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Logistics concept of car manufacturing in a foreign production plant

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Logistický koncept výroby vozů v zahraničním výrobním závodě

Anotace

Tato práce se zabývá analýzou logistického konceptu výroby automobilů v zahraničním závodě vybrané společnosti. Práce je rozdělena na dvě části, teoretickou a analytickou. V teoretické části jsou charakterizovány logistické procesy a větší pozornost je věnována dopravním možnostem podniku. V analytické části je představen vybraný podnik a jeho zahraniční projekty a je provedena analýza logistických konceptů fungujících projektů. Ke konci poslední kapitoly je provedeno vyhodnocení a jsou navržena doporučení pro zlepšení logistického konceptu výroby automobilů v zahraničí.

Klíčová slova

Balení, doprava, logistika, PEST analýza, výroba vozů, výroba v zahraničí

Logistics Concept of Car Manufacturing in a Foreign Production Plant

Annotation

This thesis deals with analyses of logistics concepts of car production in a foreign plant of a selected company. The thesis is divided into two parts, theoretical and analytical. In the theoretical part the logistic processes are characterised, and more attention is paid to the transport possibilities of the enterprises. In the analytical part the selected enterprise and its foreign projects are introduced, and an analysis of logistics concepts of functioning projects is made. Towards the end of the last chapter, an evaluation is made, and recommendations are proposed for improving the logistics concepts of car production abroad.

Key Words

Car manufacturing, logistics, packaging, PEST analysis, production abroad, transport

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List of Abbreviations

BOM Bill Of Material

CKD Completely Knocked Down

FBU Fully Built Unit

MKD Medium Knocked Down

NGO Non-Governmental Organizations

JIT Just In Time

JIS Just In Sequence

SCM Supply Chain Management

SNVI Société Nationale de Véhicules Industriels

SKD Semi Knocked Down

VW Volkswagen

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Introduction

In today's highly globalized world, it is quite common that many businesses are trying to establish a presence in foreign markets. Internationalization of business activities brings a lot of benefits for the companies - from higher profits, expansion of sales or production to acquiring new customers. The automotive industry is no exception, as more and more car manufacturers locate their production plants in other countries to fulfil the still rising demand for automobiles while lowering costs connected with their business. However, establishing a manufacturing site in a foreign country brings its own set of challenges, including logistical issues.

Logistics plays a crucial role in car manufacturing as it includes the movement and coordination of raw materials, components and finished goods from company to final customer. The logistics concept of cars manufacturing in a foreign country requires a deep understanding of the regional supply chain, customs legislation, and cultural differences. A well-designed logistics concept can improve the efficiency, lead times, costs, and overall customer experience of the production process.

The goal of this master thesis is to analyse the logistics concept of car manufacturing of a selected company in a foreign production facility, with a focus on the obstacles and opportunities that come up with producing vehicles abroad. This includes the analyses of the existing transportation routes, based on which new transport routes that the company could use in future are conducted.

This thesis deals with logistics processes and their characteristics, objectives, and breakdown of logistics. It also describes the supply chain, transport options and delivery conditions. Selected countries, where the company doing its business, are introduced and their market is analysed using PEST analysis. The chosen company, Škoda Auto, its history and present, its organisational structure and the logistics activities involved in shipping their cars to foreign countries are described. There is also a description of Škoda Auto's past and present projects, including projects in India and Vietnam, and a definition of the different levels of dismantling. Analyses of the logistics concepts used by the company to produce cars at selected plants abroad and at the same time analyses of the logistics risks and an analyses of the suitability of the locations for car production are carried out.

1 Methodology and Data

This chapter deals with the description of the methods used for the analyses of the logistics concepts for the production of cars in a foreign plant and for the design of new transport routes and concepts.

The strategy of this thesis is to firstly do an overview of existing literature on theory connected with characteristics of logistics processes and to evaluate the selected countries in which the company operates based on the PEST analysis. Further, an analyses of the company's logistics concepts of car production abroad with more emphasis on the transport concepts are made. From the gathered information, a risk analyses are carried out which helped to evaluate the suitability of the location for production. Thanks to the findings of the analyses, it is possible to propose alternative transport routes that could lead to a reduction in costs and an acceleration of the transport of the cargo.

As mentioned above, a PEST analysis is used to analyse the selected environments in which the company operates. PEST is an analysis of external and uncontrollable situations that may take different forms but are not under the control of the company. The company is forced to take these aspects into account when planning future actions and spendings of the business (Alanzi, 2018). It is therefore desirable to pay attention to this analysis and to analyse each entity in detail, to ascertain the current situation and to try to estimate the future state of these phenomena as accurately as possible. PEST analysis not only allows the company to see the opportunities, but also allows the identification of risks in the chosen environment, thus revealing to the company whether a potential new project has a chance of success. This includes an analysis of the political, economic, social and technological environment in which the company will be located (Investopedia, 2022c).

The political and legal environment are among the key factors that influence whether a firm decides to enter a given foreign market. A stable environment motivates foreign investors and exporters to enter and also has a positive effect on a country's involvement in the internationalisation process. An unstable environment, on the other hand, can cause economic isolation. The most frequently

examined factors in the analysis of the political and legal environment are the political system, political stability, the legal framework, the country's membership in integrations, the country's ties with other countries or the relationship with foreign companies (Alanzi, 2018).

The state of an area's economy strongly influences the behaviour of a given company through factors such as economic growth, inflation rates, unemployment rates, exchange rates and balance of payments. The development of these indicators can provide a company with several opportunities, but also determines possible threats that could affect the company's business plan. These factors are one of the basic inputs for strategic analysis and for assessing whether entering a given country will bring benefits to the company. (Sammut-Bonnici et al., 2015).

Knowledge of the social and cultural environment often determines the success or failure of a foreign market entry. Within the social environment, companies should focus on demographic developments, social stratification and distribution, household income, the evolution of living standards, educational developments or population mobility. The social factors that provide relevant information for companies' decision-making include the climate in society and the willingness to change set values. (Collinson et al., 2016).

The development of technology and progress itself has reached a tremendous speed and dynamism, especially in the last two centuries. The development of communication technologies and information systems, which make it possible to process large amounts of data ever more quickly and transfer them abroad in an instant, has also contributed to the globalisation of the business environment and enables worldwide communication with consumers or easy retrieval of information (Sammut-Bonnici et al., 2015).

Businesses deciding whether to enter a foreign market need to be aware of all the risks associated with entry to a foreign country. All risks must be analysed and evaluated in order to be sure that the company is able to bear these risks and to what extent. A logistics risk analysis is carried out in this master thesis to assess the suitability of the location for production. The risks are divided into territorial,

currency and market risks, foreign trading partners, liability and risks associated with the international transport of goods.

Territorial risks, which are difficult to predict, are mainly related to the political and economic instability of the country. The main types of territorial risks include payment difficulties caused by political events, natural disasters, measures that prevent the transfer of foreign exchange and administrative interference by the state, such as the withdrawal of import licenses, the imposition of anti-dumping duties or restrictions on the ability to do business (Machková et al., 2021). These risks can have a negative impact on the results of individual transactions, but also on the future implementation of business plans in each country.

Exchange rate risks can cause a company's costs or foreign exchange liabilities to increase or revenues, competitiveness, or foreign assets to decrease. Exchange rate risks result from the variability of exchange rates of individual currencies and are one of the most significant risks of international business (Collinson et al., 2016).

Market risks arise from a change in the market situation, which is caused, for example, by an economic downturn in a particular country, a change in consumer preferences, the entry of competitors or changes in exchange rates. Market risks can cause prices to change, a product to become unsaleable or weaker market position of company (Investopedia, 2023b).

Foreign trading partner risk refers to the failure of a trading partner to meet a commitment any form of international business cooperation. The most common are an unjustified withdrawal from a contract, unjustified non-acceptance of goods by the customer or insolvency of the debtor (Machková et al., 2021).

Transport risks are associated with international trade operations in tangible goods. Goods may be lost or damaged during transport and the damage is subsequently borne by the entity that bore the risk of international transport at the time (Machková et al., 2014).

Liability risk is related to consumer protection. The manufacturer is liable for damage to health or property that the consumer may suffer because of defects in the product (Machková et al., 2014).

All these risks can affect the proper functioning of the logistics process and hence the success of the company's business. For example, territorial risks can cause delays or complete unavailability of transport in some areas. Market and currency risks can affect the price of goods and the cost of transport, which can affect the overall competitiveness of the company. Foreign partner risks can affect the reliability and quality of goods. It is important for companies to consider these risks and take measures to minimise the impact on the logistics concept of doing business abroad.

On the basis of the PEST analysis and the analyses of the logistics concepts of car production abroad, the risks are identified and summarised in a table for each concept, then assigned a level of probability of occurrence and economic impact. The significance of the risks on the logistics activities of the company is also assessed.

The risk analysis methodology is based on information from BrainTools (2023). The scales assessing the probability of occurrence and the degree of economic impact of the risks are described in Table 1 and 2. The distribution of the significance of the risks, which is given by the multiplying of the probability of occurrence and the economic impact, can be seen in Table 3.

In Table 1, each risk probability is described verbally and assigned a numerical value on a scale of 1 to 5.

Table 1 Probability of risk occurrence

Level	Probability of occurrence	Description
5	Almost certain	Almost always occurs
4	Probable	Likely to occur
3	Possible	May occur sometimes
2	Unlikely	May occur, but may not occur at all
1	Almost impossible	Occurs only in rare cases

Source: Own processing

Table 2 divides the economic impact of risks on the company's activities into high, medium, and low. According to the severity of the economic impact, risks are assigned a value on a scale of 1 to 3.

Table 2 Economic impact of risks

Level	Economic impact
3	High
2	Medium
1	Small

Source: Own processing

The level of significance of the risks to the enterprise is divided into severe, medium, and low risks according to the so-called traffic light method visible in Table 3.

Table 3 Significance of risks

	Severe risks
	Medium risks
	Low risks

Source: Own processing

A wide range of secondary data, mainly books and articles, are used for the theoretical part, where the necessary information about the logistics concept and its application in practice is obtained. For the actual analysis of the logistics concept, both secondary data (company websites, annual reports, journal articles etc.) and primary data obtained from interviews with employees are used, interview questions for Vietnam production concept are put together in Table 4.

Table 4 Interview questions

1	What were the main factors that led to the decision to start production of Skoda Auto in Vietnam?
2	What is the transport concept of production in Vietnam?
3	What was the supplier selection process?
4	How is the domestic distribution and export of finished cars from Vietnam to foreign countries handled?
5	Are there any plans to expand car production in Vietnam?

Source: Own processing

Through the combination of primary and secondary data, it is possible to get a comprehensive view of the company's logistics concepts in practice and to obtain more accurate and relevant data.

2 Characteristics of Logistics Processes

Logistics is one of the most crucial elements of the modern business world. In today's globalised and constantly evolving market, it is becoming an increasingly important factor for successful business. Proper management of the flow of goods and information from producer to consumer is becoming a key factor in ensuring high quality service, speed of delivery and competitiveness of companies. Logistics is thus becoming a critical element in the entire supply chain, which includes not only the production and distribution of goods, but also their storage, transport and return to the chain.

In this chapter, the definition of logistics and its objectives is described. After that, the focus is at the logistics breakdown, supply chain and transport types.

2.1 Definition of Logistics

Logistics is concerned with getting the right product to the right place at the right time (Christopher, 2016). Further, logistics can be characterized as an activity that deals with getting the resources in the right place, at the right time, at acceptable cost and at the right quality (Gobetto, 2013). In this presentation, logistics seems like a simple process, but it is not. It is a logistics system that involves complex processes at many levels. The system works and is built on good leadership at the top (Griffin et al., 2019).

Another definition is more specific and describes logistics as a science dealing with a set of functions, namely the integrated planning, shaping, execution and control of material and information flow (Havenga, 2018).

In other publications, logistics represents the management of material and information flows from the firm to its customers. Or more generally, logistics deals with the detailed planning of any complex process (Rushton et al., 2017).

Logistics can also be viewed as a field that not only affects sectors of the economy but also the environment. It comprehensively deals with the movement of flows

through the entire supplier - producer - customer chain, where all the operations involved interact with each other constantly. There is a considerable effort to integrate and unify all items involved in the process and to use the latest technologies that should lead to improved quality, reduced costs and reduced time delays (He et al., 2018). The importance of logistics is not only due to the fact that it provides the movement of material flow, but its importance is also related to availability of needed equipment, machinery, facilities, qualified employees or capital. It is also very closely related to the processes of purchasing, production and sales, which run in parallel with the logistics.

The definition of logistics varies based on the author. Even so, the essence of logistics remains the same since it's always about the movement of material and information from one location to another at the specified time and quality.

2.2 Objectives of Logistics

Logistics objectives are generally focused on reducing storage, handling and transport costs, minimising costs and time associated with delivering goods to customers, ensuring that goods are available in the required quantity with adequate quality and improving process efficiency by optimising resource utilisation (Rushton et al., 2017).

The individual needs and requirements of company's customers should be met. The goals should be achieved in an optimal timeframe with charging the customer reasonable prices and providing the product or service in the highest possible quality with a guarantee of reliability (Ghoumrassi et al., 2017).

By focusing on internal logistics objectives (minimum cost, quality, performance etc.) the company should also meet the general economic objectives, among which the achievement of profit for the company dominates.

In addition to the internal logistics objectives, there are other objectives, namely human and environmental. Human goals of logistics include, for example, maximising worker safety, seeking to eliminate primitive routine work or providing affordable, frequent public transport to the workplace. Environmental objectives,

which are an important issue nowadays, must not be forgotten. The chosen attitude towards ecology influences the customers' perception of the company and should be reflected in the chosen procedures, suppliers, and other aspects. The growing interest in meeting ecological goals is reflected in more sustainable green logistics trends (Nomadia, 2022).

By setting objectives in different areas, contradictions can arise between the objectives, where the logistic gets into a situation where each of the objectives are mutually incompatible, e.g.: low environmental impact and lowest cost (Piecyk et al., 2015). The decision on which of the objectives the company should prioritise at the expense of others does not belong to the logistics department but to the top management.

Overall logistics objectives are focusing on cost minimization, efficiency improvement, quality improvement and flexibility. The goal of cost minimization is to reduce expenses associated with logistical procedures such as transportation, storage, and handling (Lima et al., 2020). Improving logistics processes efficiency is a key for increasing the corporate competitiveness and by focusing on the quality of logistical processes, companies can provide much better customer service, which could be also useful with securing the position on the market. By focusing on flexibility in logistics processes companies can easily and quickly adjust to market and customer needs changes.

2.3 Breakdown of Logistics

Various schemes can be found in the literature that describe the logistics from different perspectives. In general, it is always a representation of all logistical processes within an organisation, from the purchasing market to the consumer market.

One of the distinctions can be macro and micro logistics. The difference between macro logistics and micro logistics is that macro logistics works with all logistical chains and processes both within the firm and worldwide (supply network, customer network, etc.). On the contrary, micro-logistics only evaluates logistics processes

within an organisation (e.g., one plant, individual warehouses, etc.) (Faccio et al., 2018).

In manufacturing company, logistics is divided into manufacturing, business and distribution logistics (Zatrochova et al., 2022).

All economic activities in the form of production logistics are focused at completing tasks for the benefit of the manufacturing company. These are material flows that result in product, from material procurement to internal company distribution to transportation to the final customer. The difference between production logistics and business logistics is that production logistics is concerned with managing the movement of goods from production to the final customer, whereas business logistics is involved with controlling all logistics operations. The subject of distribution logistics is the operation of transportation networks and optimization of planning, which organizes the movement of shipments from origin to final destination (Zatrochova et al., 2022).

2.4 Supply Chain

The supply chain is the set of activities and processes that are linked to the production and distribution of products. The chain collapses all steps from the purchase and delivery of raw materials and supplies needed for production to the sale to the final customer (Investopedia, 2023c). The process, which is shown in Figure 1, involves several different actors, namely suppliers, manufacturers, distributors, retailers, and customers.

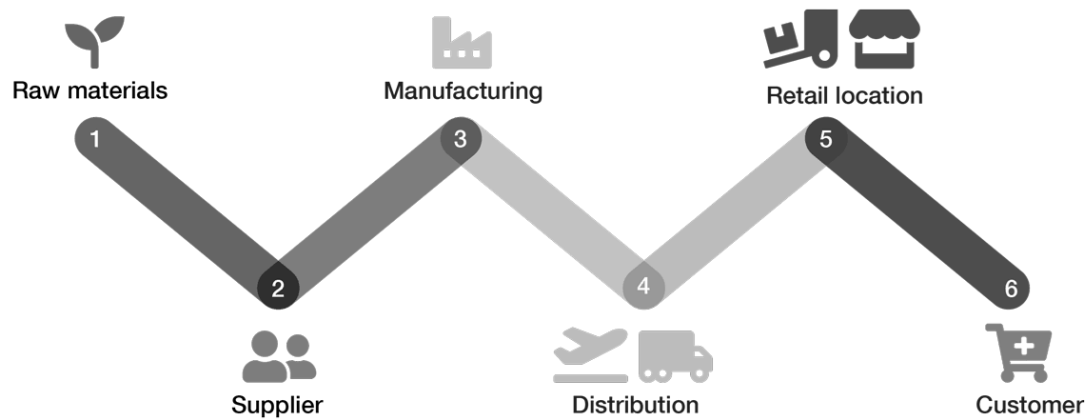


Figure 1 Supply chain
 Source: RIT, 2023

The objective of the supply chain is to optimise the whole chain so that high quality products can be offered to customers while minimising costs and maximising profits (Damodaram et al., 2022).

Supply chain management is one of the strategies of modern management, which deals with the optimization of all activities and systems to secure the entire business chain. The aim is to streamline the process that starts with order placement, processing, evaluation, continues with production, delivery of goods or services and ends with reverse flows (Lu et al., 2015). The more efficient this process becomes, the more unnecessary costs and losses due to delays decrease (Damodaram et al., 2022). It is about efficient usage of all resources entering the process, timely delivery of all products, speeding up the entire process and last but not least minimizing downtime and losses.

The supply chain can be described as a value chain because each link adds some value which ultimately reaches the customer. The added value is obtained through tangible and intangible processes that are possible thanks to the logistics infrastructure, such as transport, warehousing and communication networks (Dubey et al., 2020). Company is part of several supply chains, as it has different suppliers, customers, distributors, etc., therefore the structure of the chains can be seen as a

network structure (Hearnshaw et al., 2013). Between each pair of stated stages, there are supplier-customer relationships through which pass:

- information flows,
- material flows,
- financial flows,
- decision flows (Pfohl et al., 2009).

The material flows travelling from the supplier to the customer can include raw materials, intermediate products and finished products. In the opposite direction of flows, from customer to supplier, is servicing, reclamation, and disposal of unneeded material. By financial flows are meant several types of payments, credits, etc. Information such as orders, quantities or deliveries permeates the different stages. The actors in the supply chain make various decisions affecting the quality of the chain. In this case, these are decision flows.

Supply chain management is an especially important link in strategic, tactical and implementation management. It deals with how to effectively manage all material, information and financial flows and how to achieve the set objectives of the company through them. It starts with the first input supplied and ends with the delivery of the product to the customer, and includes value-added activities such as transport, packaging or waste disposal. The aim of the whole management process is to reduce unnecessary costs and losses that can be caused by an inefficient process. The proper functioning of SCM can be ensured with the support of various logistics technologies.

2.4.1 Logistics technologies

There are many logistics technologies applied in the supply chain, but only the most widely used technologies are listed below, namely JIT, JIC, Kanban, Milk run and Cross-docking.

JIT

The concept of Just in Time is one of the most widely used concepts in the world. This modern concept of building a logistics system in production, supply and distribution is based on synchronizing the processes of delivering material resources and finished products in the required quantities and at the time when the units of the logistics system need it, in order to minimize the costs associated with storage. This concept is characterised by minimum reserves of material resources, relationships with a limited number of reliable suppliers and perfect technological processes for production and transport (Pourasiabi et al., 2012). The use of JIT throughout the production and logistics process provides enterprises with the opportunity to reduce seven types of waste – transportation, inventory, motion, defects, overproduction, overprocessing and waiting, while obtaining a high level of quality of finished products and lower running costs (Chauhan et al., 2015).

JIS

Just in Sequence is the highest form of the Just in Time logistics concept, which is driven by advanced information systems. Under this concept, the supplier supplies its goods directly to the assembly line at the exact time, quantity, and sequence in which they will be used in production. This means lean manufacturing, where the flow of inventory from the supplier is synchronised with the customer's production schedule. Often, the supplier must also comply in the use of packaging materials, standardised crates, and even the order in which goods are stacked in the vehicle's hold (Andjelkovic, 2017).

Kanban

The Kanban system was first used by the Japanese company Toyota Motors. The essence of the system is that all production units of the plants are supplied with material resources only in the quantity and time required to fulfil the order set by the consume. Kanban optimizes its work within the framework of an order from a specific unit of the company. A characteristic feature of this system is the minimization of the duration of the production cycle (Powell, 2018) .

The management of material flows in such conditions requires an appropriate organization of information flow. This means that the better these flows are coordinated, the lower the production costs and the better the utilization of production capacity and the higher the reliability of the whole system as well as increase in competitiveness of the company.

Milk run

The Milk run principle allows to organize a continuous flow of materials, delivering only what is actually used or what is needed at the moment from various suppliers to customer or from one supplier to various customers. Above all, it is used to reduce losses in the transportation of raw materials and finished products by own vehicles (Patel, 2017).

Cross-docking

Cross-docking is a technology used in the distribution that is based on the integration of the distribution centre into the supply chain. Materials from several manufacturers are imported to the distribution centre, assembled there and immediately delivered to retail stores (Kiani Mavi et al., 2020).

2.5 Transport in Logistics

Logistics plays a significant role in international trade. The choice of logistical means depends on several factors: the actual movement of the goods, the contractual arrangements, the nature of the goods, the distance of transport, packaging, climatic conditions, or technical and other logistical equipment of the carriers. Since transportation expenses are not insignificant, it is advisable for the business partners to have a written agreement establishing how much each will contribute to transportation and cost recovery. In order to determine when costs and risks are transferred from the seller to the buyer, the delivery condition is used.

In this chapter, the different modes of transport are introduced, after that the focus is on Incoterms.

2.5.1 Transport types

One of the most crucial parts of transport in logistics is choosing the appropriate form of transportation. There are numerous possibilities, including road, rail, water, and air transport. Each type has benefits and drawbacks of its own, making it crucial to select the one that is best for a certain shipment.

Road Transport

Road transport is the most commonly used form of transport in logistics. Thanks to its flexibility, it enables fast transport of goods to their destination over short and medium distances. Compared with water or air transportation, costs of road transportation are much lower. However, for larger loads or long distances it is not the most suitable option because of the breaks that drivers need to take. This type of transportation creates also more exhaust emissions in comparison with rail or water transport (Engström, 2016).

Rail Transport

Rail transport is most often used to transport large volumes of goods and passengers over medium and long distances. This type of transport is both environmentally friendly and cost-effective. Another advantage is the high reliability of the delivery of goods and the reduction of traffic congestion on the roads. The disadvantage of choosing this mode of transport is that it is limited by the number and location of railways and railway stations. There are also delays and time constraints on train lines (Zak et al., 2014).

Air Transport

Air freight is the fastest way to transport goods around the world. This mode is most advantageous for transporting expensive, dangerous goods or goods with a short shelf life that need to be delivered as soon as possible. However, this transport is expensive, and airports and cargo space are limited by capacity, which can cause delays in deliveries. This transport is also limited by the number of suitable airport locations and the space in which the goods can be transported. Air transport is also much more polluting than other means of transport (Logisber, 2022).

Water Transport

Shipping by water is suitable for transporting large quantities of goods at long distances across seas and rivers. Shipping is often cheaper, but it is often slower than other modes of transport and its only possible with access to suitable rivers or seas and ports (Jurkovič et al., 2021). Another disadvantage is the dependence on weather, which can negatively affect delivery time and the safety of the ship.

Combined Transport

Combined transport is the transport of goods using at least two modes of transport. Its main purpose is to provide house to house transportation. If the entire transport section is covered by a single transport document, the term multimodal transport is used. Combined transport offers many advantages. Standardised packaging and unified means of transport can be used to physically move the cargo, as a result of which transport and handling costs are lowered. Due to the fact that the transport is covered by a single carrier, the risk of damage or loss of the consignment is also reduced (Hasan, 2023; 2022).

Choosing the right mode of transport depends on many factors such as speed, characteristics of the goods and costs, but it is crucial for a successful logistics chain and most importantly for ensuring customer satisfaction.

2.5.2 Incoterms

Incoterms stands for International Commercial Terms and is a set of international rules and conditions used in intercontinental trade. They are issued by the International Chamber of Commerce and are used to determine the responsibilities and obligations of the seller and buyer in the shipment of goods, reducing the risk of misunderstandings and potential disputes between the parties. Incoterms are internationally recognised and used worldwide, making trade between different countries much easier (Investopedia, 2023a).

Incoterms are quite complex set and if misunderstood, it can lead to errors. At the same time, they do not cover all aspects of international trade such as intellectual

property protection and do not guarantee the quality of the goods being transported.

The Incoterms have 11 conditions, the point of delivery and transfer of risk can be seen on Figure 2.

Point of Delivery and Transfer of Risk

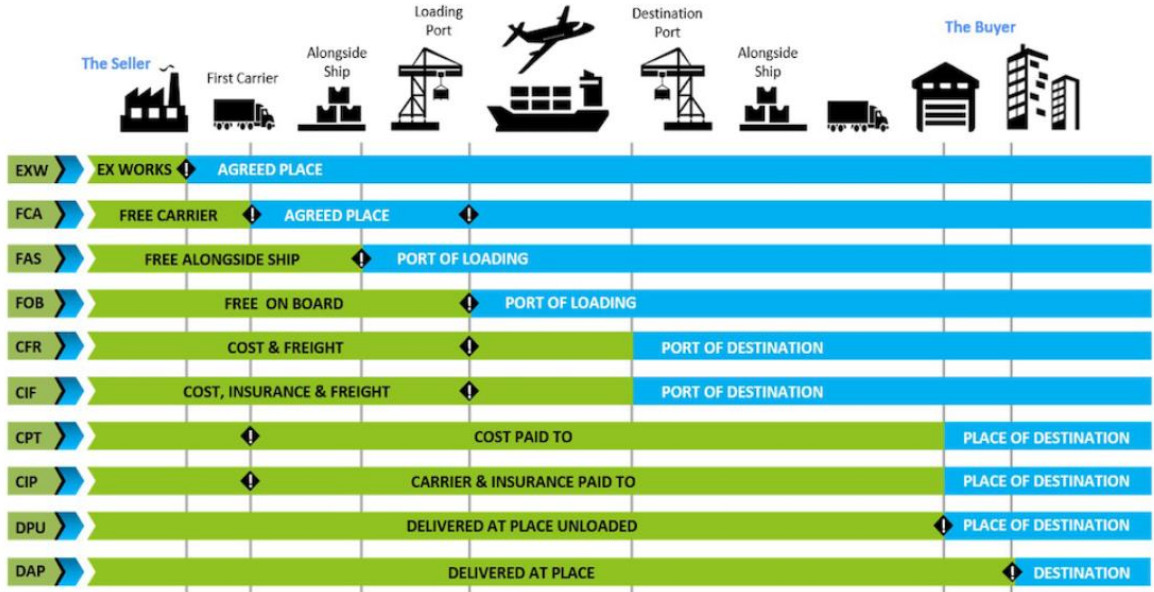


Figure 2 Incoterms
Source: Anker Shipping, 2023

Incoterms are divided into conditions for any mode of transport and conditions for water transport.

Conditions for any mode of transport

Incoterms for any mode or modes of transport count 7 conditions, which are EXW, FCA, CPT, CIP, DAP, DPU and DDP.

The most basic and shortest form of Incoterms is EXW which means Ex Works. In this condition, the seller has minimal obligations as he only needs to prepare the goods for the buyer at his production facility. All risks and costs which are related to the shipping are borne by the buyer (ICC, 2019).

FCA, which is an acronym for Free Carrier, means that the seller shall deliver the goods to the carrier which was chosen by the buyer at the agreed location. The seller does not bear the risks and the costs associated with transportation of the goods, that is the obligation of the buyer (ICC, 2019).

Another condition is CPT which means Carriage Paid To. Under this Incoterms, the seller organizes the transportation and is responsible for the costs connected with the movement of the goods to the selected location. After that the responsibilities are transferred to the buyer (ICC, 2019).

Under DAP (Delivered at Place), the seller is responsible for transportation arrangements of goods to the agreed location, after that the costs and risks pass from seller to buyer. The seller is not responsible for bearing the costs and risks associated with unloading the goods (ICC, 2019).

Conditions for water transport

There are 4 Incoterms conditions for transportation which uses water. Those are FAS, FOB, CFR, and CIF.

The seller has an obligation to deliver the goods to the side of the ship at the agreed port in a FAS (Free Alongside Ship) condition. The seller is responsible for the delivery of the goods to the agreed destination and also for the customs clearance and export formalities. The buyer bears costs and risks from the moment the goods are delivered alongside the ship (ICC, 2019).

One of the oldest clauses for water transportation is a Free On Board condition. FOB defines that the seller shall deliver the goods on board of the ship at the port of loading or to the agreed destination and also to arrange the clearance of the goods for export. The buyer shall choose a ship and is responsible for all risks and expenses related to the shipping of the goods to destination country (ICC, 2019).

Under a CFR (Cost and Freight) agreement, the risks of loss or damage of the products pass to the buyer when they are handed over to the carrier. The seller covers the costs of the transportation till the port of the final destination (ICC, 2019).

CIF (Cost, Insurance, and Freight) is similar to CFR, risks pass to buyer at the port of loading when the goods is delivered on board of the ship and costs do not pass until the port of the final destination. In this condition seller is obliged to cover a transport insurance at his own expense and has to provide the buyer with documents confirming the insurance cover of the goods (ICC, 2019).

The choice of the appropriate Incoterms clause depends on several factors and must be carefully considered and included at the initial stage of a business contract. Incoterms are very important for international trade but also for planning logistics processes, as they define who is responsible for the different steps of the transport and where the risks cross. This information is especially important for establishing logistics costs.

3 Characteristics of Chosen Markets

To better understand Škoda Auto's decision to do business in the selected markets and to obtain data to evaluate the logistics concept of manufacturing abroad and the suitability of the location for manufacturing, a PEST analyses of India and Vietnam is conducted in Chapter 3. At the same time, their automotive market is examined with the market share of competitors.

3.1 India

India, in full the Republic of India, is a federal parliamentary republic. Neighbouring states China, Bhutan, Nepal, Pakistan, Bangladesh and Myanmar. The capital city, New Delhi, is located in northern India (CIA, 2023a).

3.1.1 Political environment

The head of the state is the President, who is indirectly elected for a 5-year term. The current president is Droupadi Murmu from the year 2022. India has three forms of government, namely legislative, executive and judicial. The legislative body is the Parliament of India, which is made up of two chambers - the upper house called the House of States, which is indirectly elected, and the lower house called the House of the People, which is directly elected. The Prime Minister, who is elected by Parliament, is the head of government, a position currently held by Narendra Modi since 2014 (CIA, 2023a).

The country is a member of many international organizations such as ASEAN, WTO, WHO, OECD, UNESCO, IMF, BIS, BRICS, G 20 and many others. India is also part of the Commonwealth of Nations (CIA, 2023a).

India's foreign policy aims at protecting its own national interests. The nation's foreign policy's primary goal is to promote and uphold a peaceful and stable external environment so that domestic goals like economic development and poverty eradication may progress quickly and unrestrained. Socioeconomic

development is a top concern for the Indian government, which works to promote it both domestically and internationally. (KnowIndia, 2023).

High levels of corruption must be taken into consideration by companies who are now operating in India or intend to do so. Companies Given the low level of enforcement and monitoring, integrity is lacking in all government agencies and corrupt practices such as facilitation of payments and bribes persist. Despite improved government attempts, bribery, bureaucracy, and corruption are still pervasive. The judiciary, police, public services, and public procurement are particularly vulnerable to corruption. The primary legislative framework that combats corruption in the public sector is the Prevention of Corruption Act (GAN Integrity, 2020).

3.1.2 Economic environment

India's economy is a mix of rising modern industries, traditional rural agriculture, and handicrafts. Since the 1990s, economic liberalization in India has boosted growth, but inflexible business regulations, widespread corruption, and enduring poverty present obstacles to further development. India is a significant supplier to business outsourcing and technology services. The services sector accounts for a large part of India's economic output (Investopedia, 2022a).

India's economy is the 6th largest in the world by nominal GDP and the 3rd largest in the world by purchasing power parity (Investopedia, 2022a). Due to its large population, GDP per capita in PPP is below world average, which in 2021 was \$18,604 (The World Bank, 2023a). Table 5 shows the evolution of selected economic data for India from 2017 to 2021.

Table 5 Economic data of India

	2017	2018	2019	2020	2021
GDP in trillions \$	2,651	2,703	2,832	2,668	3,176
GDP (PPP) in trillions \$	8,187	8,925	9,435	8,884	10.03
GDP growth %	6.8	6.5	3.7	-6.6	8.7
GDP per capita (PPP) in \$	6,112	6,590	6,888	6,449	7,242
Inflation rate %	3.3	3.9	3.7	6.6	5.1
Unemployment rate %	7.7	7.7	6.5	7.9	7.7

Source: Own processing

From Table 5, can be seen that both GDP in nominal terms and GDP in PPP terms have been increasing every year in the period under study until 2019. In 2020, both indicators show a decline from the previous year, and in 2021 they all rise again. For GDP growth, a continuous decline can be seen until 2020, when GDP growth was even -6.6%. In 2021, this indicator has risen markedly to 8.7%. GDP per capita at purchasing power parity has risen from \$6,112 in 2017 to \$7,242 in 2021. As Table 1 shows, inflation peaked in 2020 at 6.6%. Unemployment has been around 7.7% in almost every year during the observation period, with only 2019 seeing a value of 6.6% (The World Bank, 2023b).

Table 6 shows the evolution of the trade balance from 2019 to 2022.

Table 6 Indian trade balance between 2019 and 2022

	2019	2020	2021	2022
Imports in billion \$	503,4	387,2	575	666,6
Exports in billion \$	330,5	282,8	390,8	444,6
Trade balance in billion \$	-157,7	-95,5	-179,9	-195,7

Source: Own processing

The table shows that the country's trade balance is negative, meaning that the country imports more than it exports (BusinessInfo.cz, 2022a).

As of 31th March 2023, the exchange rate was INR 100 = 26,27 CZK (Kurzy.cz, 2023d). Figure 3 shows the evolution of the exchange rate of the Indian rupee against the Czech crown from 2003 to 2022.



Figure 3 Evolution of the exchange rate of INR to CZK from 2003 to 2022

Source: Google Finance, 2023a

The chart clearly shows that the Czech crown is appreciating against the Indian rupee in the long run.

Figure 4 shows the evolution of the exchange rate of the Euro against the Indian rupee from 1995 to 2022.



Figure 4 Evolution of the exchange rate of EUR to INR from 1995 to 2022
 Source: Google Finance, 2023c

The chart shows that in the long run the euro is appreciating against the rupee. As of 31th March 2022, the exchange rate was EUR 1 = INR 89,41 (Kurzy.cz, 2023b).

3.1.3 Social and cultural environment

India's population was estimated at nearly 1.407 billion in 2022, making it the second most populous country in the world after China (The World Bank, 2023b). Figure 5 below shows the population pyramid as of 2022.

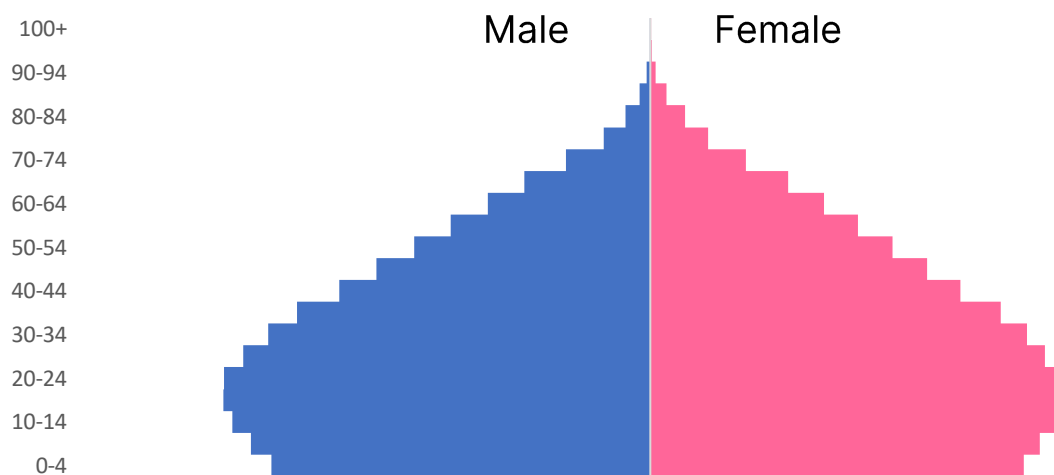


Figure 5 Indian population pyramid 2022
 Source: Own processing

As can be seen from the graph, the most represented age group are 10-14 and 20-24 followed by 30-34, so basically the working group. Interesting thing is, that the group 0-4 is smaller than the rest and that indicates that the population growth is decreasing (PopulationPyramid.net, 2023a).

Table 7 below examines population growth from 2017 to 2021.

Table 7 Indian population growth

	2017	2018	2019	2020	2021
Population growth %	1,16	1,09	1,03	0,96	0,8

Source: Own processing

As can be observed, the rate of population growth has been declining over the period under study. From 2017 to 2021, the population growth rate declined by 0.36% (Statista, 2023c).

India does not have a designated national language. Hindi has the highest number of speakers with 43.6% and is the official language of the government. English is widely used in business and administration and has the status of an auxiliary official language. Every state and territory has one or more official languages (BusinessInfo.cz, 2022a).

Table 8 shows the percentages for each religion as of 2022.

Table 8 Indian religious composition

Hinduism	80,5 %
Islam	13,4 %
Christianity	2,3 %
Others	3,8 %

Source: Own processing

In terms of religion, from the last census in 2022, Hindu religion was the predominant religion with 80.5%, followed by Islam with 13.4%, then Christianity with 2.3% and other religions whose representation was less than 2% (BusinessInfo.cz, 2022a).

3.1.4 Technological environment

India is regarded as one of the most technologically advanced countries. With a focus on science, it is gradually moving towards becoming a global leader in industrialisation and technological development. The advent of nanotechnology in India will also result in the development of not only the biomedical sector but also the nuclear sector (Basak, 2021).

India also has one of the most developed IT sectors, which has experienced remarkable growth since the early 1990s. India is a great location for entrepreneurs to start technology initiatives like software development, mobile applications, business solutions, etc. because of its extensive IT infrastructure and highly qualified IT labour (Howandwhat, 2022).

India is a country that produces more than 1.5 million engineers every year - a number that will only increase in the future. This means that some of the best tech talents in the industry are in India (India Today, 2019).

3.1.5 Indian automotive market

India is the world's 3th largest producer of passenger cars as of 2022 and the 4th largest producer of cars overall (OICA, 2023). The Indian automotive market is dominated by motorcycles and passenger vehicles, with small and medium-sized cars selling the most. India produced 22.93 million vehicles in 2022, of which motorcycles accounted for 76.9%, passenger cars 17.5%, commercial vehicles 4.1% and tricycles 1.5%. Overall, India sold 17.51 million vehicles and export over 5.6 million vehicles in 2022 (IBEF, 2023a).

In the automotive industry, the problem of decreasing air quality and rising traffic problems has been a source of worry for Indian government. India has frequently been listed as one of the world's most polluted and congested countries. To deal with the growing pressure from NGOs and environmental groups, the government has implemented a variety of measures. In comparison with conventional automobiles, taxes on electric vehicles have been significantly reduced and new pollution criteria have been released (Statista, 2023a).

There are many global and domestic passenger car companies operating in the Indian automobile market. Figure 6 shows an overview of these companies along with their market share in 2022.

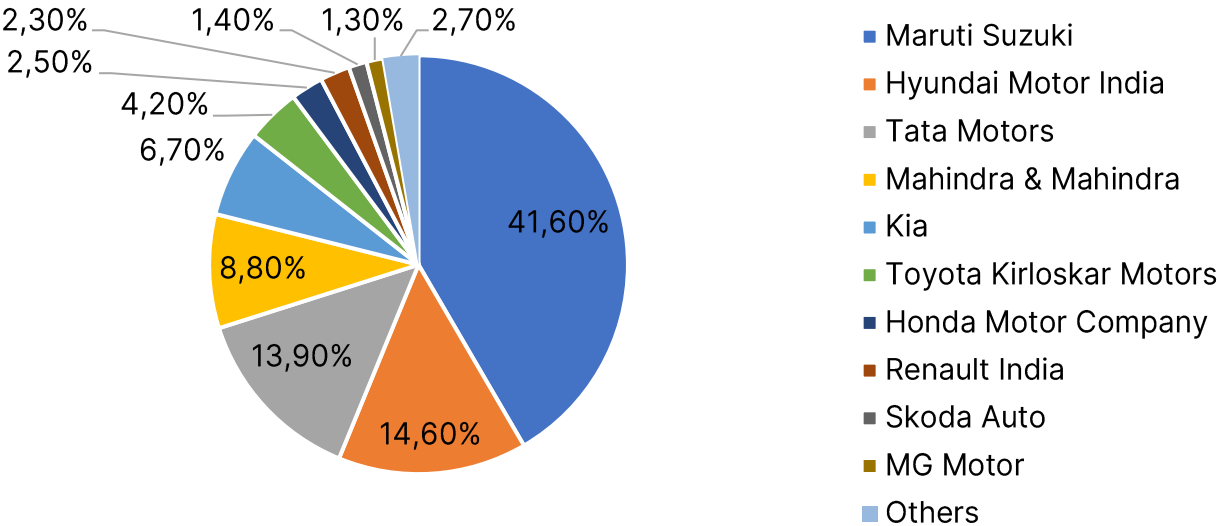


Figure 6 Companies share of the Indian passenger car automotive market in 2022
 Source: Own processing

Maruti Suzuki is the largest automobile manufacturer in India, holding nearly half of the Indian market share in passenger vehicle production. The company has three manufacturing plants in India and is very popular for its affordable but value-for-money vehicles (AckoDrive, 2023).

The second largest car manufacturer is Hyundai Motor India with a market share of 14.6% (AckoDrive, 2023). Hyundai has two manufacturing plants in India and is one of the top exporters of passenger cars to Africa and the Middle East (IndianCompanies.in, 2023).

Tata Motors is another automobile giant operating in the Indian market and is among the top three vehicle brands in India. The products of this company include buses, trucks, commercial vehicles and passenger cars. Tata Motors has six manufacturing plants in India (AckoDrive, 2023).

Mahindra & Mahindra is the largest manufacturer of SUVs in India, and it is also the largest manufacturer of tractors which it sells to several countries. The company has five manufacturing plants in India (AckoDrive, 2023).

Kia is one of the newer companies in the Indian market that are into car manufacturing but still it has managed to gain 6.7% of the market share with its unique design and feature-rich cars. Kia started producing its first cars here in 2019 and its market share is expected to grow (AckoDrive, 2023).

Other companies dedicated to manufacturing passenger cars include Volkswagen Group along with Skoda Auto, Toyota Kirloskar Motors, Honda Motor Company, Renault India and many more (AckoDrive, 2023).

3.2 Vietnam

Vietnam is officially called the Socialist Republic of Vietnam and it lies in Southeast Asia, on the eastern part of the West Indies with access to the South China Sea. Neighbouring states are China, along with Cambodia and Laos. The capital is Hanoi, located in the north of the country. Its counterpart is Ho Chi Minh City, which is the most populous city in the south of the country (CIA, 2023b).

3.2.1 Political environment

Since 1986, there has been a transformation from a highly centrally planned economy to a market economy. An economic reform plan called Đổi Mới encouraged the modernisation and liberalisation of the economy, opening up with the rest of the world and prioritising the export of products (CIA, 2023b).

The state is headed by a president elected by the National Congress from among the deputies of the Communist Party of Vietnam. This party is the only official one in the country and has a legislative function, at the same time it makes decisions and oversees the activities of the state. Võ Văn Thưởng is president since March 2023 (CIA, 2023b).

Vietnam is a member of many international organisations worldwide. The most important are memberships in associations such as ASEAN, WTO or Trans-Pacific Partnership pact (CIA, 2023b). The last-mentioned organization has enabled Vietnamese businesses to integrate into the world market, the legal system has been improved as well as conditions for both domestic and foreign operators. (Investopedia, 2022b).

The Vietnamese judiciary is highly susceptible to corruption because it is constrained by political interference, a lack of openness, and an ineffective legal system. Bribes and other irregular payments are thought to be prevalent practice in exchange for favourable court rulings. Lawyers are frequently asked to pay bribes to judges. Companies express a lack of faith in the independence of the judiciary, and the effectiveness of the legal system for resolving disputes and overturning rules is given a low rating. Vietnam has a comprehensive anti-corruption law framework in place, but enforcement is still difficult, and the majority of high-level corruption charges are believed to have political motivations (GAN Integrity, 2020).

3.2.2 Economic environment

The economy of Vietnam is a socialist-oriented market economy. Vietnam's economy is the 36th largest in the world by nominal GDP and the 23rd largest by purchasing power parity. Because of its large population in rural areas, GDP per capita in purchasing power parity is below the world average (The World Bank, 2023c).

Table 9 shows the evolution of selected economic data for Vietnam from 2017 to 2021.

Table 9 Vietnamese economic data

	2017	2018	2019	2020	2021
GDP in trillions \$	281,4	310,1	334,4	346,6	366,1
GDP (PPP) in trillions \$	799,6	888,7	971,9	1,02	1,08
GDP growth %	6.9	7.5	7.4	2.9	2.6
GDP per capita (PPP) in \$	9,050	9,866	10,684	11,023	11,676
Inflation rate %	3.5	3.5	2.8	3.2	1.8
Unemployment rate %	1.9	1.2	1.7	2.1	2.4

Source: Own processing

From Table 9, can be seen that both GDP in nominal terms and GDP in PPP terms have been increasing every year in the period under study. For GDP growth, a continuous increase until 2019 could be seen, but after this year there is a rapid decrease which continued also to year 2021. This is caused by Covid-19 pandemic, which was affecting the whole world. GDP per capita at purchasing power parity has risen from \$9,050 in 2017 to \$11,676 in 2021. As Table 1 shows, inflation reached its minimum in 2021, when it was 1.8%. Unemployment rate has been around 2% in almost every year during the observation period, with only 2018 seeing a value of 1.2% (The World Bank, 2023c).

Table 10 shows the evolution of the trade balance from 2015 to 2019.

Table 10 Vietnamese trade balance from 2019 to 2022

	2019	2020	2021	2022
Imports in billion \$	253,4	262,7	331,2	393,2
Exports in billion \$	264,3	282,5	335,9	396,2
Trade balance in billion \$	21,5	30,6	18,7	19,5

Source: Own processing

The table shows that the country's trade balance is positive, meaning that the country exports more than it imports (BusinessInfo.cz, 2022b).

As of 31th March 2023, the exchange rate was 1 CZK = 1085.42 VND (Kurzy.cz, 2023a). Figure 7 shows the evolution of the exchange rate of the Czech crown against Vietnamese dong from 2003 to 2022.



Figure 7 Evolution of the exchange rate of CZK to VND from 2003 to 2022
Source: Google Finance, 2023b

The chart clearly shows that the Czech crown is appreciating against the Vietnamese dong in the long run.

As of 31th March 2023, the exchange rate of the Czech National Bank was 1 EUR = 25,496.6 VND (Kurzy.cz, 2023c). Figure 8 shows the evolution of the exchange rate of the Euro against the Vietnamese dong from 2003 to 2022.



Figure 8 Evolution of the exchange rate of EUR to VND from 2003 to 2022
Source: Google Finance, 2023d

The chart shows that under observed period Euro is appreciating against the Vietnamese dong once again after the decline caused by Covid-19.

3.2.3 Social and cultural environment

With economic growth and greater openness to external influences due to globalisation, changes in the Vietnamese social environment are occurring. While rising wages and living standards are helping lay the foundation for the development of different social classes according to income, cultural identity remains the same.

With a population of more than 98 million, Vietnam is the 15th most populous country in the world and 8th in the Asian countries (The World Bank, 2023c). Figure 9 below shows the population pyramid as of 2022.

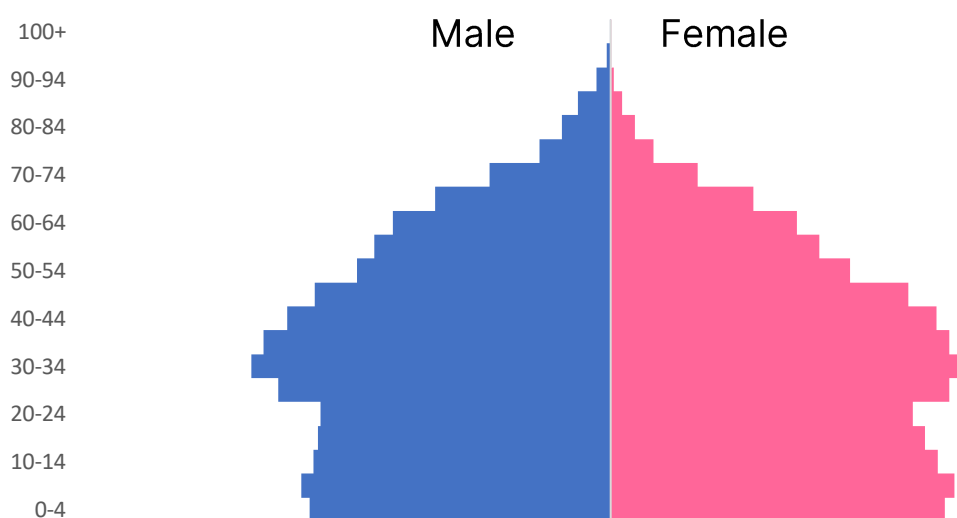


Figure 9 Vietnamese population pyramid in 2022

Source: Own processing

In terms of demographics, the largest group of economically active people aged 15-64. This group accounts for approximately 69 %. Population aged 0-15 make up 23% and the smallest proportion is the retired population with 8% of the total population (PopulationPyramid.net, 2023b).

Table 11 below examines population growth from 2017 to 2021.

Table 11 Vietnamese population growth

	2017	2018	2019	2020	2021
Population growth %	1,0	0,9	0,9	0,9	0,8

Source: Own processing

As can be seen from the table, this growth rate has been declining slightly over the period under review, falling by 0.2% since 2017 (The World Bank, 2023c).

The official language is Vietnamese, and the most widely spoken foreign languages are English, Chinese, Russian and French (BusinessInfo.cz, 2022b).

Table 12 shows the percentages for religion share of Vietnamese population.

Table 12 Vietnamese religious composition

Non-religious	74%
Buddhism	15%
Christianity	9%

Source: Own processing

The majority of Vietnam's population is non-religious. The remaining 26% of the population is mainly Buddhist and Christian (BusinessInfo.cz, 2022b).

3.2.4 Technological environment

The technology and research sector has seen the biggest global shift in quality and innovation in the last decade. It is therefore clear that in a country like Vietnam, which is experiencing economic growth, there is a need to meet the growing demand for quality in the information and communication technologies. The process of digitalization can be seen in the evolution of the population's access to the Internet, which in 2021 is 74% of the total population, compared to 2010 when only 31% of the population had access to the Internet (The World Bank, 2023c).

Another indicator can be seen in government spending on research and development. According to the indicator of the amount of investment spent on R&D, Vietnam allocated 0.53% of GDP to this area in 2019 (Trading Economics, 2023). Although the state is trying to raise the level of science through a higher earmarked budget, the private sector, which employs 83% of the workforce and will probably be the driving force for Vietnam economy, remains the main source of funding (Eastspring Investment, 2020).

3.2.5 Vietnamese automotive market

In Vietnam, buying a car has long been seen as a significant investment. However, as the economy grows, more people are able to acquire such cars due to their increased purchasing power. The automobile sector in Vietnam is currently one of the fastest growing across Southeast Asia. Cars are becoming increasingly common in Vietnamese cities, replacing motorcycles as one of the primary ways of transportation for many city dwellers even if they are still considered to be expensive (Statista, 2023b).

Vietnam produced about 284 thousand passenger cars in 2022, the total car sales were about 358 thousand units (Statista, 2023e). The number of automobiles produced in Vietnam has remained small, making up about 10% of the market. As a result of their competitive pricing and low maintenance costs, international brands, particularly those from Japan and Korea, have dominated the automotive market in Vietnam.

Figure 10 shows an overview of a market share of leading car manufacturers in Vietnam in 2022.

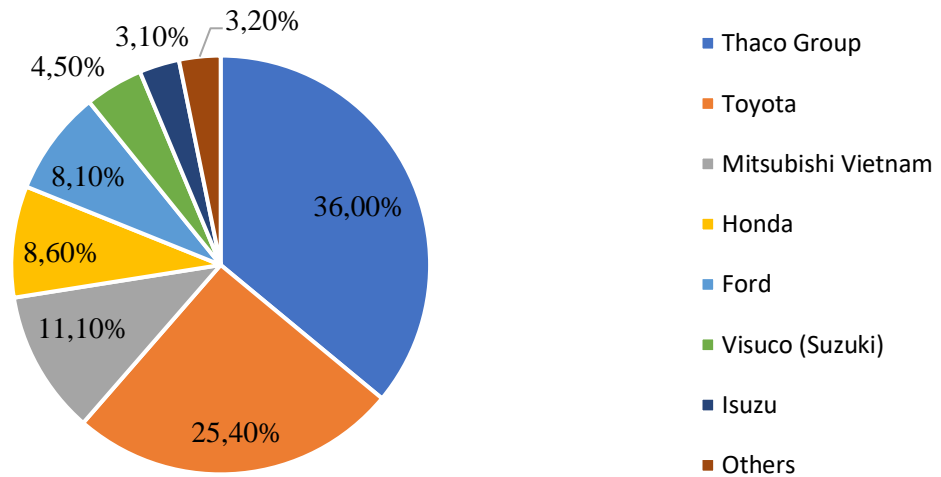


Figure 10 Companies share of the Vietnamese passenger car automotive market in 2022

Source: Own processing

The leading automobile manufacturer in 2022 was the Thaco Group with market share 36%. This company was established in 1996 and it is one of the pioneers of automobile manufacturing in Vietnam. Thanks to Thaco Group's right to produce and distribute cars of brands such as Kia, Mazda, Peugeot and BMW, it has surpassed Japan's Toyota (Statista, 2023d).

Toyota ranks second as the largest car manufacturer in Vietnam with 25.40%. The company sold more than 91,000 vehicles here in 2022 (Statista, 2023d).

Other companies dedicated to manufacturing passenger cars include Ford, Mitsubishi Vietnam, Honda, Visuco, Isuzu and other smaller car manufacturers (Statista, 2023d).

4 Introduction of Škoda Auto

This chapter presents the history of the automotive industry in the Czech Republic and how Škoda Auto became one of the most important companies in this field. Furthermore, the present of the company and organizational structure is mentioned. In this chapter, focus is also on preparation of transporting of cars and parts and components to foreign countries and production plants.

4.1 History of the Company

Škoda Auto is the most important car manufacturer operating in the Czech Republic, whose history dates back to 1895, when Václav Laurin and Václav Klement founded the company Laurin & Klement in Mladá Boleslav, which focused on the repair and production of bicycles. In 1898, Václav Laurin and Václav Klement founded their first own factory, until then they had been operating in a small workshop. In 1905 they started the production of the first "Voiturette A" cars, which were remarkably successful, and in 1907 the company Laurin & Klement was transformed from a family company into a joint-stock company. However, the First World War put an end to the boom in car production in Czech Republic and the company was used for war equipment production (Škoda Auto a.s., 2023b).

After the war, the company merged with the Škoda Works in Pilsen in 1925, leading to the demise of the Laurin & Klement brand and the adoption of the Škoda name and signature winged arrow. Towards the end of World War II, the car factory was repeatedly bombed and largely destroyed. After the war, in 1945, the company was nationalised, separated from the Škoda plant in Pilsen and renamed Automobilové závody, národní podnik. Due to the established regime and limited contact with foreign countries, the cars gradually became obsolete and were unable to compete in the Western markets (Škoda Auto a.s., 2023b).

After the Velvet Revolution, in order to preserve the company's competitive ability, in 1991 the company merged with the German Volkswagen Group, which acquired a 30% shareholding. Škoda Auto thus became the fourth brand, alongside VW, Audi

and Seat, to join the group. The VW Group gradually increased its shareholding until it acquired 100% of Škoda Auto's shares in 2000 (Škoda Auto a.s., 2023b).

4.2 Present of the Company

Škoda Auto is based in Mladá Boleslav, where the main plant is also located. The other two subsidiary plants are located in Kvasiny and Vrchlabí (Škoda Auto a.s., 2023d). Currently, the company offers 8 model lines in its portfolio on the European market - Fabia, Scala, Kamiq, Octavia, Karoq, Kodiaq, Superb and Enyaq iV (Škoda Auto a.s., 2023a). Those models are produced either in Mladá Boleslav or in Kvasiny plant. The Vrchlabí plant is focused on the production of components, mainly DQ200 gearboxes. Abroad, Škoda Auto manufactures in Slovakia, India, Ukraine and China.

Worldwide, the company employed more than 35 thousand employees of various nationalities in Czech Republic in the year 2022 (Škoda Auto a.s., 2023c). Škoda Auto is constantly modernising and keeping pace with innovations in the automotive industry. In 2021, Strategy 2030 was presented, defining a new direction and development for the entire company (Škoda Storyboard, 2021).

4.2.1 Sales worldwide

Figure 11 shows Škoda Auto's total sales from 2015 to 2022.

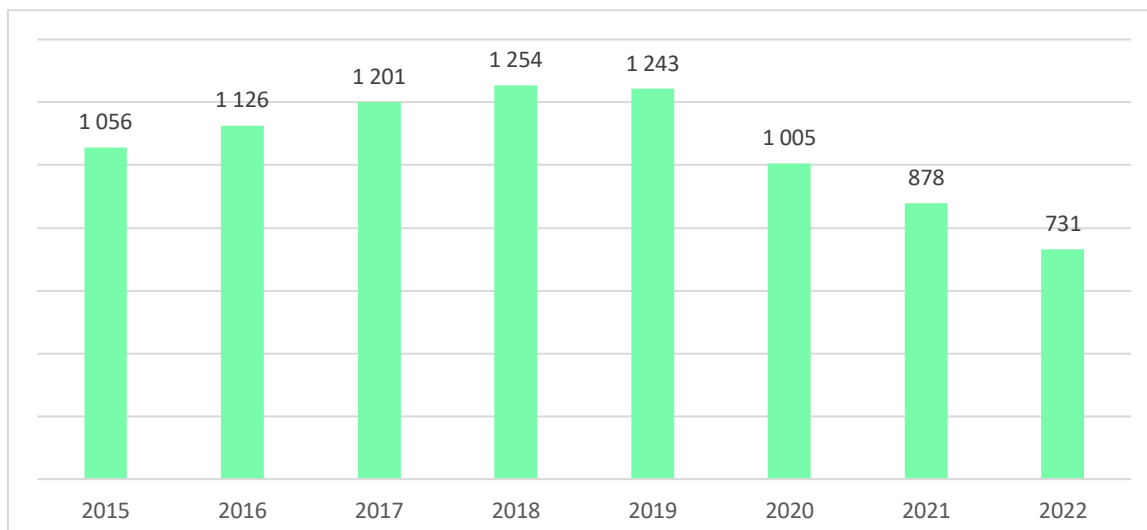


Figure 11 Total sales of Škoda Auto from 2015 to 2022

Source: Own processing

From 2015 to 2018, the Mladá Boleslav car factory has seen steady increase in total car sales. In 2018, Škoda Auto sold a record of 1,254 million cars, 53 thousand more than in the previous year. However, due to the circumstances of the Covid-19 pandemic and the war in Ukraine, there was a decline in cars produced and sold across the world, but Škoda Auto is still a modern and attractive brand that celebrates all generations (Škoda Storyboard, 2023b).

Table 13 shows sales in defined regions between the 2018 and 2022.

Table 13 Sales by regions from 2018 to 2022

	2018	2019	2020	2021	2022
Central Europe	212,928	215,784	181,937	164,050	147,937
Eastern Europe	127,533	138,791	134,393	126,253	49,863
Western Europe	486,356	520,475	434,461	408,970	376,953
Overseas and Asia	426,924	367,717	254,025	178,929	156,509

Source: Own processing

Most cars were delivered to the Western European markets, followed by the markets overseas and Asian markets, Central Europe, and Eastern Europe.

In 2022, Škoda Auto delivered around 380 thousand of its vehicles to customers in Western Europe. The company exported the most cars to neighbouring Germany, with 134,260 cars sold there. Germany is also the current biggest market for Škoda. Another important market in Western Europe for Škoda auto is the UK, where Škoda auto delivered 49,555 of its cars in 2022, thanks to which it remained in the top 5 most prominent markets (Škoda Storyboard, 2023b) .

44,600 vehicles were delivered to Chinese customers in 2022, which is a decrease by 37.4% from the previous year. China thus left the position of the top 5 most prominent markets and fell from the first place, which it held for over 10 years, to the sixth place. Thanks to introduction of two models, Kushaq and Slavia, especially made for Indian market, Škoda Auto's car sales rise by 127,7% from the previous year, when it delivered 51,865 cars in 2022 (Škoda Storyboard, 2023b).

Central Europe is another important market for Škoda Auto. Overall, Škoda delivered almost 150 thousand cars. In the Czech Republic, Škoda sold more than 71 thousand cars, which made it the second biggest market worldwide. Poland also achieved success when it became one of the 5 prominent markets with 44 985 sold cars (Škoda Storyboard, 2023b).

Sales in Eastern Europe fell by 60,5% year-on-year. Škoda Auto sold only 49 863 cars (Škoda Storyboard, 2023b).

As can be seen from Table 13 and Figure 12, sales in the European regions have been declining since 2019. Overseas and in Asia, sales have been declining since 2018.

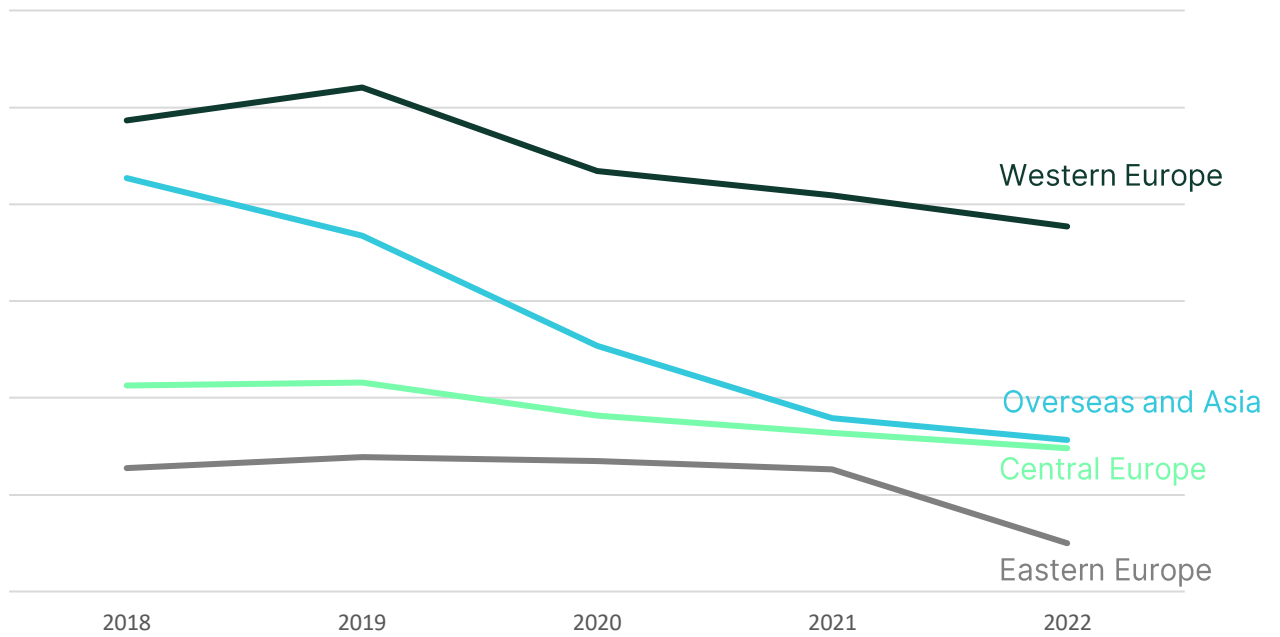


Figure 12 Škoda Auto's sales by regions
Source: Own processing

4.3 Organisational Structure

Organisational structure is divided into two bodies, which are Board of Management and Supervisory Board. As you can see on Figure 13, Board of Management is headed by Board Chairman, from the year 2021 this role is represented by Mr. Klaus Zellmer. The other six areas of Board of Management are Human Resources, Sales and Marketing, Technical Development, Production and Logistics, Finance and IT and Purchasing (Škoda Storyboard, 2023a). These departments continue to be tree-structured into other subdivisions.

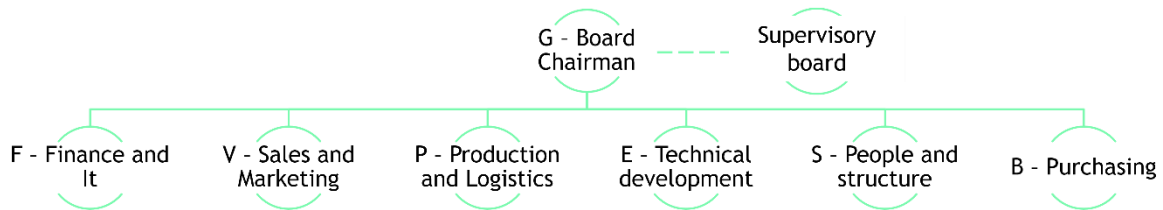


Figure 13 Organizational structure
 Source: Own processing

The department of Production and Logistics includes the Brand Logistics Department, which is then divided into other sub-departments which ensures the planning and management of all logistics processes within the company's operations. This department also ensures the planning of production programmes and the central management of dismantling and pre-production logistics. Under Brand Logistics is a unit called Parts dispatch centre, which provides packaging and dispatch of parts for production in foreign plants.

4.3.1 Parts dispatch centre

This chapter deals with an overview of the logistics concepts operating at Škoda Auto before individual parts, components or vehicles are shipped from the main plant to their final destination.

In many of the steps involved in the logistics of foreign projects, internal logistics is at the forefront, ensuring the transport of parts or finished vehicles to the centre. Škoda Auto manufactures its own parts at its home plant or purchases them from external suppliers. The parts are then transported to the Parts dispatch centre as required.

Finished vehicles, which are further dismantled at the CKD centre to the required level of disassembly, are transported either in-house or from the Kvasiny plant. Depending on the depth of dismantling, the transported parts in the container are

also adjusted, depending on the model being transported. The FBU vehicles are fully operational, and at the centre they are only drained of the operating fluids contained in them. Parts dispatch centre also prepares only parts and components which will be used to build complete car in foreign plants.

The packaging of parts going from the centre to foreign plants varies from project to project, depending on production depth or model range as well as the destination to which the shipment is going. The packaging is always developed separately for each model in order to achieve the lowest possible costs while ensuring a sufficient level of quality, i.e., to avoid damage to the parts during loading operations and especially during transport. The risk is the usage of several transport branches during one transport route, with the associated increase in the frequency of loading operations and other handling.

Packaging fulfils a number of important functions. The protective function is one of them as packaging protects the product from damage, both mechanical and against biological and chemical influences or climatic conditions and their changes. However, the protection also works in reverse, i.e., the external environment is protected from disturbance by the product.

Packaging, or handling, storage and transport units, which are storage boxes, crates, pallets, roller boxes, crates, containers and swap bodies, must be determined on the basis of the principle of composability, so that they facilitate operability and are linked to the means of transport and storage.

The Parts dispatch centre at Škoda Auto uses a large variety of different packaging materials that have different functions, for example to prevent dust and moisture from penetrating the packaging or to prevent mechanical damage to parts during transport. These include PE films, bubble films, GLT packaging or wooden packaging.

At the beginning of loading of container there is a bill of materials - a list of all the parts for a given car that need to be delivered to the foreign plant for a given project. How many parts are included in the BOM depends on the depth of disassembly, the model and what country it is being shipped to. According to the

BOM, the packaging for each part is processed. The batch of parts that is shipped must be processed within a certain time interval so that there are no problems in the external plants due to lack of storage capacity.

The transport and storage equipment mainly fulfils the function of handling and storage. The most commonly used units encountered in logistics chains include storage boxes, crates, pallets, roll containers and containers.

For transporting its vehicles to foreign plants, Škoda Auto uses combined transport in unified transport units, namely containers and railway wagons. Different means of transport are used for different projects. Their deployment depends mainly on the size of the bodies and parts they transport.

Since 2000, Škoda Auto has been using 2-in-1 container transport for transporting not only car bodies. This means that two car bodies and other necessary parts and components were loaded into one container (Pilous Packaging, 2018). This concept can be seen in Figure 14.



Figure 14 2-in-1 concept
Source: Pilous Packaging, 2018

In 2006, this packaging concept was upgraded and 3 bodies with other necessary parts started to be loaded into the container, this could be seen of Figure 15. This innovation aimed to reduce logistics costs and increase the use of space inside the container (Pilous Packaging, 2018).



Figure 15 3-in-1 concept
Source: Pilous Packaging, 2018

Another innovation that won Packaging of the Year 2016 and 2017 was the 4-in-1 concept. ŠKODA developed the innovative 4-in-1 system in cooperation with packaging supplier Pilous for transporting painted car bodies from the Mladá Boleslav plant to the Indian plant in Aurangabad (Pilous Packaging, 2018). This concept, which is shown on Figure 16, results in efficient container utilisation and a 25% reduction in CO2 emissions per transport, while reducing the number of containers by a quarter through the use of 4-in-1 (Škoda Logistika, 2023).



Figure 16 4-in-1 concept
Source: Pilous Packaging, 2018

Wooden pallets are used for the transport of car bodies and larger parts and components, while paper boxes are used for smaller parts and components. Everything must be loaded onto the wooden pallets, which are one-way and must be disposed of after reaching the final destination, before being loaded into the container.

5 Foreign Projects of Škoda Auto

As mentioned in Chapter 4, Škoda is present in many countries around the world. Its production plants in Europe and Asia manage to serve over 100 markets worldwide. Škoda Auto produces not only finished cars at its and partner's plants, but also cars that are in various stages of disassembly. The disassembly levels, on-hold projects and as well as current projects are described in this chapter.

5.1 Levels of Disassembly

There are three levels of disassembly, namely SKD, MKD and CKD. With levels of disassembly is also connected the term FBU.

FBU alias fully built units are completely assembled vehicles. With this option, the company pays lower packing costs but high duties.

SKD (short for Semi-Knocked-Down) kits consist of a fully equipped body, powertrain (engine, transmission and front axle), rear axle and other chassis parts (e.g., wheels, fuel tank, exhaust system, etc.). The assembly plant will assemble the car and thoroughly inspect and test it, using the same methodology and under the same conditions as in all Škoda Auto's "parent" production plants in the Czech Republic. The SKD system is currently being used to assemble cars in Ukraine and previously, for example, in Algeria and Kazakhstan (Auto.cz, 2006).

MKD, or medium knocked-down, is one of the four basic levels of staggering that Škoda uses in transport. MKD is an assembly set that consists of a painted unassembled body and approximately 1,300 to 1,700 other parts in various levels of layout. The assembly of such a car takes place on a standard assembly line. With the help of MKD, the cars were assembled in for example Russia (Auto.cz, 2006).

The highest level of disassembly is represented by the so-called CKD assembly kits ("Completely-Knocked-Down"). In this system, body parts and other individual components are delivered from the factory already in a high degree of dismantling. The assembly plant then welds and paints the bodywork, assembles the power unit

and other components, and finishes the car on a standard assembly line (Auto.cz, 2006).

The company uses a special concept called Parts and components to manufacture cars in India. This concept differs from MKD kits in that the parts and components are not supplied in one kit but as separate parts.

5.2 On-hold foreign projects

Škoda Auto has produced in many countries in the past. In the past, it has assembled its vehicles in Turkey, New Zealand and Bosnia and Herzegovina, for example (Auto.cz, 2006). Other projects that the carmaker started abroad, but which are now unfortunately on hold, included production in countries such as Algeria, Kazakhstan and Russia.

Algeria

In Algeria, the company opened its factory in 2012 in the Algerian town of Relizane, where the Skoda Octavia, Skoda Rapid and Skoda Fabia were produced with the help of SKD. The factory was part of the joint venture between Skoda Auto and the Algerian state-owned company SNVI. Vehicle production at the Relizane plant was stopped, due to parts supply problems and a lack of production efficiency, which led to losses. However, Skoda Auto still has a presence in Algeria and offers its vehicles on the Algerian market through its local distributors.

Kazakhstan

The first sales of Škoda cars in Kazakhstan began in 1998, when the company cooperated with its local partner Azia Avto. In 2004, the latter opened a plant in Ust-Kamenogorsk, and Skoda Auto began producing Octavia model there in 2005. The companies cooperated here until 2021, when the project was put on hold due to Azia Avto's problems.

Russia

In the Russian market, Volkswagen initially had only an assembly plant, which opened in 2007 in the Russian city of Kaluga, near the capital Moscow. Until 2010, imported parts, the so-called SKD kits, were assembled here. In 2010, assembly of CKD cars began. The switch from SKD to CKD was mainly due to customs barriers, where there was a limited time for importing SKD sets. Another plant was located in Nizhny Novgorod. Škoda Auto took over responsibility for the Russia region from VW in 2021. However, due to the war in Ukraine, Škoda Auto initially suspended and then completely ceased production there.

5.3 Current Foreign Projects

Škoda Auto currently manufactures in four foreign countries. Namely Slovakia, China, Ukraine and India. In 2023, the company will also expand its operations to Vietnam. It is India and Vietnam that are the focus of Chapter 6, which analyses Škoda Auto's logistics concept for the production of cars abroad, so the company's operations in these countries are presented there.

China

Škoda Auto entered the Chinese market for the very first time in 1936 and operated 5 stores with their products. In 2007, Škoda Auto re-entered Chinese market under the auspices of SAIC Volkswagen and began production in an industrial area of Shanghai called An-tching. Today, Skoda Auto operates not only in Shanghai, but also in the cities of Nanjing, Yicheng, Ningbo and Changsha.

From 2010 to 2020, the Chinese market was the most important for the company, as one in four Škoda cars produced were sold there. In China, the company offers 10 models, including two SUVs intended only for the Chinese market.

Figure 17 shows the evolution of the number of cars produced between 2018 and 2022.

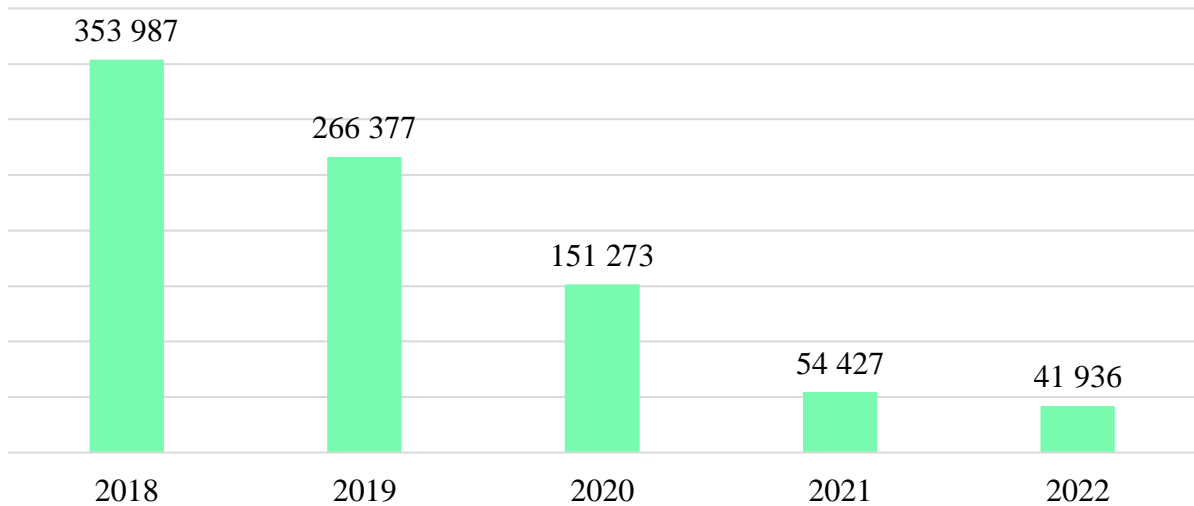


Figure 17 Number of cars produced in China from 2018 to 2022
 Source: Own processing

In 2018, most cars in the observed period were produced. From that year there can be seen gradual decrease to something more than 40 thousand cars produced in 2022 (Škoda Storyboard, 2023b).

Figure 18 shows the trend of cars sold in the Chinese automobile market from 2018 to 2022.

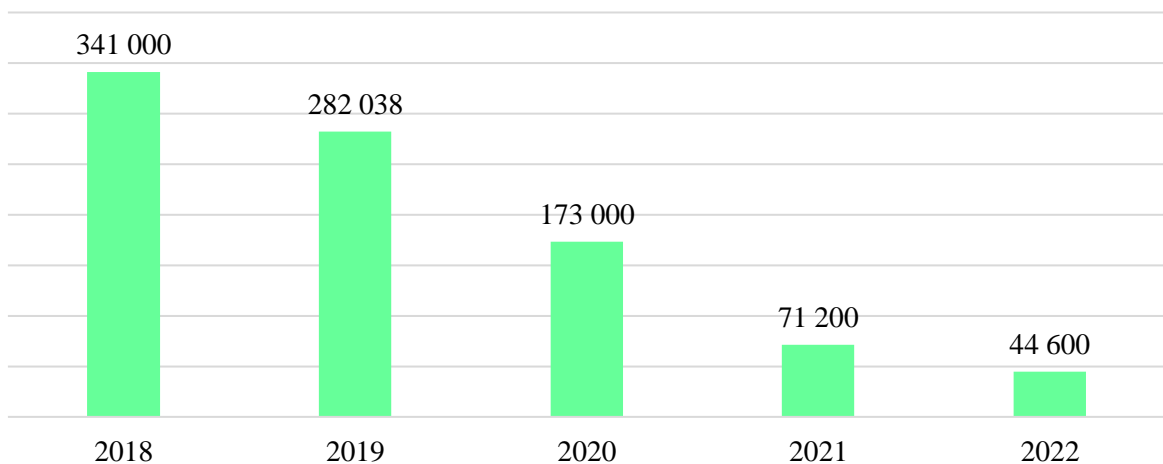


Figure 18 Number of cars sold in China from 2018 to 2022
 Source: Own processing

As with the production of Škoda cars, the company has sold significantly fewer cars each year since 2018. In 2022, it sold almost 300,000 fewer cars compared to 2018 (Škoda Storyboard, 2023b).

Ukraine

In 2002, Škoda Auto entered the Ukrainian market, where it produces its vehicles in cooperation with its local partner Eurocar. Since then, more than 193,000 cars have been produced at the factory, which is proof of the success of this cooperation.

Over the years, Škoda Auto has gradually expanded its production in Ukraine. It first started production there with the SKD system and in 2006 added MKD. These systems enabled Škoda to produce its cars in Ukraine and thus improve the availability of its products to customers there. Škoda Auto started deliveries of FBU cars in Ukraine in 2019. This move enabled the company to offer a wider range of vehicles to customers there.

Unfortunately, due to the war in Ukraine, deliveries of cars from the Czech Republic were halted, but deliveries of SKD kits resumed in June 2022.

6 Analysis of the Logistics Concept of Car Manufacturing Abroad

This chapter focuses on the analyses of the logistics concepts of vehicles manufacturing in India and Vietnam. India is chosen because it is currently one of the most important markets for Škoda Auto. Vietnam is chosen because of the synergies with the Indian project and because Vietnam is a new destination where Škoda Auto expands its production to.

In this chapter, the transport concepts are described and not only the logistics risks are analysed and evaluated, but also an analyses of the suitability of location for production is conducted.

6.1 India

The history of Škoda car manufacturing in India dates back to 1999, when Škoda Auto India Private Limited was established in Aurangabad, India, as a wholly owned subsidiary of Škoda auto a.s. The actual production started in 2001 with the Skoda Octavia. Then in 2007, Volkswagen India Pvt Ltd started production in Pune (Volkswagen India, 2023). In October 2019, Volkswagen Group India announced the merger of its three Indian companies into a new entity called Skoda Auto Volkswagen India Pvt Ltd based in Pune. Skoda Auto has been given the management of this grouping within the group (IndiaTimes, 2019).

The first model launched in the Indian market was the Octavia in 2002. As of 2022, the Indian portfolio offered 5 Skoda models – Octavia, Superb, Kodiaq, Slavia and Kushaq. Of the above models, Octavia, Superb and Kodiaq are assembled in Aurangabad, while Slavia and Kushaq are assembled in Pune (Škoda Storyboard, 2023b).

As already mentioned, Škoda Auto has two production plants in India. The Aurangabad plant produces cars from parts and components delivered from Mladá Boleslav and other suppliers, it is painted car body and parts in lots. This is different from MKD that is sent like a kit. At the Pune plant, cars are produced locally. Almost

100% of the car's value is localized in India, but some components still have to be imported from Europe.

Figure 19 shows the evolution of the number of cars produced between 2018 and 2022. It should be noted that the product portfolio has varied from year to year, as is shown in Table 14.

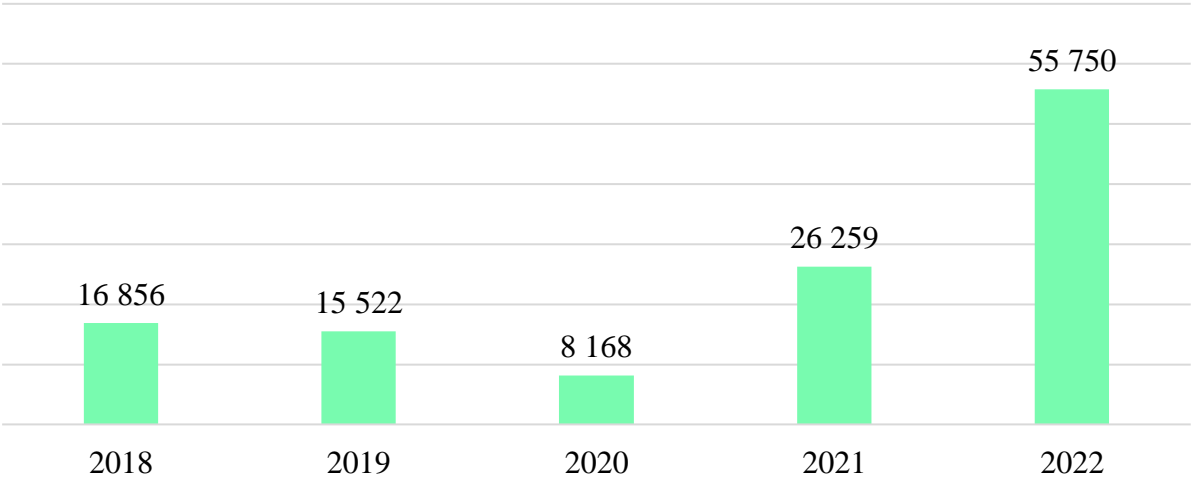


Figure 19 Number of cars produced in India from 2018 to 2022
Source: Own processing

The chart shows that the lowest number of cars were produced in 2020, it was due to the pandemic of Covid-19. The highest number of cars was produced in 2022 (Škoda Storyboard, 2023b).

Table 14 shows the production trend of each model from 2018 to 2022.

Table 14 Number of manufactured cars in India by models from 2018 to 2022

	2018	2019	2020	2021	2022
Rapid	9 989	9 529	6 700	6 259	-
Octavia	2 891	2 731	14	1 670	1 417
Superb	1 752	1 415	1 352	1 704	1 771
Kodiaq	2 224	1 847	5	139	1 175
Slavia	-	-	-	134	24 664
Kushaq	-	-	97	16 353	26 723

Source: Own processing

In 2018, 9 989 Rapid cars were produced, the highest number in the period under review. The model was last produced in India in the year 2021, as the production of this model stopped worldwide. The most Octavia cars were produced in 2018, at 2 891 units. From the table, it could be seen that the most Superb cars produced was in 2022, when 1,771 vehicles were produced. Production of Kodiaq, which started in the year 2017 in Aurangabad, produced 2,224 units. In the year 2020, first Kushaqs, model developed especially for the Indian market, were produced. The company introduced another model made especially for India in 2021, the model is called Slavia. Both models seen a big rise in its production as can be seen from the table (Škoda Storyboard, 2023b).

Figure 20 shows the trend of cars sold in the Indian automobile market from 2018 to 2022.

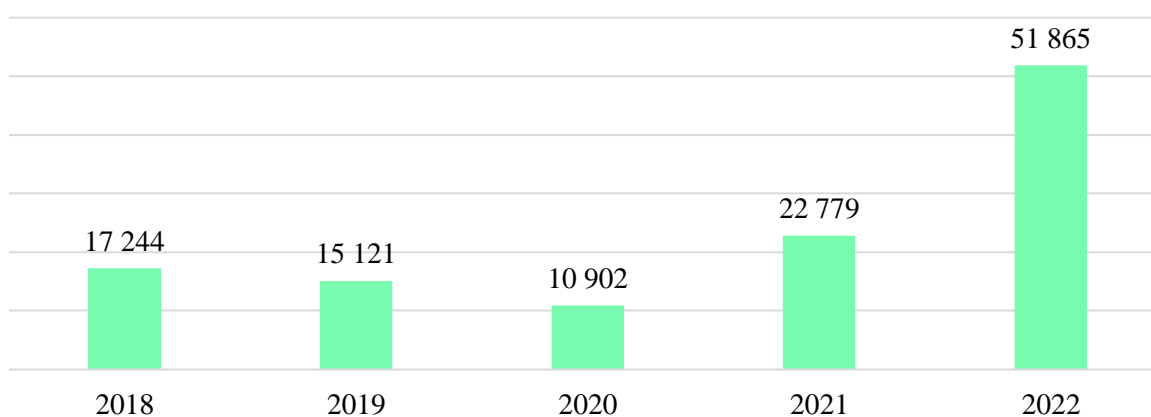


Figure 20 Number of sold cars in India from 2018 to 2022

Source: Own processing

In 2018, 17,244 vehicles were delivered to customers. In 2019, with a total of 15,121 vehicles sold, a decrease of 12.3% was recorded. The following year, the company saw a 27.9% decrease in cars sold. In 2021, the growth was 108.9% when the company sold 22,779 cars. This growth was caused by the introduction of a new vehicle, Kushaq, directly for Indian market. In 2022, Škoda Auto delivered a total of 51,865 vehicles, an increase of 127.7% compared to the previous year. This was due to the company launching another car specially developed for the Indian market, the Slavia model. India has thus for the first time ever ranked among the top five markets, taking the third position overall behind Germany (134,260 units sold) and the Czech Republic (71,152 units sold) (Škoda Storyboard, 2023b).

6.1.1 Transport and packaging

As mentioned above, Skoda Auto has two manufacturing plants in India where it supplies parts and components to India. Deliveries to India are subject to the FCA delivery condition explained in section 2.5.2.

Transport to both plants is combined, using road, rail and sea transport. Transport of most parts to Pune plant is within India as this production plant focuses on production of Kushaq and Slavia, models made specially for this market. Both models are almost fully localised, so components are shipped to production plant from local suppliers. Some parts are still shipped from Czech Republic and also from other countries around the world, those suppliers ship their parts directly to Pune plant. The transport of local parts to Pune and the logistics concept of the material flow of parts with final destination in Pune can be seen in more detail in Figure 21.

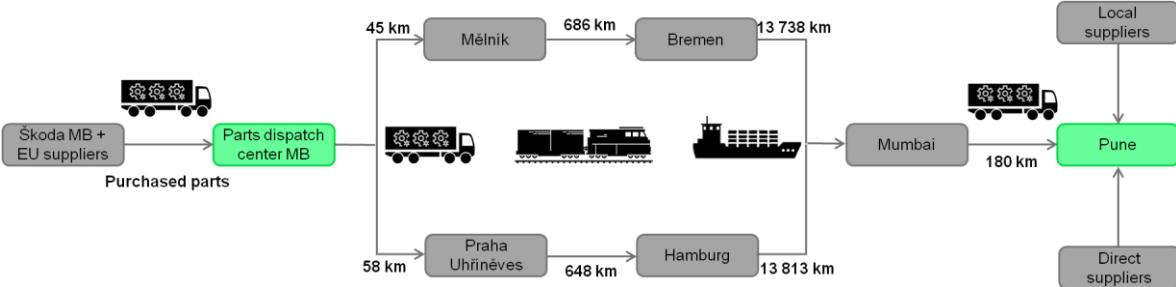


Figure 21 Material flow to Pune
Source: Own processing

Purchased parts are transported from suppliers to the Parts dispatch centre in Mladá Boleslav. From there, the containers are then transported by truck either to the container terminal in Mělník, from where they are transported by train to Bremen or to container terminal in Praha Uhřetěves, from where they are transported by train to Hamburg. In Bremen or Hamburg containers are transported by boat to Mumbai, from where the trucks head to Pune using road transport.

The entire transportation process is 14,649 km long using the route through Bremen and 14,699 km long using the route through Hamburg.

Parts and components needed for production of cars in Aurangabad are shipped as already painted bodies, which are shipped along with lots of non-localised parts in containers. This material flow is shown in more detail in Figure 22.

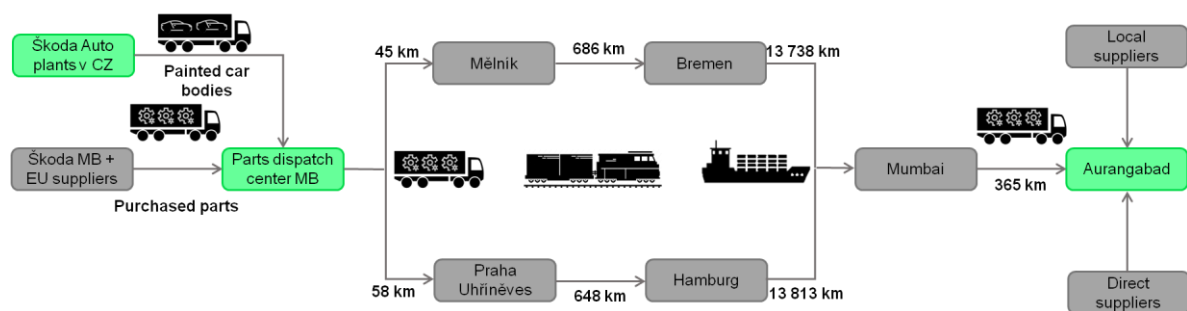


Figure 22 Material flow to Aurangabad
Source: Own processing

The painted car bodies are delivered from Škoda Autos plants in Czech Republic to Parts dispatch centre in Mladá Boleslav. Other components are also transported from the suppliers to the centre, where everything is stacked in a container and prepared for transport. Using road transport, the containers are first transported to the container terminal in Mělník or to Praha Uhřetěves, from where they are switched to rail transport to take the cars to ports in Bremen or Hamburg. From the ports, the containers go by sea to Mumbai, where they are transported by truck to the Aurangabad plant which is 365 km away. Some parts used for parts and components production localised in India and some are delivered from other countries directly to Aurangabad plant. The total journey from Mladá Boleslav to the Aurangabad plant is 14,834 km when using the route with Bremen and 14,884 km when using the route with port in Hamburg.

Transporting goods across India is the most challenging of the entire route, as the quality of the roads cannot be compared to European roads in all places, while the country is full of slowdown speed bumps, the trucks are older and Indian drivers usually brake hard at the last minute, which can damage the cargo being transported.

The routes used to India as well as the whole transportation route can be seen on Figure 23.

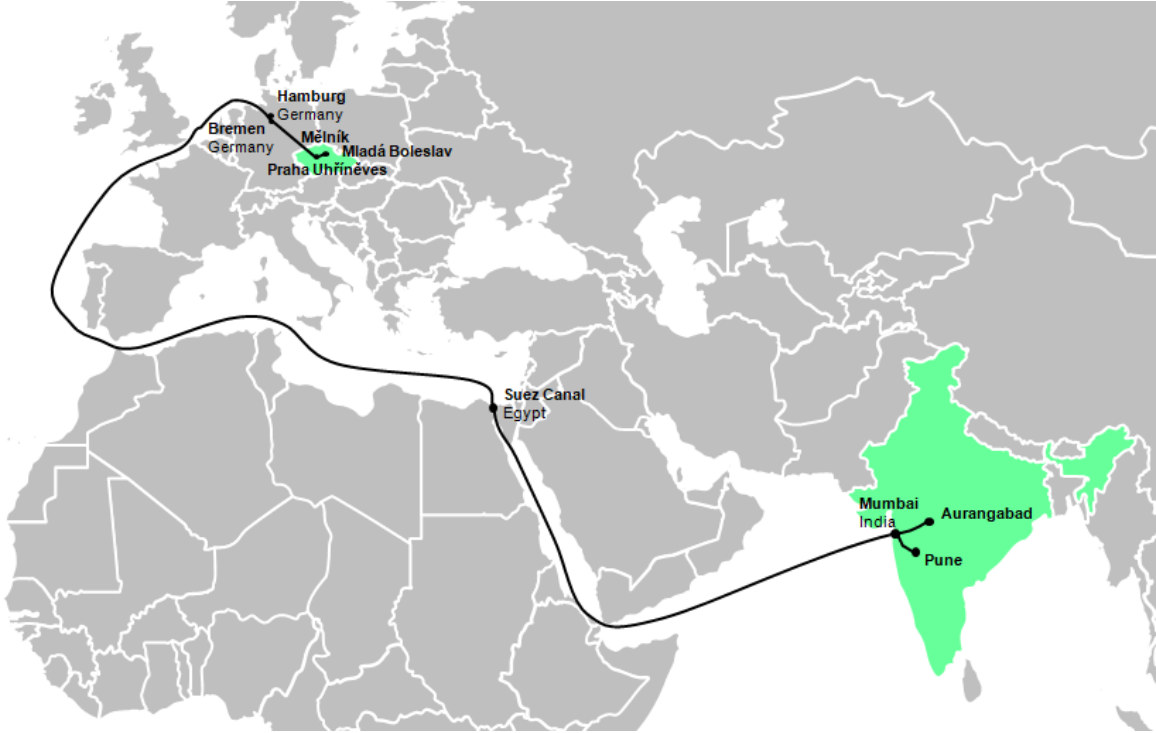


Figure 23 Transportation route to India
Source: Own processing

As can be seen, Škoda Auto has to use the Suez Canal to supply parts and components to India, the Suez Canal is a very important transport corridor but has limited capacity and freight traffic can often be delayed. At the same time, the operating and maintenance costs of the canal are remarkably high, which can affect the cost of shipping and thus the bottom line.

6.1.2 Production and storage

The capacity of the plants varies widely. The Pune plant, which covers 2.3 million square meters, includes capacity for body shop, paint shop and assembly shop. The capacity of the Aurangabad plant, which covers only 0.3 million square meters, includes only assembly capacity. At the same time, it is not possible to accurately determine the production capacity for Skoda Auto vehicles only. In fact, both plants produce or complete the assembly of vehicles of other VW Group brands operating in the Indian market (Volkswagen Newsroom, 2023).

A standard assembly line equipped with all VW Group standard equipment (manipulators, fixtures, electronically controlled tools, lifters, testing and filling equipment etc.) is required for the production of parts and components cars. Those cars originate from EU plants of VW Group.

6.1.3 Dealers and suppliers

Almost all parts required for the production of Kushaq and Slavia are localized in India, meaning that they are purchased from local suppliers. For production of other Škoda cars, parts and components are shipped from suppliers all over the world.

Once the car is made, it goes to dealers. The relationship between Škoda Auto and the dealer network has commission-agency elements. The dealer buys the cars from the company at a predetermined price and resells them to end customers at catalogue prices, which include its margin. The company has more than 238 dealers in 146 cities across the country (CarDekho, 2023).

6.1.4 Logistics risk analysis

The risks arising from the analysis of the Indian market as well as the analysis of the logistics concept for the production of cars in the foreign market were identified as logistics risks. Table 15 contains those risks, to which are assigned a probability of occurrence value and an economic impact value according to its impact on the company's business in the Indian market. The PO x EI column contains the

materiality of these risks. The risks are further assigned a colour according to the scale in Table 3 based on their materiality.

Table 15 Logistics risks for Indian project

Risk description		Probability of occurrence	Economic impact	PO X EI
Territorial risks				
Administrative state intervention	Parts and components	3	3	9
	Local production	3	3	9
Political instability of the country		2	2	4
Natural disasters		2	2	4
Market and Exchange rates risks				
Change in Exchange rates		1	2	2
Inflation		2	2	4
Decline in demand/customer loyalty		4	3	12
Threat of competition		4	2	8
Reduction in the price of competing products		3	2	6
Risks of foreign partners				
Partner withdrawal from contract	Parts and components	1	2	2
	Local production	2	3	6
Non-acceptance of vehicles by customer		1	2	2
Failure of parts delivery	Parts and components	1	2	2
	Local production	2	3	6
Transportation risks				
Loss of cargo	Parts and components	1	3	3
	Local production	1	3	3
Damage to cargo during transport	Parts and components	2	1	2
	Local production	2	1	2
Transport delays	Parts and components	2	1	2
	Local production	1	3	3
Liability risks				
Defective product		1	1	1
Storage damage		1	1	1

Source: Own processing

The political situation in India is currently relatively stable, and the Indian government has a positive attitude towards foreign investors, investing in infrastructure development and trying to improve the overall efficiency of the business environment. Companies do not need to worry about the political situation and the stability of the country. However, as far as state intervention is concerned, corporate CO2 responsibility has been increasingly addressed recently and, just as the European Union is considering certain sanctions on the production of internal combustion cars, India is also considering this step. So, the company should also take this risk into account. Another territorial risk may be natural disasters. Every year, India experiences monsoon rains that cause flooding, which can significantly affect the operation of plants.

In terms of foreign exchange risks, the company must focus on the correct choice of currencies in which it trades. In India, the company buys and sells cars in Indian rupees, and exports cars to other countries in euros. The evolution of the exchange rate of the Indian rupee against the Czech crown and the evolution of the euro against the Indian rupee can be seen in Figures 3 and 4 in Chapter 3.2.1 The figures show that both the exchange rate of the Czech koruna to the rupee and the Euro to the rupee are appreciating. Inflation is another risk that may have a negative impact on the company's business. Rising inflation causes depreciation of savings and reduction in purchasing power.

Among the market risks, risks from competitors, reduction in price of competitors' products and decrease in demand for products have been identified. The competition in the market is really high, automobile companies operating in India are seen in Figure 6 in chapter 3.1.5. With the passenger car market being so highly occupied, there is a risk that other companies will try to reduce the prices of their products, which would be a risk for the company. The high competition in the market is also linked to a decline in demand for Škoda Auto's products and a decline in customer loyalty, who have a wide range of cars to choose from at low prices.

There is almost no risk to the company from the withdrawal of foreign partners from the contract and the non-acceptance of goods by the dealer. As far as the supply of parts needed to prepare Parts and components production is concerned, contracts are concluded with several suppliers and Škoda Auto takes such risks into account

and keeps a stock of parts. With local production, failure to supply local parts would also mean theoretical downtime on the production lines.

There is a risk of cargo loss both when transporting parts from Europe and when transporting parts across India. The risk of cargo damage during transport from Europe is possible, especially when containers are transhipped several times during the journey. At the same time, there is a high likelihood of delays in transporting the cargo when travelling from Europe, while this is less likely when manufacturing locally.

Liability risks included the risks of delivery of a defective product and damage to that product during storage. However, Škoda Auto has thorough testing and trials in place and this risk is therefore very low.

6.1.5 Destination suitability analysis for production

India's transport infrastructure includes an extensive network of roads, highways, railways, ports and airports. However, the level of this infrastructure can vary from region to region and in some parts of India the infrastructure is still inadequate.

Road transport is the most important mode of transport in India and accounts for most of the movement of goods and people. In recent years, there has been major investment in expanding and upgrading the road network and building new highways, but there are still places where road infrastructure is inadequate. Trains are a popular form of travel and are often overcrowded. However, some lines are outdated and need to be updated. India also has many airports, some of which are international and serve as gateways to the country. India's ports are important for trade and foreign exchange and are located on the east and west coasts (IBEF, 2023b).

Overall, India's transport infrastructure is still in a formative stage and is trying to adapt to the growing needs of the population and business.

India is a country with a huge industrial base and provides a range of raw materials and supplies such as steel, aluminium and other required raw materials needed for

the production of automobiles. India also offers cheap and skilled labour that can reduce overall production costs and improve the efficiency of the manufacturing process (IBEF, 2023c).

6.1.6 Alternative transport route

An alternative option to sea transport is to transport parts and components by rail or air. The first proposal for improvement is to use a planned rail corridor called the North South Transport Corridor. This currently only theoretical corridor would run through Russia, Iran and Azerbaijan to India. The current route for transporting cargos from Europe to India and the proposed new route can be seen in Figure 24.

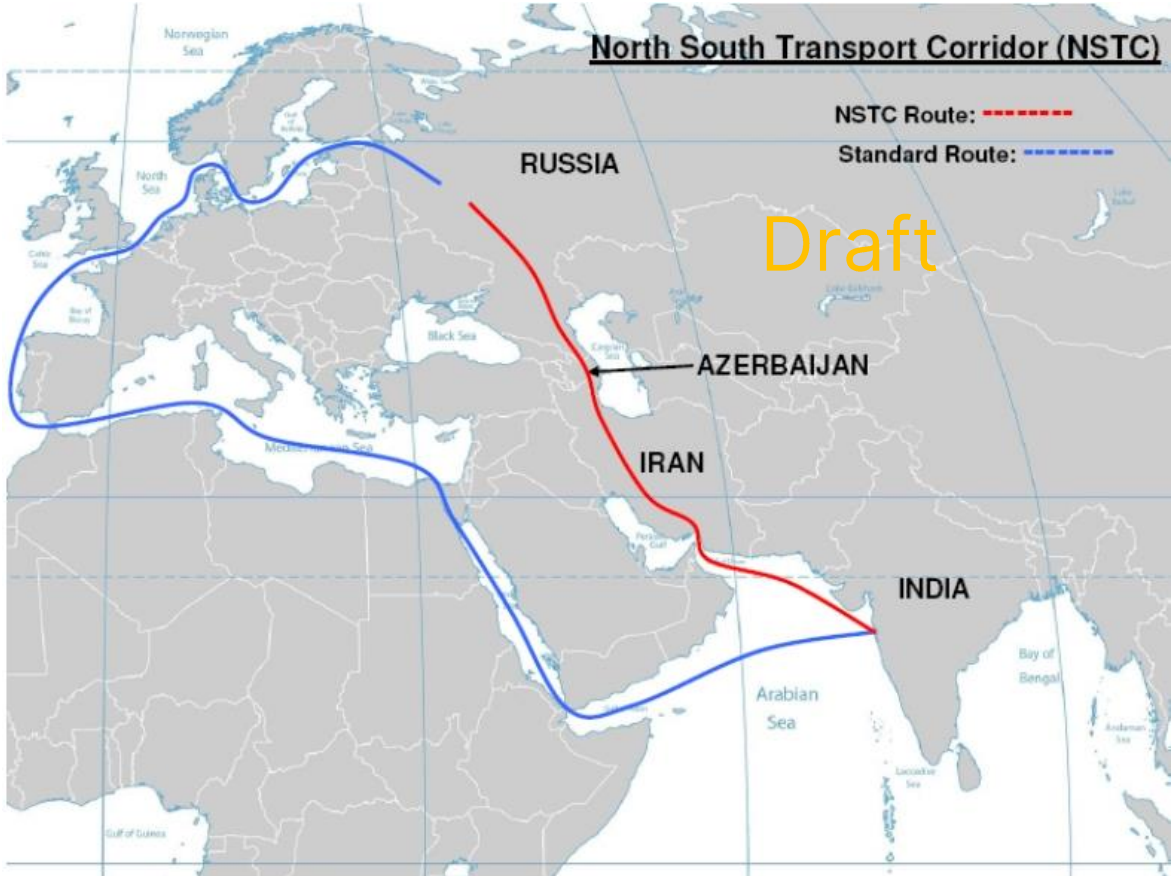


Figure 24 North South Transport Corridor
Source: GCR, 2023

Transportation in this concept would be combined, with containers starting their journey in Mladá Boleslav, through Poland to the Russian border, where they would

transfer to a broad-gauge track through Iran to Azerbaijan. Here the containers would be transferred to a ship and from the port of Azerbaijan they would arrive in Mumbai. From there, they would then continue by road to the Skoda Auto plant in India.

The blue route in Figure 24 leads from Russia and is roughly 16,000 km long (The Nation, 2022), the description of the transport concept used by Škoda Auto shows that the transport from Mladá Boleslav to India is roughly 14,900 km long and takes about 50 days. The red route is 7200 km and the transport from Russia to India takes 25 days (The New Indian Express, 2022). Škoda Auto would have to transport its cars to Moscow first. This route is 8240 km long and would take 10 days to complete the new proposed route.

Air transport could be also possible for deliveries of parts and components and also components for Kushaq and Slavia. The flight route and the price are based on the specific flight and varies from airline to airline. The flight would begin in Prague with possible stopover on one of major European airports and then to final destination, Mumbai International Airport. The air distance is around 6 150 km and the flight itself takes less than a day. Other necessary operations such as transport from the factory to the airport, check-in, loading and customs clearance take on average 7 days.

The proposed routes could only be implemented if international relations between the countries through which the potential routes pass are established and the routes are safe for cargo and people.

Table 16 compares these two proposals with the currently used chosen mode of transport in terms of average transport time in days (without activities related to transportation to other country), approximate distance in km and average costs of transportation per container or per 1 tonne for air transportation. The data are collected from the website Searates (2023), ShipHub (2023) and Quartz (2021).

Table 16 Transportation types comparison for India

TYPE OF TRANSPORTATION	TIME	DISTANCE	COSTS per CNT/ per 1 tonne
SEA	21 days	14 800km	\$2,700
RAIL	10 days	8 240km	\$4,900 to 15,000
AIR	<1 day	6 150km	\$3,800

Source: Own processing

Air transport is the best in terms of time and distance. For the delivery of individual components, this type of transport could be considered, but for the delivery of parts and components needed for production of cars in Aurangabad, which are delivered in larger quantities and due to the higher cost of using air transport, it cannot be considered. Rail transport is less costly than air transport but is still more costly than sea transportation. When compared with the sea transport used at the same time, there could be savings in delivery time. Time can be evaluated as lost profit in terms of opportunity cost. However, there is currently no official proposed rail route.

6.2 Vietnam

In 2022, the Czech carmaker announced that it will continue its internationalisation and enter the strategic market of Vietnam. In cooperation with local partner Thanh Cong Motor, Škoda Auto will offer European models here as early as 2023. The Kodiaq, Karoq, Superb and Octavia model series will be imported. A line is also under construction to assemble the Kushaq and Slavia models, which Škoda manufactures in India. A complete set of parts needed to assemble these two models will be delivered to Vietnam. The production line is expected to be ready in the first half of 2024 (Škoda Auto a.s., 2022).

The first factor that led to Skoda's decision to enter the Vietnamese market is the potential it offers. Vietnam is one of the fastest growing markets in Southeast Asia with great potential for car sales. With a population of over 98 million, Vietnam's potential purchasing power is very large indeed. The Vietnamese economy has also stabilised and attracted investors from all over the world.

Another factor that led Skoda to decide to enter is Vietnam's membership of the ASEAN group. This grouping brings together 10 Southeast Asian countries and gives Skoda the opportunity to expand its business in the region. At the same time, it is the very essence of ASEAN that goods can be exported duty-free between the countries of the grouping.

The third factor that encouraged entry is the historical relationship between the Czech Republic and Vietnam. Historically, relations between these countries have been very well established and are still maintained today through trade and culture. These relationships can help Skoda to enter the Vietnamese market as they increase brand awareness and trust of Vietnamese consumers in products from the Czech Republic.

Škoda imports its vehicles from Mladá Boleslav in the form of FBU, i.e., it imports finished vehicles to Vietnam. Later, it plans to produce cars using CKD kits imported from India. This move gives Skoda the opportunity to reduce production costs and increase its competitiveness in the Vietnamese market. With full-scale production, transportation and customs costs are reduced, allowing the company to offer its cars at a competitive price.

6.2.1 Transport and packaging

Škoda Auto decided to supply cars to the Vietnamese market initially in the form of FBU. Cars from the higher price category were selected, namely Karoq, Kodiaq, Octavia, Superb and after year 2025 also electric vehicles Enyaq iV and Enyaq Coupé iV (Škoda Storyboard, 2022). The cars will be sent from the Czech Republic directly to Vietnam, due to customs restrictions, the planned stop by Škoda, for example, in India to translate and get better conditions may not be made. At the same time, there is also a free trade agreement between the EU and Vietnam, and this removes most of the tariff restrictions and regulatory barriers. Deliveries to Vietnam are subject to the CFR delivery condition explained in Chapter 2.5.2.

Figure 25 shows the transport concept of FBU sets from Mladá Boleslav to Vietnam.

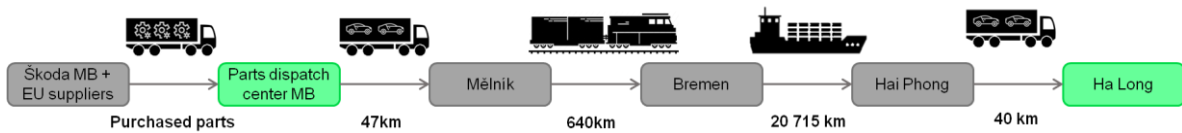


Figure 25 Material flow from Mladá Boleslav to Ha Long

Source: Own processing

First, all the parts needed to make the car are delivered and it is then handed over to the CKD centre where it is packed and prepared for transport. The FBU kits next travel to the port of Bremerhaven where they then continue by boat through the Suez Canal to the port of Hai Phong. At the port, the transshipment takes place, and the vehicles continue to their partner Thanh Cong. Interestingly, there is also a port in Ha Long, which is closer to the Thanh Cong manufacturing plant, but there is a bridge that is too low and there is insufficient water level for the cargo ship to sink.

The next step Skoda Auto plans to take is to produce two more models, this time in CKD form and shipped from India. The transport flow for this concept is shown in Figure 26.

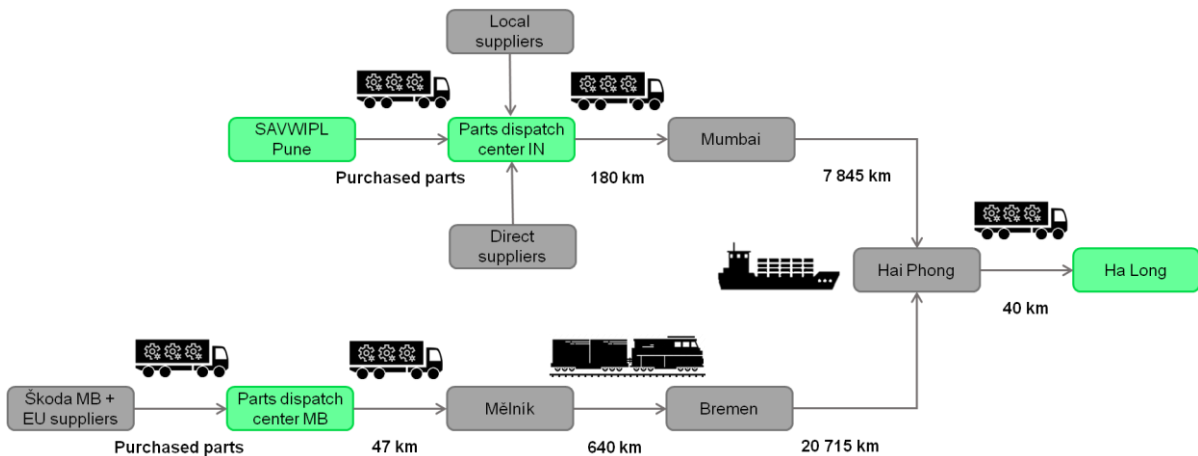


Figure 26 Material flow from Mladá Boleslav and Pune to Ha Long

Source: Own processing

The parts for CKD planned models are almost 100% localised in India, but some components must be continuously shipped from Mladá Boleslav through Bremerhaven port. All Indian parts required for production are ready for transport at the PEC centre in Pune, from where they will head to Mumbai and then by boat to

the port of Hai Phong. Here, the containers are again transferred and delivered by road to the Thanh Cong production plant in the Viet Hung region.

Figure 27 shows the routes that FBU and the parts needed for CKD production have to take to reach Vietnam.

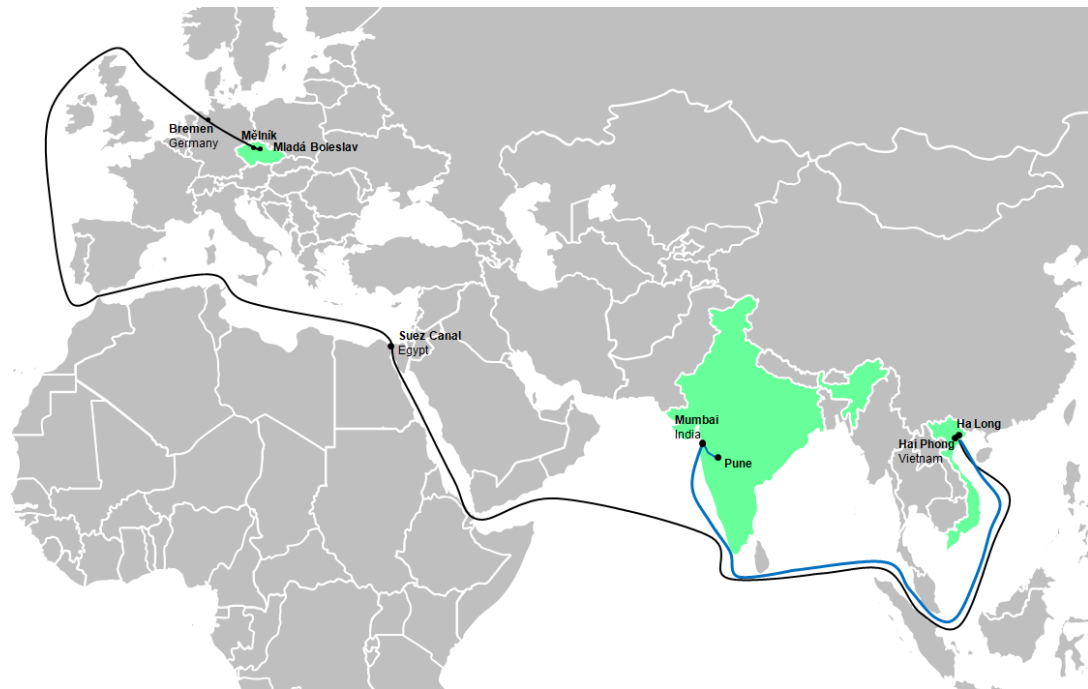


Figure 27 Transportation route to Vietnam
Source: Own processing

As can be seen, Škoda Auto must use the Suez Canal to supply parts and components to FBU vehicles from Europe to Vietnam, just as it does to transport parts to India.

As already mentioned, and described in Chapter 4.3.1, Škoda Auto uses wooden pallets when shipping abroad.

6.2.2 Production and storage

Škoda Auto started its operations in Vietnam in cooperation with Thanh Cong, a local company with many years of experience in the production and sale of cars. The company plans to sell 30,000 cars per year, with the possibility of further growth to 40,000 cars per year. The company has started construction of a new

plant in Quang Ninh province (Škoda Storyboard, 2022), an illustration of what it should look like can be seen in Figure 28.



Figure 28 Illustration of new production plant of Thanh Cong
Source: VNBT, 2023

The plant is expected to be completed in the first half of 2024, with production of CKD cars starting in late 2024 (Škoda Storyboard, 2022). As CKD kits need a fully equipped assembly plant, there will be a body shop, paint shop and assembly shop.

Based on the negotiated volumes, the new plant will include separate warehouses for parts storage and furthermore shops on the single halls that will be folded for logistics.

Since the cars will be shipped from India as well, an area in Pune is being prepared to house the one-piece assemblies required for production. If the production volume in Vietnam is increased in the future, the PEC in India would have to be expanded as well.

6.2.3 Dealers and suppliers

As far as suppliers are concerned, as mentioned above, all parts are sent in a set from India, and their origin is mostly Indian, with some being European. So locally in Vietnam, there are no localized parts and components.

The cars will be sold in Vietnam through a local partner network. The first dealerships should be in Hanoi or Ho Chi Minh City, but on an ongoing basis the company plans to open more dealerships and plans to expand the sales network to more than 50 partners (Škoda Storyboard, 2022).

The Škoda Auto dealer network in Vietnam will be run by Thanh Cong, with profits for the company coming from the sale of parts and spare parts.

As far as distribution in Vietnam and theoretical export of cars from Vietnam to foreign countries is concerned, road, rail and water transport will be used. The new plant is also being built near the river, allowing Thanh Cong to build its own port there in the future and ship cars by water directly from its plant.

6.2.4 Logistics risk analysis

The risks arising from the analysis of the Vietnamese market and the analysis of the logistics concept to produce the car in the foreign market were identified as logistics risks. These risks are territorial, market and currency, transportation, foreign partners, and liability risks. The probability of occurrence and the degree of economic impact on Škoda Auto are determined for the identified risks. The risks and their assessment can be seen in Table 17.

Table 17 Logistics risks of Vietnamese project

Risk description		Probability of occurrence	Economic impact	PO X EI
Territorial risks				
Administrative	FBU	2	2	4
state intervention	CKD	3	2	6
Political instability of the country		2	2	4
Natural disasters		3	2	6
Market and Exchange rates risks				
Change in Exchange rates		2	2	4
Inflation		2	2	4
Decline in demand/customer loyalty		3	3	9
Threat of competition		4	2	8
Reduction in the price of competing products		4	2	8
Risks of foreign partner				
Partner withdrawal from contract		2	3	6
Non-acceptance of vehicles by customer		1	2	2
Transportation risks				
Loss of cargo	FBU	1	3	3
	CKD	1	3	3
Damage to cargo during transport	FBU	3	3	9
	CKD	3	1	3
Transport delays	FBU	3	1	3
	CKD	2	3	6
Liability risks				
Defective product	FBU	1	1	1
	CKD	2	2	4
Storage damage		1	1	1

Source: Own processing

The political situation in Vietnam is currently relatively stable, the Vietnamese government has a positive attitude towards foreign investors and is trying to improve the overall efficiency of the business environment. As already mentioned in Chapter 3.2, Vietnam is a socialist country, so the state partially interferes in the activities of companies doing business there. Natural disasters can be another territorial risk. Vietnam is prone to natural disasters such as floods or tropical cyclones.

In terms of exchange rate risks, the company has little to worry about. As can be seen in Chapter 3.2.2, the exchange rate is more or less stable and tends to appreciate in the Euro-Vietnamese dong and Czech crown-Vietnamese dong relationship. Inflation is another risk that can have a negative impact on the company's economic performance, but as can be seen in Table 9, inflation in Vietnam is around 3%, even dropping to 1.8% in 2021.

Among the market risks, risks from competitors, reduction in the price of competitors' products and decrease in demand for products were identified. Skoda Auto is new to the Vietnamese market with production, so it will be able to supply more cars to customers than it has done so far. Even so, it will have to face relatively abundant competition, which has experience in the market and customers are used to the cars sold by them.

There is almost no risk to the company from a foreign partner withdrawing from the contract and the dealer not taking delivery. The company has a contract with Thanh Cong, which also manages distribution through its dealer network. At the same time, this cooperation is new, so withdrawal is unlikely.

Both when transporting parts from Europe and when transporting parts from India, there is a risk of cargo loss, damage during transshipment or the likelihood of delays, which is greater when delivering FBUs from Europe.

Liability risks included the risk of delivery of defective product and damage to the product during storage. The cooperation between the companies is new, as already mentioned, so initially there is a greater risk of defective product being delivered when manufacturing cars using CKD than when delivering FBU cars.

6.2.5 Destination suitability analysis for production

In recent years, Vietnam has become an attractive destination for many international companies looking for new sources of production and opportunities to reduce production costs. The country's location in Southeast Asia allows for easy and fast transportation to other countries in the region, as well as to the rest of the world.

In recent years, Vietnam has invested heavily in upgrading its infrastructure, particularly its road network and ports, to improve competitiveness and attract foreign investors. Thanks to this move, freight shipments are now relatively dependable and fast. Vietnam has 251 ports from which 45 are seaports and 2 accounts for international port. This makes it quite easy to transport goods and raw materials between Vietnam and foreign countries. However, there are still transportation challenges in areas outside the major cities, and companies should carefully consider geographic location and infrastructure availability when planning production. (Vietnam Briefing, 2022a).

In addition, Vietnam also has other advantages for international companies such as a friendly business environment, low tax rates and accommodating government policies. The government also actively encourages foreign investment and seeks to improve trade relations with foreign partners. These factors, together with the above-mentioned advantages, make Vietnam an attractive and suitable location for manufacturing (Vietnam Briefing, 2022b).

6.2.6 Alternative transport route

An alternative option to sea transport is same as for India, by rail or air. In terms of rail transport for FBU cars, the Trans-Siberian and Trans-Mongolian Railroad, which runs from Moscow to Beijing, could be used. The Railways is shown on Figure 29.



Figure 29 Trans-Siberian and Trans-Mongolian Railroad
Source: Britannica, 2023

The Figure 30 not only shows another look at Trans-Siberian Railway, but also provides an insight into the railway connection between China and Vietnam.

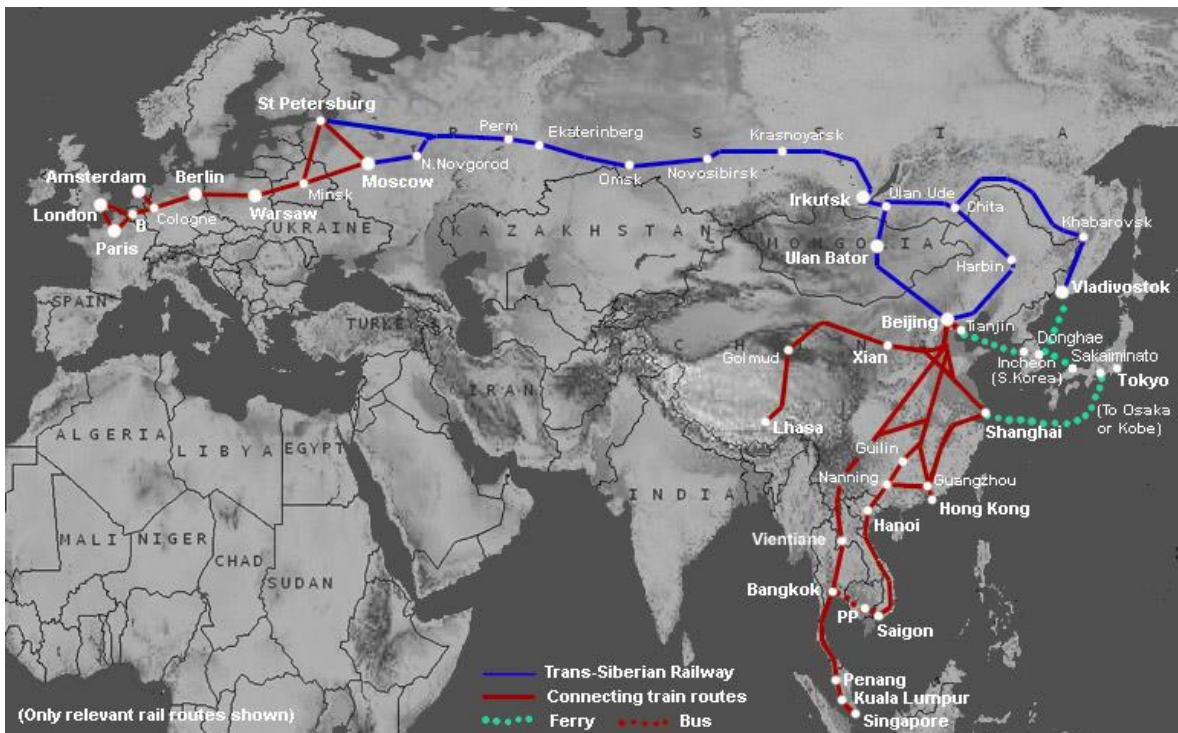


Figure 30 Railroad connections through Europe and Asia
Source: Seat61, 2023

After the consideration based on railway routes in the Figure 29 and 30, new possible railways route is designed and can be seen on Figure 31.

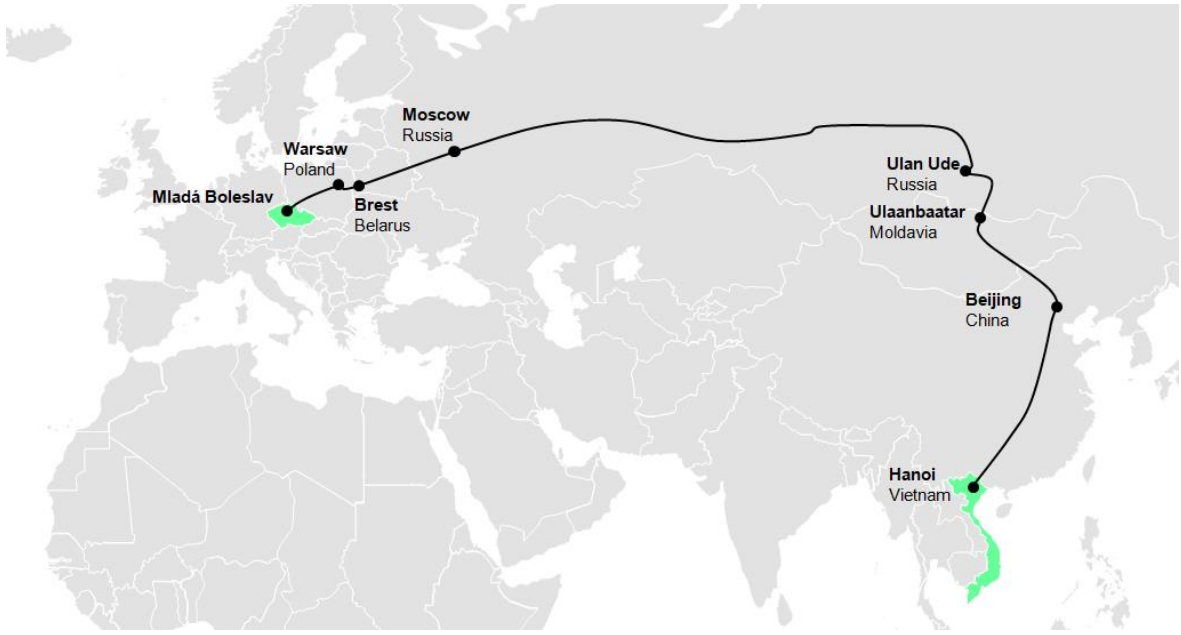


Figure 31 Alternative route from Mladá Boleslav to Vietnam
Source: Own processing

The containers would start their journey in Mladá Boleslav, go through Poland to Brest. where would be a first transfer to the broad-gauge track at the Belarus border, than through Moldavia to China board, where the wagons would be transferred a second time, to Nanning in China, which has a construction railway to Hanoi, from where they would continue by road to the Thanh Cong production plant.

As far as the rail transport for CKD wagons from India is concerned, here the proposed route is more complicated, as the railways from India to Vietnam are not complete and also the gauges are different in width. Figure 32 shows the Trans-Asian Railway Network.



Figure 32 Trans-Asian Railway Network

Source: Bangkok Post, 2014

The sets would be delivered from Pune to Mumbai from where they would head via Bangladesh, where the switch to narrower gauges must be made, Myanmar, and China to Vietnam to Hanoi from where the sets would then be delivered by rail to Hanoi and then by road to the manufacturing plant. However, as mentioned the railroad between these countries is not complete and is discontinuous, thus the containers would have to be transloaded onto trucks and would have to be transported to another part of the railroad.

Air transport, even though it is very expensive and not applicable for a large number of trucks in the execution of a single delivery, could be possible for both concept FBU and also CKD. The flight route, which could have a stopover at other major international airports, transport time and the final price depend on the services provided by the individual airlines. For FBU, the flight begins in Prague. Goods are usually transported by plane to one of the major European airports and then to the airport in Hanoi or Hai Phong. The air distance is around 8,400 km, depending on each route. For CKD, the flight would be from Mumbai airport, from which the air distance is around 3,500 km, depending on each route (SeaRates, 2023) .

As was stated in chapter 6.1.6, these roads are only possible for implementation if international relations between the countries through which the potential routes pass are established and the routes are safe.

Table 18 below compares the different modes of transport in terms of average time in days, approximate distance in km, average costs of only transportation per container or per 1 tonne for air transport. The data are collected from the website Searates (2023), ShipHub (2023) and Quartz (2021).

Table 18 Transportation types comparison for Vietnam

TYPE OF TRANSPORTATION		TIME	DISTANCE	COSTS per CNT/ per 1 tonne
SEA	CZ	42 days	20 715km	\$1,500
	IN	25 days	7 845km	\$1,800
RAIL	CZ	20 days	12 300km	\$4,900 to 10,000
	IN	7 days	6 000km	
AIR	CZ	<1 day	8 400km	\$18,150
	IN		3 500km	

Source: Own processing

As is shown in table 18 above air transport is the best in terms of transport time and distance. However, since vehicles in the hundreds will be regularly dispatched to Vietnam and airplanes are limited with its space, it cannot be taken into account for this reason. The costs for air transportation are also extremely high. For the delivery of FBU wagons from Czech Republic, rail transport could be considered, but there would be many transshipments on the way of the containers, increasing the risk of damage to the cargo and the need for a larger rail yard where the containers could be stored for later removal. Compared to sea transport, rail transport takes half the time, and the distance is also much shorter. For CKD sets shipped from India there could be also time savings, but there is no such significant difference in distances as with FBU deliveries from Europe. However, as can be seen from the average costs, price for one container in rail transport is much higher than in sea transport.

As was found from the analysis of both transport concepts, Škoda Auto uses one-way wooden pallets for transporting parts. This chosen method of transporting parts is not so suitable from an ecological point of view. The production of wooden pallets leads to deforestation and thus to a gradual depletion of natural resources.

In addition, wooden pallets can be susceptible to moisture, dust and dirt accumulation or damage during transport, which can lead to cargo endangerment.

One way to avoid using one-way wooden pallets and make shipping parts abroad more sustainable is to invest in metal pallets. These have several advantages, among them being the high strength and stability that metal pallets provide. They are thus able to bear high loads and there is less risk of damage than there is with wooden pallets. Due to their resistance to damage, metal pallets have a long-life span, and using them saves the resources needed to produce wooden pallets while reducing the costs needed to dispose of the pallets after each journey. Another advantage of metal pallets is that they can be made from recyclable materials or from surplus material from mouldings. The pallets themselves can then be reused to produce new metal pallets or other items. Their recyclability thus represents a significant step towards sustainability and a lessening of the impact on our environment.

Company that has a wide range of several types of iron pallets is Trans-Rak International. Trans-Rak International, a company founded in 2000, has transformed the transportation in automotive sector with its innovative vehicle containerization tools. Through its innovative equipment, Trans-Rak simplifies the loading of automobiles into containers and offers secure and dependable solutions. Products offered by Trans Rak are all tested and certified (Trans-Rak International, 2023a).

Iron pallets are available for both car transport and for the transport of cars in a certain degree of staggering. For the transport of finished cars, the company offers so-called R-RAKs and EL-RAKs (Trans-Rak International, 2023a).

The R-RAK is a removable racking system that is guided into each container, is very lightweight and easy and quick to load (Trans-Rak International, 2023d). Figure 33 shows the inside of a container using an R-RAK and the R-RAK pallet that allows the car to be lifted to the ceiling of the container.



Figure 33 R-RAK system

Source: Trans-Rak International, 2023d

When using this type, the wagons must be loaded inside the container. However, the company wanted to simplify this process and make better use of the container space and so developed the EL-RAK system.

The pallets, called EL-RAK, stand for Exterior Loading Racking System and can be seen in Figure 34.

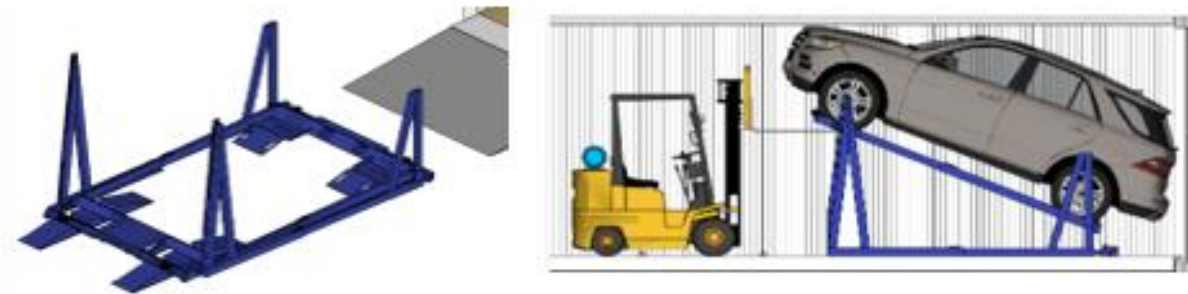


Figure 34 EL-RAK system

Source: Trans-Rak International, 2023b

This type is one of the company's newest products and allows the handling and loading of cars into the container from the wind, which is a great advantage over other types of commonly used pallets. Companies that use EL-RAKs can lift the car to the required height inside the container, thus optimizing the use of the upper part of the space and allowing more cars to fit in the lower part of the container. This increases the load factor of the container and thus saves costs (Trans-Rak International, 2023b). A fully occupied container using EL-RAKs can be seen in Figure 35.

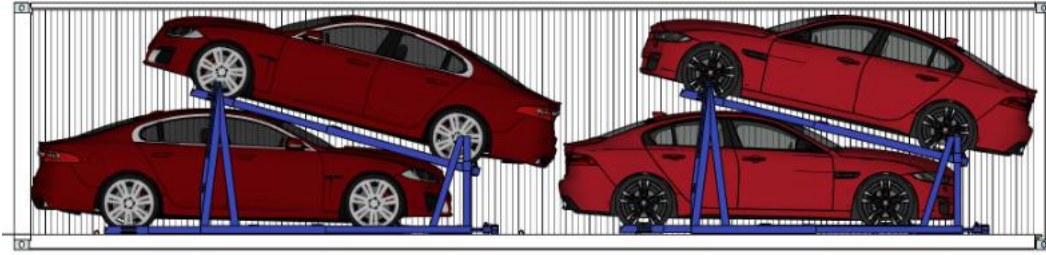


Figure 35 Fully occupied container using EL-RAK system
Source: Trans-Rak International, 2023b

The company also offers the so-called SKD-RAK, which is a system for staggered cars. The pallets are adapted to vehicles that are already without wheels or without the ability to be easily handled. The wagons are placed on the pallet before loading into the container, where they are then adapted to the internal arrangement (Trans-Rak International, 2023e). This view can be seen in figure 36.



Figure 36 SKD-RAK
Source: Trans-Rak International, 2023e

However, other necessary parts must be sent in a separate container. But the company has also devised an overflow concept where other goods can be loaded into the container.

The palletised cargo racking system, or P-RAK, allows for the addition of an extra deck and the possibility to not only transport finished cars or bodies, but to load also multiple pallets and boxes with other parts and components (Trans-Rak International, 2023c). The P-RAK cargo system can be seen in Figure 37.



Figure 37 P-RAK cargo system
Source: Trans-Rak International, 2023c

The wheels on the platform allow loading from the outside, so that the load can be lifted to the required height inside the container and the space is maximised, considering the safety of the load. Loading can be seen in Figure 38.



Figure 38 P-RAK loading
Source: Trans-Rak International, 2023c

By using iron pallets, the use of wood is eliminated and by making all pallets stackable (as shown in Figure 39), pallet returns are maximized. The company waits until the entire container is full and sends the pallets back to the parent plant.

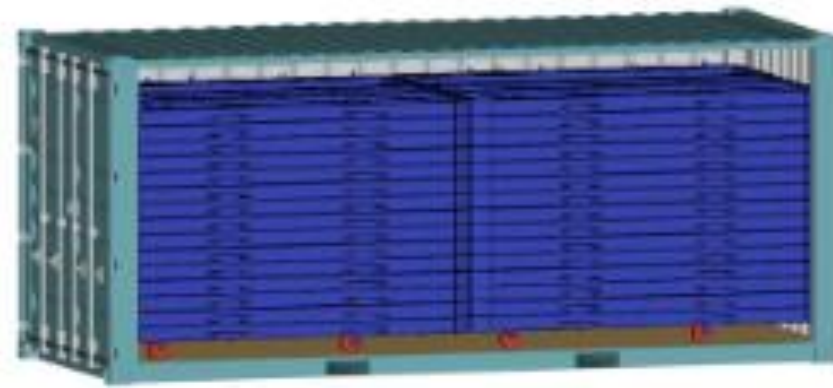


Figure 39 Stackable metal pallets

Source: Trans-Rak International, 2023c

Another company that offers the use of iron pallets for the transfer of finished or folded cars is Kar-Tainer. Kar-Tainer is a world leader in container vehicle solutions and provides specialized transportation systems for its partners in the automotive, transportation and logistics industries. It offers solutions offers cassette systems for loading of 2,3 or 4 FBU cars or and SKD cassette system for knocked down vehicles as well as motorcycles into containers. The externally loaded cassette system provides huge operational and safety benefits. The company also provides pallets on a leasing basis, which makes it possible to use their services without a high initial investment. According to company, 3, 4, or even 5 vehicles can be safely packed into a 40-foot container - but most importantly, vehicles do not drive into the container, the container can be loaded in 5 minutes without anything attached to it, no chains to tie down vehicles, and no personnel inside the container during the loading process. As for the return of empty pallets, they are stackable, so the company can wait until it has a fully filled container before sending them back (Kar-Tainer, 2023).

The use of iron pallets brings with it many advantages, from reducing the environmental burden and avoiding the felling of trees needed for the production of wooden pallets, reducing costs by using reusable pallets, eliminating the costs of disposing of one-way pallets or allowing maximum use of container space when loading cars inside. The returnable cassette systems also enable to reduce the amount of shipped containers with maximizing the load capacity and reducing costs and CO2 emissions. Additionally, it increases operational effectiveness at the

receiving assembly factory as well as at the warehouse or packaging facility. Thus, it would certainly be worthwhile for Škoda Auto to investigate the use of iron pallets for transporting vehicles, parts and components abroad.

Conclusion

Logistics is one of the most important activities of a company. Its proper coordination is needed to ensure production and supply of individual plants as well as the smooth delivery of goods to the final customer. It accounts for a large proportion of the company's costs and directly contributes to the final price of the goods. Larger companies building a Corporate Social Responsibility concept and taking pride in an environmentally friendly approach, seek to increase the share of rail transport in their total transport in the framework of so-called green logistics. New modern trends and technologies in logistics make it possible to realise savings and simplify the overall transport process. In the international environment, the need for unification has led to the adjustment of the different modes of transport international conventions, which also lay down the requirements of the necessary transport documents. The actual implementation of the transport, costs and risks involved are closely related with the delivery condition. The main role of the delivery condition is to determine the transfer of risks and costs from the seller to the buyer and determines the obligations of both parties. The transport of fully built cars is very specific, demanding on space, storage, coordination and requires large transport capacities.

The main objective of this thesis was to analyse the logistic concept of car production in a foreign plant. The selected company was Škoda Auto, which has manufacturing operations in many foreign countries. The foreign countries that were selected for the analysis were India, which is one of the biggest markets for the company, and Vietnam, where Škoda Auto has decided to newly enter.

Škoda Auto has set up a particularly good production and logistics concept in India. This is evidenced by the near-maximum localisation of materials and parts required for car production, its two fully equipped manufacturing plants, and the fact that the Indian plant will be used for the preparation of CKD car kits that will head to Vietnam. With the installed production capacity, the company should focus primarily on increasing local production of cars and in the future try to localize all the necessary parts to eliminate the cost of sourcing these components from Europe, thereby reducing the risk of delivery delays and downtime on production lines. The company has also taken an important step towards expansion into another Asian

country. Vietnam provides many opportunities to expand the company's operations to other Asian countries. Vietnam itself provides the company with a large buying power of customers, but its membership of ASEAN also provides Skoda Auto with many benefits in the form of duty-free export of FBU cars to other member states and by expanding the number of potential customers.

In terms of the transport concepts, the company uses combined transport for both countries, which relies, same as transport to India, on sea transport. As part of the analysis of the of logistics concept for car production, two alternative options were proposed for each of these concepts and were compared with the current planned routes. In order to continue to maintain successful business, the company should continue to use a sea transport, as it was the most suitable option in terms of costs. However, there is still the possibility of using rail transport in the future, once a rail links are built and the worldwide situation is better. By using rail shipping, the time required to deliver the containers would be saved and this could change the packaging concept of the uniform parts, which are wrapped in special films to protect them from corrosion during sea transport. This could result in cost savings. In the future, rail transport could become cheaper, as this method is more ecological and more environmentally friendly.

A recommendation for the company is also to evaluate the usage of metal pallets for transportation to other countries and to monitor trends in the use individual types of transportation as these could change in the near future as many countries have begun to take measures towards a more sustainable and green future.

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