

Chapter 2

AUTOMOBILE PRODUCTION AND DISTRIBUTION

Abstract In this chapter we take a look at the ongoing globalization process of the automobile industry. Thereby we explain the increasing transportation volume currently observed in the face of a stagnating automobile production.

We argue that an increase in number is caused by two impacts. First, production is outsourced in order to benefit from lower salaries in transition countries. Furthermore, currency exchange risks are alleviated. Finally, a production close to foreign markets may help to conquer foreign markets. We show, that next to the obvious reasons above, also the organizational structure of a multinational firm accounts to the vehicle transport volume imposed.

We describe challenges for outbound logistics resulting from distribution strategies in a globalized production before we describe the hub and spoke concept as an answer of the transport industry to the demand raised by modern vehicle distribution. Finally we sketch benefits gained by logistics service providers who aim at the holistic support of a distribution network.

2.1 Trends in Automobile Production

Automobile production has always been an important segment of the industries of North America, Japan and Western Europe. The technical complexity of automobiles led at an early stage to pioneering production techniques, which later on were often transferred into other industrial sectors. In this way automobile production was a driving force in the development of the industrial nations in the 20th century.

2.1.1 A Quick Glimpse to History

From the beginning of the automobile industry, manufacturers have recognized the importance of the economies of scales resulting from the

Table 2.1. Distribution of the share (in %) of foreign direct investments undertaken by the German automobile industry. Three years are selected to typify the last two decades. Investments in regions of particular interest are displayed in bold face.

Region	1981	1990	1998
EU central	15.0	23.1	14.2
EU periphery ^a	10.8	24.4	7.7
America	40.4	23.3	12.7
Africa ^b	10.6	5.8	1.3
Asia ^c	—	1.0	0.4
Other industrial countries	21.4	20.0	52.7
Other transition countries ^d	—	2.4	11.0

^a Ireland, Portugal and Spain.

^b Rep. of South Africa and Nigeria.

^c excluding China.

^d including China.

high investments required for vehicle mass production. Before the Second World War, Ford and General Motors aimed at extending their market share by undertaking investments preferably in Europe. At that time, the increasing automobile market allowed a co-existence with the domestic manufacturers of Europe.

After the Second World War, Japan successfully entered the market, mainly because of a significant reduction of the production costs achieved by means of new production and distribution systems (Amasaka, 2002). The Japanese manufacturers produced automobiles in extremely large numbers and shipped these vehicles to their export markets worldwide, see Borstnar (1999) for a comprehensive treatment of this topic.

During the 1980s, Japanese manufacturers began to produce in closer proximity to their export markets abroad, while American and European manufacturers started to engage Japanese production technology. Although the relative advantage of the Japanese manufacturers gradually declined, Japan had already established itself as a third important region of automobile production.

The economic pressure triggered by the Japanese competitors has led to foreign investments also being made by European manufacturers. Table 2.1 lists direct foreign investments of German manufacturers for selected years as compiled by Spatz and Nunnenkamp (2002). One clearly observes the massive engagement in South- and Central America, as well as in South Africa in the 1980s.

In the 1990s, fallen customs barriers in Europe have caused a shift of the investments abroad towards the low-income countries at the European Union (EU) periphery. Recently, the political developments in the countries of Central and Eastern Europe have drawn foreign direct investments towards this emerging region (Tulder and Ruigrok, 1998).

The continuous investment of the automobile industry has led to a change in the share of the production abroad compared to the domestic production volume. In 1990 already 26% of the German cars were being produced abroad; this figure had increased to almost 44% by 2000 (Verband der Automobilindustrie, 2002). Since this trend also holds for manufacturers located in other industrial countries, we are going to take a closer look at the way investments are undertaken.

2.1.2 Shift Towards Emerging Markets

Since is manpower-intensive, one can observe a drift of production towards low-income countries. However, the complexity of operations requires a relatively high industrial standard, such that transition countries like South Africa or Indonesia receive particular attention as candidates for automobile production (Pontrandolfo and Okogbaa, 1999). As transition countries are also emerging markets for automobile manufacturers, local distribution and services can easily be established as a side effect of an investment in production facilities.

Some transition countries like Malaysia protect their local production (Proton) by imposing import tariffs, sometimes in the range of a multiple of the product's value. According to Lüders (2001), Malaysia levies up to 300% customs duty on automobile imports. Custom rates can usually be alleviated or even be avoided by adding a local content to import automobiles. For the case of an import market of limited capacity, cars are typically shipped in parts, which are then assembled by making use of the local workforce.

Dependent on the level of pre-assembly of the parts shipped, we distinguish between "semi knocked down" (SKD) and "completely knocked down" (CKD). With SKD, a relatively small portion of cars are delivered in a semi-assembled fashion, whereas with CKD only parts are delivered for later assembly in the destination country. In the same vein, finished vehicles are sometimes referred to as "completely built up" (CBU). SKD/CKD solutions do not require an intricate management of supply and inventory of parts, which eases the implementation of an assembly plant as an initial investment in a transition country.

Whenever an emerging market exceeds a certain capacity, the country is considered for a "transplant", abbreviating a transferred plant. Besides the supply to the local market, automobiles are also produced for

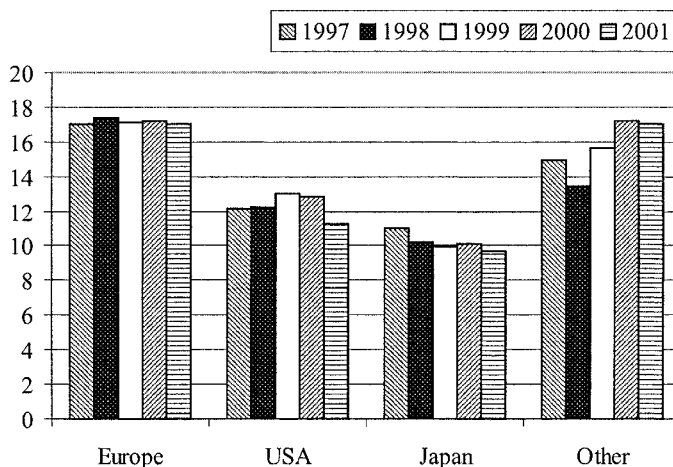


Figure 2.1. Automobile production in millions between 1997 and 2001 and main regions of production. The figures are compiled by the author on the basis of material provided by Ward's Communication (various issues).

export. In this way, economies of scale can be achieved and, moreover, the export surplus gained can be balanced with incidental import customs (Kuhn, 1998). As an example, Kuhn describes the development of a South African plant from a CBU importer to a SKD producer, and finally to a CBU exporter of niche products, i.e. right steering versions of certain Mercedes models.

Typically, local suppliers contribute to the local content of a transplant, leading to new sources of supply for other locations of the manufacturer, too. In this way, an interwoven logistical network emerges. For a comprehensive study with regard to the development of the Bayrische Motorenwerke (BMW) production at Spartanburg, South Carolina, see Dornier et al. (1998, Chapter 9-1).

Apart from the above-described foreign investments, local investments in automobile production exist, too. Borstnar (1999) describes the role of the Korean government as entrepreneur for the automobile industry. Similarly, China is expanding the production of automobiles to serve its protected local market, while currently lacking international competitiveness.

Summarizing, we observe a gradual decline of automobile production in the triad, namely North America, Japan and Western Europe, in favor of other countries, as illustrated in Figure 2.1. With the exception of China, these countries at least partially produce for export, while the main markets for automobiles continue to remain in the industrial

	degree of hierarchical control	
	weak	strong
internationalization	multidomestic	worldwide
globalization	multiregional	transregional

Figure 2.2. Possible configurations of multinationalization.

countries of the triad. Therefore, we can expect an increase of vehicle transportation due to the diversification of automobile production.

2.1.3 Multinational Configurations

Transportation demand may be estimated in more detail by considering the imbalances between production and sales within a geographical region on a per model level. For instance, a surplus of Mercedes M-class production in Tuscaloosa, USA, cannot offset the existing demand for S-class cars in North America, so that S-class cars have to be shipped from Sindelfingen in Germany.

In order to assess whether demand imbalances contribute to the transportation demand in general, and whether they will increase in the future, global strategies of the automobile industry are considered in the following. See Pontrandolfo and Okogbaa (1999), for an introduction into global manufacturing issues, Bélis-Bergouignan et al. (2000), for a transition model of global strategies for the automobile industry and finally Kuhn (1998) for the implementation of the model at Daimler Benz AG (now Daimler/Chrysler).

With respect to the above literature, Figure 2.2 considers different configurations of multinational corporations with respect to the principles of hierarchy and the degree of hierarchical control. Internationalization as a principle of hierarchy refers to the process of expanding a corporation’s sphere of operation without any change to its initial structure. This means that only unilateral flows exist, originated at the center. In contrast to this, globalization involves multilateral flows in a poly-centric system. Both principles may appear with either a weak or a strong hierarchical control of the firm’s activities.

- A *worldwide* configuration refers to an automobile manufacturer building and selling more or less identical automobiles worldwide, governed by a strong central control. Next to sales, also marketing, after-sales and service activities are centrally controlled. Although this configu-

ration may not fully satisfy foreign customers, it allows the manufacturer to switch easily between production in different geographical regions and transportation into these regions. Many Far Eastern manufacturers like Toyota stand proxy for the worldwide configuration.

- A *multidomestic* configuration keeps the limited product range of the worldwide configuration, but adds geographical differentiation with respect to service activities. National subsidiaries may appear as domestic firms, although their products are not. The advantage of greater adaptation is paid by a weak control in the multidomestic configuration. Volkswagen may serve as an appropriate example of this configuration. Transportation will gradually decline because imbalances of volume between different regions are no longer resolved by a central control.
- In a *multiregional* configuration, products are designed and built with respect to the consumer taste of a certain geographical region. Products tend to become incompatible with each other and cannot be exchanged between different regions anymore. As an example, consider the configuration of General Motors, e.g. Vauxhall (UK), Opel (Germany), and Holden (Australia). The domestic companies have been virtually independent, as they act on regional markets with only weak central control. Consequently, the transport volume is only marginal.
- The *transregional* configuration adds stronger control to the multi-regional configuration. It respects the differentiation of consumer taste with regard to geographical regions, however it aims at unifying product lines wherever possible (e.g. Daimler Chrysler). Regional satellites rather than domestic subsidiaries act under a strong central coordination of activities (Cohen and Mallik, 1997). Generally, the transregional configuration has obvious advantages as it combines customer orientation and production efficiency. Furthermore, it can make use of locally available resources and warrants a firm's flexibility.

The trend towards stronger hierarchical control schemes goes hand in hand with an increasing transportation volume, particularly for the transregional configuration. With regard to economies of scale, typically the worldwide production of a vehicle model is awarded to one single plant only. This increases the distance moved per automobile produced, which in turn will lead to a substantial increase in vehicle transportation (Cullen, 1998).

The additional costs encountered for vehicle transportation are limited, if not negligible. Kiedel (2001) names 250 to 500 Euro for an intercontinental transport. In discussions at a workshop of the German Operations Research Society (GOR) on vehicle delivery in 2003, a range of 2-3% of a vehicle's value is amounted for transportation purposes. Thus, an increase of transportation distance will not necessarily level advantages gained from economies of scale in production.

In order to adopt this hypothesis of increasing transportation volume, evidence for the transregional configuration of the automobile industry is needed.

Kobrin (1991) suggests an *Index of Transnational Integration* in order to measure globalization at an industry level. The index is defined as the proportion of international sales of a firm that are intrafirm. The logic behind this measure is that global supply chain coordination will lead to increased intrafirm flows of value. Highly integrated industries are motor vehicles (0.43), followed by electronic components (0.38). A less integrated industry is, for instance, glass production (0.11). Although Kobrin has performed this investigation on 1982 data of the USA, we can state a mainly transregional configuration for the automobile industry.

Cohen and Mallik (1997) repeated this investigation for 1989 data and achieved comparable indices (motor vehicles (0.39), electronic components (0.43), glass products (0.20)). Interestingly, the index decreased for highly integrated industries and increased for non-globalized producing industries. The authors argue that the index does not take care of outsourcing, which has become a hallmark of globalization today. Thus, the automobile industry remains a highly integrated industry and continues its course of integration through significant outsourcing activities.

2.2 Challenges for Outbound Logistics

Literature outlines the ongoing convergence of consumer taste resulting in the design of so-called 'world cars'. However, model classes like for example 'van' or 'utility' are still designed for the US market. As a new development of the transregional configuration, vehicles designed for a specific market are available also on other markets. Therefore as an obstacle, a manufacturer's globalization strategy may lead to a large variety of car models which may be far from a unified product line.

Although consumers can choose from an almost confusing variety of vehicle models, they are not willing to wait for the delivery of the vehicle for too long. Miemczyk and Holweg (2001) argue that although most customers would rather wait instead of buying an incorrectly equipped vehicle, the majority of North American consumers are not willing to wait more than three weeks. Similar observations have also been made

for the UK market, where 61% of customers want their vehicle to be delivered within 14 days or less.

In order to cope with customer expectations, today on average 55, 70, and 20 days of sales are held in Europe, USA, and Japan respectively (Miemczyk and Holweg, 2001). The exceptionally small storage level for Japan results from the practice of satisfying domestic orders directly from stock, which is originally intended for export. According to the same authors, in Europe savings of 10 billion Euros have been estimated for the elimination of finished vehicle stocks. In order to cut inventory-holding costs, manufacturers have set up “built to order” programs, aiming at a time span of approximately 14 days from order to delivery. Recently, only 3-day car production spans have been pronounced (Holweg and Miemczyk, 2003).

Outbound logistics of finished vehicles are confronted with a set of constraints, which are hard to meet simultaneously:

- The transportation volume will increase due to foreign investments of manufacturers and furthermore due to their shift towards transregional configurations.
- A vast variety of vehicle models exists from which customers may choose. As a result the number of items per model sold on a regional market will be relatively small.
- In order to avoid extensive buffer stocks, the transportation lead-time has to be sufficiently short. This requires a fast transportation mode and, probably more important, a high frequency of transports.
- Since a vehicle model is typically produced in one plant worldwide, the transportation distance to the customer market can be very great.

Even major manufacturers will ship volumes, which does not justify the exclusive utilization of transport facilities. Hence, vehicle manufacturers have to accept sharing a liner service in order to warrant a high frequency of transports at reasonable costs (Hines et al., 2002). For this reason a worldwide transportation network has been evolved which is subject of the following considerations.

2.2.1 Distribution Strategies

From the viewpoint of the vehicle manufacturer, the annual volume of a transport relation is fragmented into frequent consignments of relatively small vehicle quantities. The duration of transport has to be reasonably short in order to implement “built to order” concepts. Thus,

from the manufacturers' point of view, frequent direct shipments are desirable, but can be hardly afforded (Hines et al., 2002).

We identify four logistics solutions to the problem of cutting down the delivery times on regional markets. All of them have been already implemented, although not every solution fits the needs of every manufacturer's distribution policy.

- Vehicles are "built to stock" and a considerable inventory of vehicles is held at the import compound from which customer orders are supplied.
- Vehicles are "built to stock", but the inventory level is reduced by providing a final customer-order driven assembly step at the import compound.
- Vehicles are "built to order", and a point-to-point line haul service with frequent intermediate port calls is engaged.
- Vehicles are "built to order", and an efficient trunk haul is engaged with the drawback of additional transshipments and short-sea feedering.

Strategic developments of ports have to fit the above distribution policies of vehicle manufacturers in order to survive in the long run. In the sequel we describe hub and spoke approaches, which are slowly winning recognition in order to implement competitive distribution policies.

2.2.2 Hub and Spoke Distribution

Supply lines are becoming more fragmented and finished vehicles have to be shipped in smaller quantities. This causes a steady increase in the demand for more port calls to be made by the car carriers for a given volume of vehicles. The greater number of port calls also increases the travel time, which contrasts with the expectations of the manufacturers for "built to order" vehicle delivery.

Carrier companies are interested in making fewer port calls while shipping a number of vehicles. A remedy is offered by a hub and spoke-like design of the delivery network, as is already common for container transportation. Trunk haul routes between hub ports are serviced without intermediate port calls. As an alternative to road transportation, relatively small and flexible feeder ships service the legs from the vehicle plant to the sending hub, as well as from the receiving hub to the final destination.

The trend towards the feedering of legs in vehicle transportation has not become widely accepted so far, chiefly because of the reluctance

of the manufacturers to accept transshipment related to the very high damage levels that were common in car shipping (Drewry, 1999). Nevertheless, a trend towards the transshipment of vehicles is already evident. Manufacturers will accept the general need for the transshipment of cars because this will enable the carriers to reduce transportation times and increase the frequency of port calls.

In 1978, the United States' Airline Deregulation Act' led to the reorganization of flight legs in 'hub and spoke' systems operated by the major airlines. This change of structure has been accompanied by a multitude of publications concerned with 'hub and spoke' systems. Next to the issue of optimal hub locations (O'Kelly, 1986) the effect on the utilization and frequency of flight connections has been subject to research (Phillips, 1987). The German reader is referred to the comprehensive PhD. thesis of Mayer (2001). Several advantages can be outlined:

- The *economies of density* refer to the consolidation of flows of goods. The improved utilization of transportation capacity can be used to improve the frequency of transport.
- The *economies of scope* refer to composite advantages due to the utilization of shared facilities. Hubs are used by a multitude of logistic relations, such that fixed costs can be shared among all relations involved.
- The *economies of scale* refer to the increased volume of goods for hub-to-hub relations. Among other digression effects on the costs, savings due to larger transportation and transshipment facilities exist.

However, also the disadvantages of hub and spoke transportation systems have to be taken into account:

- The *need for transshipment* may cause inconvenience or may lead to a general reluctance of customers. The time required for transshipment, however, may be over-compensated by the higher frequency of transports offered.
- A *congestion of traffic* has been observed for hubs, leading to a capacity overload of the transshipment facilities. As a common wisdom, an overloaded system entails a deteriorating efficiency of operations.

Although a hub and spoke network for vehicle transportation can provide benefits for manufacturers and for carriers at the same time, the additional transshipment of vehicles remains as a strong argument against the constitution of a hub and spoke system. As a remedy, hub feeder-ing can also be performed by means of the hinterland transportation.

A lengthening of the hinterland transport may be accepted in order to achieve transshipment at a port with a high frequency of carrier callings.

Depending on the distribution policy pursued, manufacturers will consider the need for rapid transport, and in this event costs and transportation times of an additional feeder shipment have to be traded off against a hinterland detour (Abrahamsson et al., 1998). With respect to Western Europe, currently noteworthy short-sea feederage is performed to Scandinavia, UK and to the Iberian Peninsula only. For these routes, land transportation is applicable at extremely high costs.

Hinterland detouring for the matter of accessing a port with a high frequency of car carrier calling has led to a redefinition of the term “hub” in the context of vehicle transports. “Although it is common to speak of hub and spoke ports in the call shipping business, the term here is used to describe the volume of cars moved, rather than denoting the number of feeder movements” (Drewry, 1999).

2.2.3 Logistic System Leadership

Up to now the demand of nearly all manufacturers has been just for a basic transport service — and not for an integrated series of functions or operational management capabilities. However, actors in the vehicle logistics market anticipate a significant increase of contract logistics during the next few years. For instance, Drewry (1999) reports that the Wallenius Wilhelmsen Lines’ objective is “that logistics should represent up to 30% of the group’s revenue within 5-10 years, compared to only 2% today”.

Indeed, Wallenius Wilhelmsen Lines has taken over the “Richard Lawson Autologistics Group” and it has started to run a terminal in Zeebrügge under its own management. Although the port has attracted significant transshipment volume in recent years, this development does not necessarily depend on the increasing vertical integration of Wallenius Wilhelmsen Lines. Temporary alliances between different partners of the logistic chain have long been known in order to harmonize tenders with respect to manufacturer demands.

One important reason for the reluctance of manufacturers to get involved with dedicated transshipment arrangements may stem from their dreaded loss of independence. The distribution of vehicles is a vital function in the environment of globalized production and manufacturers will not hand over the responsibility to a third party (Holocher, 2000). However, the demand for “built to order” will lead to complex vehicle distribution policies, which may also accelerate the transfer from basic transport to complex logistic arrangements.

2.3 Summary

We have discussed the ongoing globalization of automobile production. We have shown that the transportation volume of finished vehicles increases due to production abroad in general, and due to the transregional configuration of automobile manufacturers, in particular. Since there are good reasons for automobile manufacturers to spread production even further, we expect a continuous growth of vehicle transports for the future.

We have described several ways of organizing the worldwide distribution of vehicles and we have shed light on the possible role of ports in this process. “Built to order” concepts are likely to prevail, which will stress the importance of a suitable distribution policy in years to come. Ports are playing a particular role as they are acting as a hub within a complex transport arrangement. Besides the seamless integration of intermodal transshipment in the supply chain, ports may position themselves as third-party logistics provider controlling the entire supply chain of an automobile manufacturer.

In the next chapter, we are going to discuss prerequisites for a competitive port. However, competitiveness of a port is not restricted to the transshipment of finished vehicles. Also used cars and trucks as well as other heavy machines are transshipped in ports. Next to the requirements concerning port infrastructure the logistic demand differs for short-sea and deep-sea transports. By comparing the development of 8 major ports of the Lowlands, i.e. Belgium, The Netherlands and Germany we explain how ports respond to the demand caused by globalized production.

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