spokes.

#### 4. Conclusions

A successful management of the supply-delivery chain requires many decisions regarding the flow of information, products and funds. The conception, planning and operation of a supply chain have a strong impact on the profitability and overall success of the company. The planning of the supply-delivery chain establishes parameters within which a supply chain can function for a certain period of time. During planning, companies must include in their decisions a certain degree of uncertainty with regard to the demand, exchange rates and competition for that period of time. Due to shorter periods of time and better prognoses than the ones during the conception phase, they try to incorporate any flexibility included in the supply chain during the conception phase and to exploit it in order to improve the outcomes. As a result of the planning phase, companies define a set of operational policies that govern their short term operations.

Within the operations of the supply-delivery chain, the time frame is weeks or days, and during this phase companies take decisions regarding the individual orders placed by customers. At operational level, the configuration of the supply-delivery chain is considered to be a fix one and the planning policies are already defined. The aim of the operations of the supply chain is to manage the orders placed by customers in the best way possible. During this phase, firms allocate stockpiles and production to individual orders, establish a deadline until which the order has to be honoured, generate lists of transport at storehouses and place order to replenish their stockpiles. Because operational decisions are taken on a short term (minutes, hours or days), the degree of uncertainty with regard to the information about demand is reduced. Due to the constraints established by the configuration and planning policies, the aim during the operational phase is to exploit the reduction of the degree of uncertainty and the optimization of the performance.

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