The organization of spare-parts of capital goods

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Overview

According to a study by Aberdeen Group (2005), global spending on after-sales services totals more than 1,500 billion US dollars annually. Spare-parts sales and services in the United States accounted for 8% of the annual Gross Domestic Product. Deloitte (2006) carried out a study among a group of more than 120 large Original Equipment Manufacturers in Europe, North America and the Asia-Pacific region with combined revenues of more than 1,500 billion US dollars. They reported that 26% of these revenues (390 billion US dollars) came from services. This means that the customer pays for maintenance and uptime of the capital good.

Spare-parts availability is an important part of the uptime of a “capital good”. Capital goods are machines or products used by manufacturers to produce their end-products or by service organizations to deliver their services. The acquisition cost of one capital good may vary from a couple of thousand dollars (e.g. the X-ray scanner from Philips, $200,000) to a couple of million (e.g. …en though the acquisition … Therefore, the capital

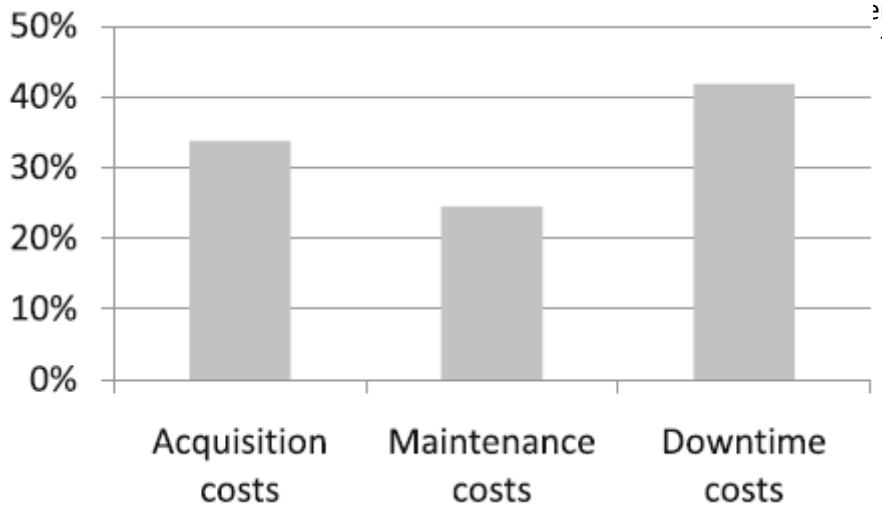

Figure 1: The acquisition, maintenance and downtime ratio's for capital goods.

What is being organized?

The spare-parts and the mechanic availability are the main resources being organized, these have all a physical format. These resources ensure that the machine meets the requiring service degree (e.g. 99%). We can classify the spare-parts in two different categories. The critical and the non-critical parts. Since we are only interested in the organization of the spare-parts affecting the service degree, we disregard the non-critical spare-parts. They may all be organized in the central warehouse since the demand and the need stay low.

The unit of analysis is the spare-part with mainly its extrinsic properties. The most important extrinsic and intrinsic properties are the price and demand rate respectively.

One important design question of the organizing system is the granularity. The resources are often aggregates of other resources. An example is a radiator or dynamo. They can be disaggregated by the

different resources. An example of resource with the lowest granularity are: screws, frames, ball-bearings, and pipelines. Important design questions to decide the level of granularity are: “How much time does: the disassembly, the collection and the reassembly take?” and “How large is the storage cost for the difference situations?”

The organizing system has to be designed in such a way that a collection of resources may be changed continuously. A warehouse provides spare-parts to many different users with some overlapping resources between the capital goods. This means that the uniqueness of the resource differs. For example, a screw may be used for many other machines while a specific lens for only one specific machine.

The difference in the size, availability, and production costs of spare-parts is large. This may differ from a simple screw to a specified lens engineered specifically for a capital good. The cost of manufacturing may differ from $0.01 to $150,000.

Why is it being organized?

The main purpose in this organizing system is organizing the resources in such a way that the service degree requirement is met. The second objective is minimizing the corresponding cost with this solution.

The main difference between organizing systems for spare-parts from capital goods or consumer goods is the demand rate. This is in the first place due to the objective of a failure. A capital good manufacturer loses money by downtime of the capital good, while a consumer goods manufacturer earns money by downtime of the machine. In addition, the important incentive of a different organizing system is the demand (i.e. the number of sales). For example the airport baggage handling systems sold is much lower than the number of BMW 3-series sold. This results in a lower demand of baggage handling system spare-parts than BMW spare-parts. Therefore, organizing the spare-parts of capital goods requires another approach than organizing the spare-parts of consumer goods.

The chance of a failure together with the low amount of spare-parts results in a low total demand. The downtime of the machine is very expensive, which requires a fast response time in order to fix it. The next question: “Where are the spare-parts stored?” has to be taken into account for the different service areas. Other important factors influencing the decision of storage are: the cost of transportation, the response time, the costs of storage and labor, the political situation, the size of the resource, the granularity, and the demand rate.

How much is it being organized?

The size of the resource collection is very big, the number of resources to be organized is a couple of thousand for one capital good. This number depends on the granularity of the resource which may cause a serious reduction in the amount of resources organized. However, this probability is fairly small since the expenses of having a many resources combined are high.

The number of intended users is fairly small which simplifies the organization of the user requirements. The only interaction the user has in this organizing system is the notification of failure. In some cases this may be automated but in many cases this still is not. The user still reports an error to the organizing system. They arrange the availability of the resources. Think about the earlier mentioned spare-parts and mechanic.

When is it begin organized?

For most companies, the spare-parts organization structure has already been decided by default by the first production of a machine. This is mainly due to the, at first sight, not crucial importance of the spare parts. Secondary, the main concern when starting a company is getting the machines running and delivering a competitive product. The spare-parts management is in many cases implemented in a later stage which makes it more difficult to make an optimal solution. In order to be optimal, the entire system has to change in many cases. Sometimes, the organization is also done based on best practices because they do not have the knowledge in-house.

The resources are created as soon as the capital good is delivered at the user. From this moment, the resource provider is responsible for the up-time of the capital good. This needs the resource availability. The number of locations served by the warehouses change continuously which makes it a continuous process organizing the resource.

Whenever a new resource a resource is selected for inclusion in this organizing system, two important questions will be asked i.e. “What is the cost of the resource?” and “What is the demand rate?” The reason for inclusion is the necessity of the resource in order to meet the requirements.

How or by whom, or by what computational processes, is it being organized?

In mathematical terms is the service degree requirement a constraint and the cost minimization the main objective. This creates essentially only one possible outcome if only these two entities are considered.

The spare-parts are being organized by optimizing the different characters of each resource. However, more characteristics play a role.

Where is it being organized?

The location where the spare-parts are held is a local or central warehouse. The location of this warehouse depends on many different things. Important factors are the distances to the different serving areas, the cost for having a warehouse in a particular area (think about: tax rates, land prices, construction costs, maintenance costs, worker availability).

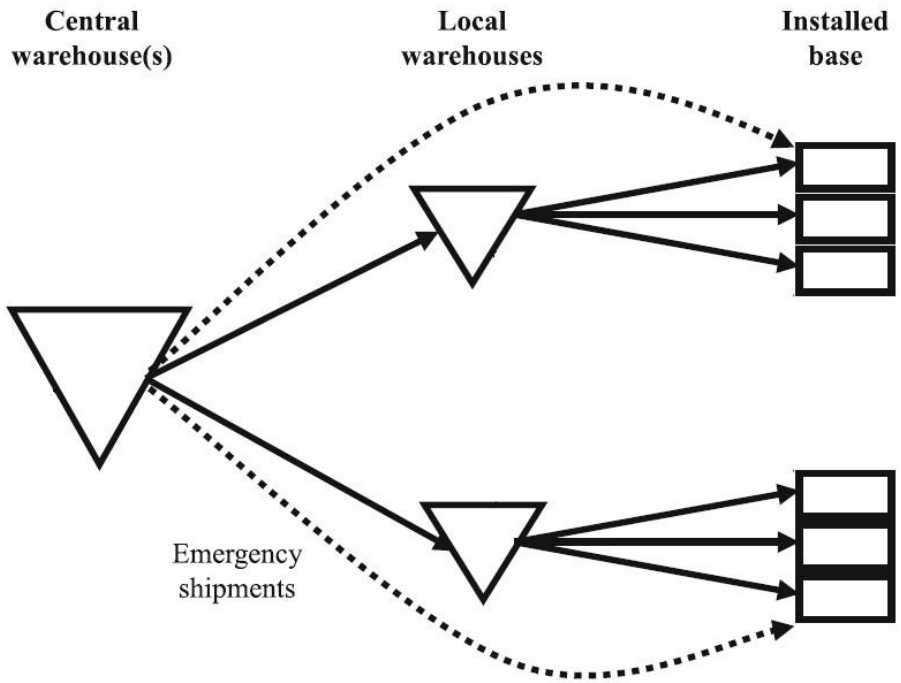

Figure 2: Our organizing system with a central warehouse serving multiple local warehouses and each local warehouse serving multiple service locations (installed base).

In addition, the general rule is the expensive resources with a low demand rate are organized in the central warehouse and the cheap resource with high demand are located in the local warehouse. So this is done by the price demand ratio. The higher the ratio, the higher the chance of being organized in a local warehouse.

The way this organizing system could look like in the United States can be seen in figure 3.

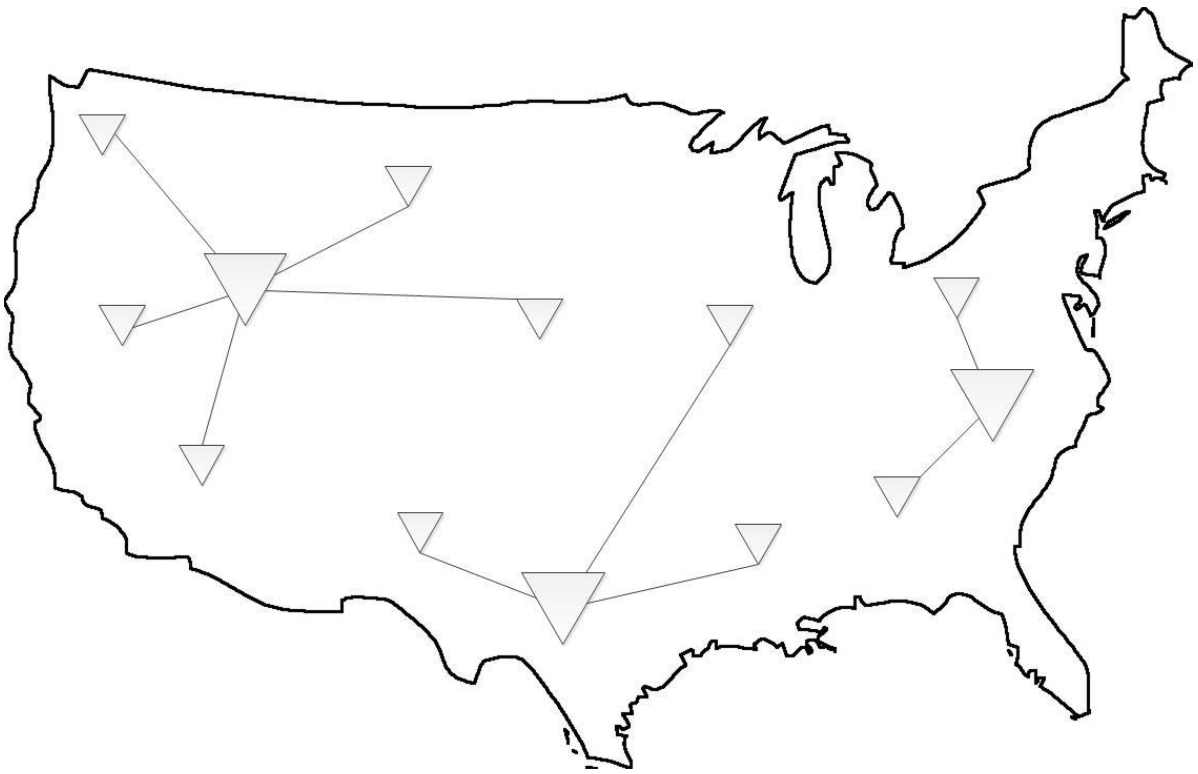

Figure 3: Case study example of our spare-parts organizing system with three local warehouses and ten local warehouses.

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