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Sources of Competitiveness in the Automotive Industry of the Republic of Belarus

UNITED NATIONS
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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
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Comments

This project report presents the findings of the preparatory assistance phase of the UNIDO project "International Strengthening and Policy Support to Upgrade Component Manufacturers in the Automotive Industry of the Republic of Belarus" based on the work of the Clusters and Business Linkages Unit of the Business, Investment and Technology Branch of UNIDO. Comments and suggestions on issues raised in this report are welcome and may be addressed to Adnan Seric at a.seric@unido.org.

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Mr. Adnan Seric, UNIDO Project Manager, developed the research concept and had overall management responsibility for the project. The project report was written by Ms. Bertha Vallejo, UNIDO consultant, with research assistance from Mr. Viacheslav Bakhanovich, UNIDO national expert.

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LIST OF ABBREVIATIONS

BELAZ – Belarusian Automobile Plant (Zhodino)

BNTU – Belarusian National Technical University

BoP – Balance of Payments

BSSR – Byelorussian Soviet Socialist Republic

BYR – Belarusian Rubbles (currency)

CBI – Centre for the Promotion of Imports from Developing Countries of the European Union

CIS – Commonwealth of Independent States

CKD – Complete Knock-Down

CVCC – Compound Vortex Controlled Combustion

EPS – Electronic Stability Programs

EU – European Union

EU-15 – EU prior to the first round of enlargement in 2004

EU-27 – EU including the New Member States

EUR – Euro (currency)

FDI – Foreign Direct Investment

FTA – Free Trade Agreements

GAZ – Gorky Automobile Plant

GDP – Gross Domestic Product

GPS – Global Positioning System

HS – Harmonized System

IPM – Institute of Privatization and Management

ISO – International Organization for Standardization

JIT – Just-in-Time

JSC – Joint Stock Company

LPG – Liquefied Petroleum Gas

MAZ – Minsk Automobile Plant

MMZ – Minsk Motor Plant

MOI – Ministry of Industry

MOAZ – Mogilev Automobile Plant named after S.M. Kirov

MPS – Modular Production Systems

MPZ – Minsk Gear Plant

MTZ – Minsk Tractor Works, sometimes it is also referred as Minsk Tractor Plant

NG – Natural Gas

OEM – Original Equipment Manufacturer

OICA – International Organization of Motor Vehicle Manufacturers

PAZ – Pavlovo Bus Factory

QC – Quality Control

RUE – Republican Unitary Enterprise

R&D – Research and Development

SUVs – Sport Utility Vehicle

TvEx – Tver Excavator Plant

UNDP – United Nations Development Programme

UNIDO – United Nations Industrial Development Organization

URAL – Ural Automobile Plant

USSR – Union of Soviet Socialist Republics

VAT – Value Added Tax

YaMZ – Avtodizel Yaroslavl Motor Works

EXECUTIVE SUMMARY

The Republic of Belarus has a long standing tradition in machine tools, casting and manufacturing with its automotive sector divided into three main segments: heavy duty vehicles, buses and coaches and agricultural vehicles. The present report describes the existing production structures in these segments and approximates the extent of their value chain integration, domestically as well as internationally, against the background of changes in sector-specific supply and demand factors that are having a significant impact on the development of the automotive industry at large.

The report findings indicate that, although there have been efforts to technologically upgrade firms in the sector, the Belarusian automotive industry continues lagging behind globally accepted requirements and standards by a significant number of years. This fact is particularly evident in the areas of production and innovation processes as well as emission standards – preventing the industry from expanding and penetrating lucrative neighbouring markets, such as the European Union. The sector competiveness is further inhibited by the absence of market-driven linkages among the value chain actors, and in particular between firms, knowledge centres and relevant support institutions.

The report identifies areas of possible policy interventions that are considered to be critical for future success of the automotive industry in the Republic of Belarus. More specifically, it suggests that the basic elements of lean production, quality control and certification and standardization should be adapted to the national context and applied across the sector in order to align it with globally observed organizational and production trends. Moreover, particular attention should be paid to creation of market-driven linkages among sector-relevant stakeholders as a means to stimulate investment and innovation in organizational and production processes. In this respect, the policy makers are advised to actively support efforts to: *i)* create a favorable framework for promoting (technological) collaboration between firms and research and educational centres in particular, *ii)* encourage formation of partnerships between domestic firms and foreign OEMs and component manufacturers and *iii)* stimulate uptake of cleaner production technologies and standards along with provision of active support in development and adaptation of new technologies (e.g. hybrid engines and vehicles).

1 INTRODUCTION

The automotive industry has been present in the Republic of Belarus since the early 1940s, when it came under the former Byelorussian Soviet Socialist Republic (BSSR)[1]. With a long tradition in the machine tools industry, most companies in the sector originated as factories manufacturing equipment for the transportation of minerals, as manufacturers of tractors or as parts and components suppliers. Important lessons can be found in the industry's evolution through different phases of the Belarusian industrialization process, as it moved from a highly protected environment to a gradually more liberalized economy. The automotive industry (including the production of agricultural machinery) accounted in 2008 for about 20% of Belarusian industrial output.[2] After the Russian Federation, the Republic of Belarus is the second largest producer of heavy commercial vehicles within the CIS region (see **Table 1**).

The industry has consistently been a central aspect in legislation and in innovative policies, such as the 5-year Social Economic Development Plan of the Republic of Belarus, which proposes restructuring and creation of an integrated industry (considering national and foreign investment).

1 Automobile industry refers to passenger cars (including SUVs) production and it is not considered part of the present study since the automobile production in the Republic of Belarus is concentrated on heavy commercial vehicles manufacturing. Automotive industry in the context of the Republic of Belarus and for the purpose of this report refers to the production of heavy vehicles, buses and coaches and agricultural vehicles, as well as their parts and components suppliers.

2 Central Intelligence Agency (2011, p. 34).

3 EU is used as abbreviation for the European Union; EU-15 is used for the 15 nations which made up the EU until 2004.

TABLE 1.
GLOBAL PRODUCTION OF HEAVY COMMERCIAL VEHICLES (IN UNITS)

	1999	2001	2003	2005	2007	2008
Global Production	**1,928,840**	**2,216,614**	**2,523,632**	**2,980,619**	**3,262,784**	**3,785,534**
Japan	626,023	595,403	772,927	723,663	718,901	734,923
EU-15[3]	418, 719	480,085	457,344	549,502	660,387	662,039
CIS	49,937	57,620	54,387	92,129	134,579	138,471
Russia	36,275	39,612	50,019	65,965	103,932	102,393
Belarus	**12,846**	**15,996**	**16,856**	**22,500**	**25,548**	**26,291**
Turkey	23,049	9,683	19,041	37,227	34,544	36,800
NAFTA	558,218	331,150	341,037	548,974	405,301	342,873
South America	67,632	85,480	87,870	137,831	186,603	208,368

Source: International Organization of Motor Vehicle Manufacturers (2007, 2008, 2009).

The report is divided into five parts. The first part presents a comprehensive description of the current situation of the Republic of Belarus, particularly its machinery and metal-working industry part of which is the automotive industry. Following, the second part presents an overview of the automotive industry worldwide, particularly its main supply and demand factors that are shaping the industry development. The third part identifies the existing national OEMs (or assemblers), their products and supply chain as well as the main organizational characteristics. In the forth part, a through analysis of the current state of the national industry is provided based on the analysis of survey questionnaires administered to large number of domestic OEMs and component suppliers and in-depth interviews conducted with sector support institutions. The report concludes with a set of recommendations on how to potentially raise industry's level of competitiveness given currently observed situation.

2 METHODOLOGY

2.1 Rationale of the Study

The automotive industry worldwide is constantly in a state of technological and organizational change, and this has an impact on the manufacturing activities located in transition and developing economies. The heavy commercial vehicle industry worldwide has been subject to increasingly stringent production, quality, organizational and environmental standards.

In the case of the Republic of Belarus, its automotive production is lagging behind commonly accepted international standards. This has important economic and social implications for the economy that for two main reasons should not be ignored. First, the automotive industry along with its supporting industries is the main sector of the country's industrial activity, constituting about 43% of industrial output and providing about 35% of industrial employment. Second, its main commercial partner is the Russian Federation with circa 30% of total Belarusian exports to Russia being related to the automotive industry.[4]

Regulatory standards in neighbouring EU members (Poland, Lithuania and Latvia) and their adoption in important trade partners, such as the adoption in 2010 of the Euro IV standards by the Russian Federation, could have important commercial implications for Belarus if its automotive production is not upgraded accordingly.

The present project constitutes an important effort towards the strengthening and upgrading of the Belarusian automotive industry. It presents a view of the industry as a whole within the framework of the global industry and identifies the key areas in which efforts should be made according to possible technological trajectories or scenarios.

2.2 Data Collection and Quantitative Analysis

The global perspective of the industry presented here is based on information available from the assemblers of heavy vehicles, buses and coaches and agricultural machinery. News on strategic alliances and collaboration projects between companies has been supported by a deep search of automotive news in various newspapers, magazines and electronic media.

The data on global automotive production comes from the International Organization of Motor Vehicle Manufacturers (OICA). Data on the participation of the automotive industry in the economy of Republic of Belarus was provided by the Belarus Ministry of Statistics, the World Bank and the US Central Intelligence Agency. The Centre for the Promotion of Imports from Developing Countries (CBI) of the European Union served as a major source of information regarding market, environmental, production, and quality requirements for imports of heavy vehicles and automotive parts and components to the European Union.

The UNDP Office in the Republic of Belarus provided useful material on the development frameworks for the country, the social implications of trade policy and various aspects of business models followed in the CIS region. The Ministry of Education of the Republic of Belarus provided documentation on technological efforts made at the Belarus National Technical University (BNTU). This was complemented by public access to regulations and policies and very useful talks with the Ministry of Industry (MOI).

The analytical part of the report is based on company-level questionnaires administered to automotive companies in the country. The research team registered 61 companies dealing with automotive parts and components.[5] With the support of the BNTU and a private training company (Steps-for-Success), a group of BNTU researchers and enumerators administered the surveys in the companies. The companies were visited during the period June 20-27, 2011, and each interview took about three hours. Of the 61 companies, 32 participated in our survey resulting in a response rate of 52.4 percent.[6]

The information provided in the questionnaires was analysed using statistical methods for comparison among

4 http://forum.soyuz.by/main-news

5 This compilation was based on lists of companies provided by the MOI, the Chamber of Commerce and internet search.

6 10 of these companies are under the Ministry of Defense and we were not granted permission to interview them.

different groups (i.e. types of companies). To complement the analysis, between August 1st and 4th, the international and national experts conducted personal interviews with two main national OEMs: MAZ (heavy commercial vehicles, buses and coaches) and BELAZ (heavy commercial vehicles); and with a first-tier supplier: MMZ (diesel engines). These interviews provided a view of the environment in which the industry is operating and of the companies' relationship with the public and private sector. Furthermore, two meetings were organized with the Chamber of Commerce – one with its Foreign Economic Cooperation Department and one with its Business and Training Centre. This provided a snapshot of public sector's efforts to promote the industry. Further meetings were held with automotive industry officials at the Ministry of Industry's Automotive Department and the Ministry of Economy's Department of Industry, Transport and Communications, as a means to obtain further insights into the legal framework in which the industry operates.

2.3 Limitations of the Study

Only MAZ, BELAZ and MMZ agreed to personal interviews. Manufacturers of agricultural vehicles and construction machinery, as well as other domestic assemblers, participated neither in the questionnaire nor in the interviews. Detailed statistical information on the operations of the industry is not publicly available and the research team did not have access to it.

3 BACKGROUND OF THE STUDY: THE REPUBLIC OF BELARUS

The Republic of Belarus is strategically located between the Russian Federation to the east and the European Union to the west. Within the former Soviet states, in 2008 Belarus had the lowest inequality level with a Gini coefficient of 27.9 during the period 1992-2007, closely followed by Ukraine (28.2) and the Russian Federation (42.3).[7]

After the collapse of the USSR in 1991, all the former Soviet republics experienced major macroeconomic instability and marked declines in output. The deepest drop in Belarusian output (about 40% decline in its GDP) was felt during the period 1992-1994, when the country started to undertake initial market reforms.[8] In the mid-1990s, the country started to implement a strategy based on re-stabilizing centralized state control over the economy, along with several reform measures, such as the lifting of price controls and the elimination of most energy cross-subsidization.[9]

Unlike other transition economies, Belarus overcame the initial GDP decline very quickly. Beginning in 1996 the country started recovering, with a positive trend of GDP growth as well as a significant decline in poverty and unemployment rates. One of the explanations for Belarus growth is that it had been achieved largely due to the trade and para-fiscal transfers from Russia.[10]

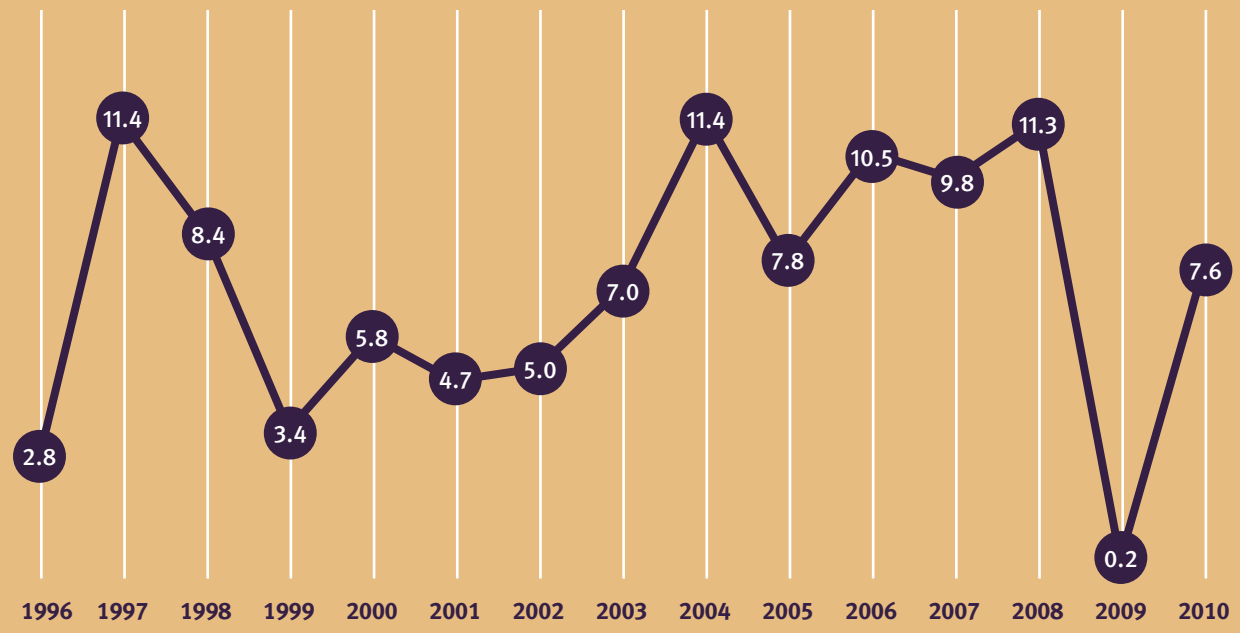
7 The Gini index lies between 0 and 100. A value of 0 represents absolute equality and 100 absolute inequality (World Bank, 2011).

8 International Monetary Fund (2005).

9 Yemelyanau (2008).

10 According to Bakanova and de Souza (2002, p. 2), Belarus's growth rate was based on the combination of an expansionary policy stimulating demand and production in state-owned companies (regardless of cost), and the tightening of administrative control over all economic activities.

FIGURE 1.
GDP GROWTH (ANNUAL %)



Source: The World Bank (2011).

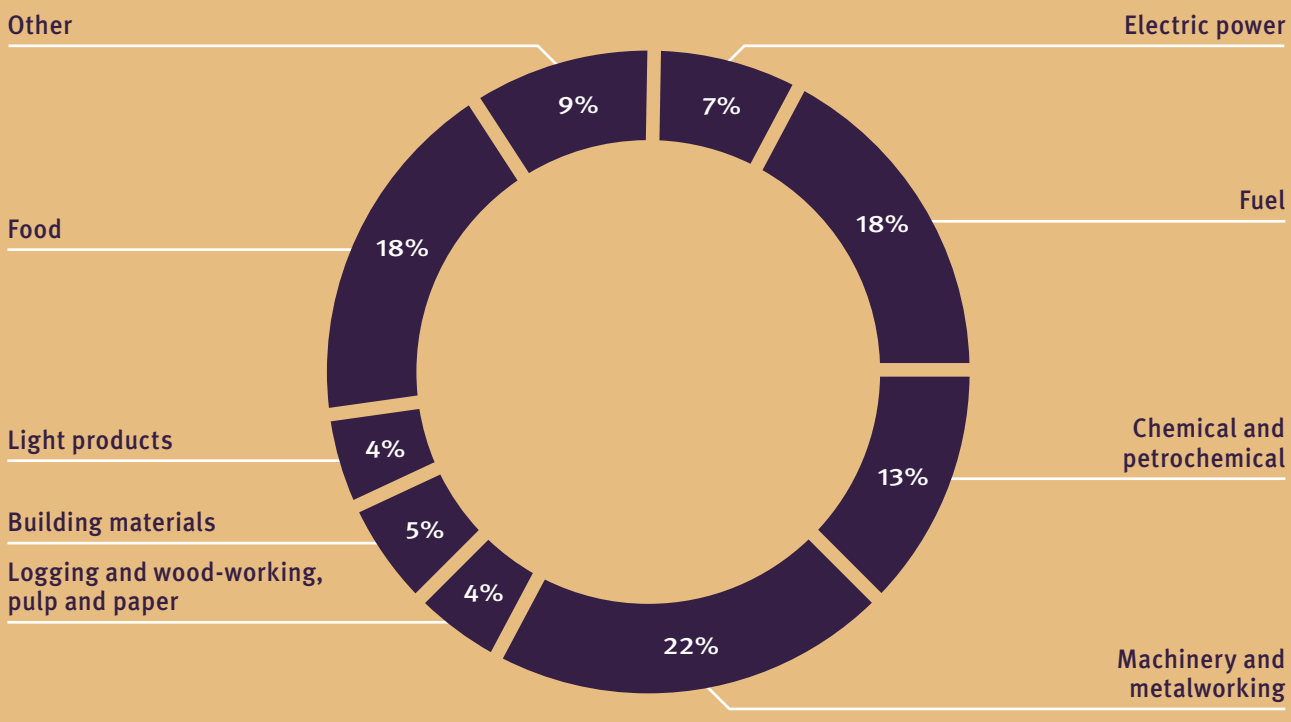
Although some movements towards privatization have taken place and may have a positive impact on the industrial sector's restructuring, the actual business environment for private companies remains difficult.[11] The private sector share in GDP is about 30% (the lowest among transition economies), and FDI inflows are much lower than expected, given the country's geographical location.[12]

Belarus developed a diversified and extensive industrial base (with many assembly operations) under the central planning system of the former Soviet republics.[13] The four main industrial sectors of Belarus are machinery and metalworking, fuel, food and chemical and petrochemical industries. Together, these four sectors account for around 70% of the country's industrial production (see **Figure 2**).

The automotive and tractor industry in Belarus is one of the industries inherited from the USSR and one of the most important industrial activities in the country now. Its output is statistically registered together with the metalworking industry, but official estimates indicate that it constitutes about 22% of the output of this industrial activity.[14] The state recognizes that the automotive industry overall is an important industrial sector, and it continues to play a dominant role. In the last 5 years, the state has started a campaign to upgrade and strengthen the industry, including several presidential decrees and development programmes which will continue for at least the next 5 years (i.e. The Programme of Social and Economic Development 2011-2015).

11 World Bank (2005).
12 International Monetary Fund (2011)
13 Bakanova & Souza (2002)
14 National Statistical Committee of the Republic of Belarus (2011b)

FIGURE 2.
STRUCTURE OF BELARUS INDUSTRIAL OUTPUT 2010 (IN % OF TOTAL OUTPUT)



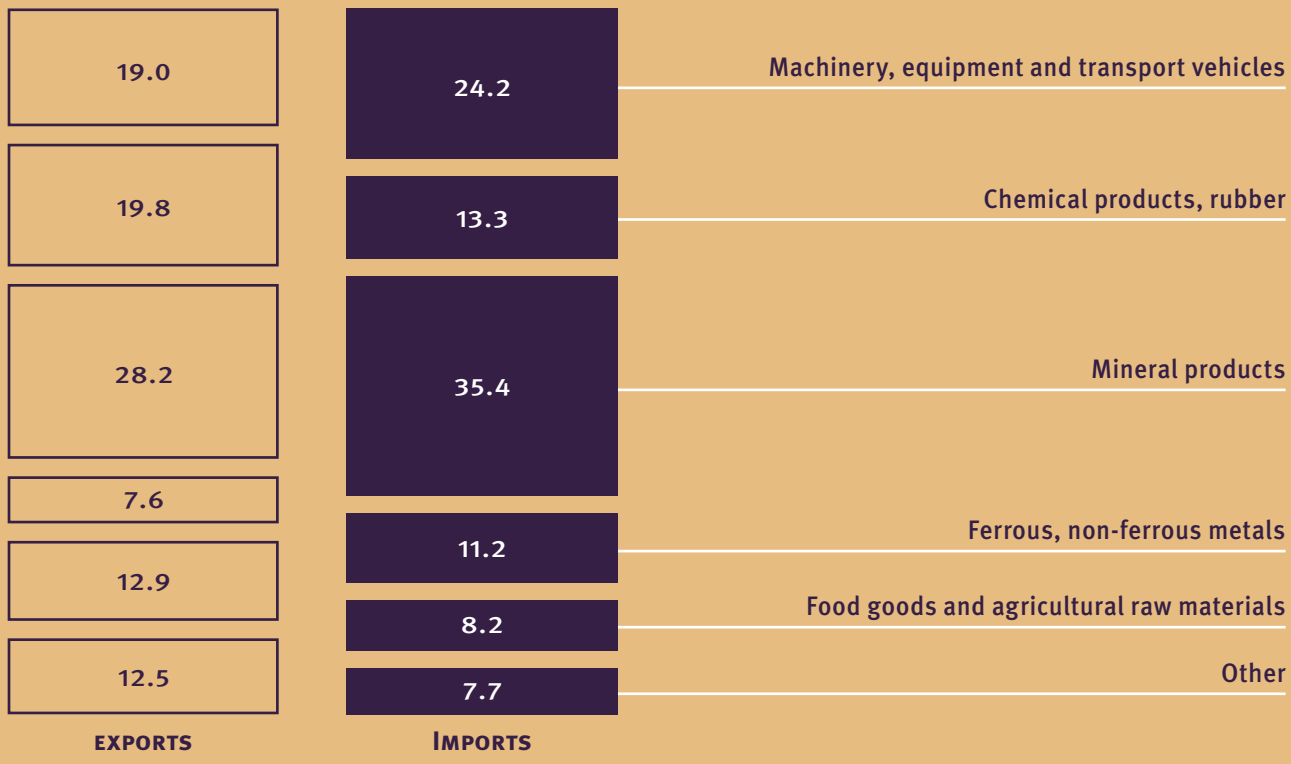
Source: National Statistical Committee of the Republic of Belarus (2011b).

Regarding trade, Russia is the most important trade partner of Belarus, followed by the CIS countries.[15] Trade to other non-CIS regions is slowly increasing but remains low. The commodity structure of trade is relatively stable, with a slight decrease in the share of vehicles, textiles and apparel on the exports side, and an increased share of oil and oil products, machinery and equipment on the imports side.[16] **Figure 3** presents the commodity structure of exports and imports for 2010.

The leading exporters of these commodities are traditional Belarusian state-owned companies still benefiting from soft budget constraints.[17] The fuel and chemical industries are the main industrial producers and exporters, followed by machinery and metalworking, which includes automotive companies such as Belshina (tires), MAZ (heavy vehicles, buses and trailers) and Amkodor (loaders and carriers). These companies not only export, mostly to CIS countries, but also have strong domestic positions.[18]

15 World Bank (2011)
16 World Bank (2005).
17 Bakanova, Estrin, Pelipas & Pukovich (2006).
18 World Bank (2010).

FIGURE 3.
COMMODITY STRUCTURE OF EXPORTS AND IMPORTS IN 2010 (%)



Source: National Statistical Committee of the Republic of Belarus (2011a).

3 BACKGROUND OF THE STUDY: THE REPUBLIC OF BELARUS

Belarus has relatively good infrastructure and an educated and skilled labor force.[19] Important characteristics that differentiate the Republic of Belarus from other CIS countries are:

I. A dominance of traditional state-owned companies in production and exports.

II. High degree of government intervention in companies' management (including intervention in companies' planning of output, wages and employment). The abolishment of the golden share rule (e.g. the right of the state to take over management of privatized companies) in 2008 represented important progress in structural reforms.

III. High levels of tax and budget redistribution in support of traditional companies and employment. Taxation is heavy and complex, with simultaneous application of turnover tax, value added tax (VAT) and equity increases subject to a 24% corporate income tax.[20] This robust fiscal revenue supports socially oriented expenditures and maintains declining sectors.[21] This ability of the government to collect taxes makes it possible to accelerate economic reforms.[22]

IV. High trade dependence on the Russian Federation along with poor geographic diversification of exports.[23] While other CIS countries saw their exports to the Russian Federation decrease while their energy imports increased, Belarus continued to maintain close economic ties with Russia, preventing the country from experiencing the rapid decline observed in other CIS countries.[24]

19 EBRD (2009).
20 EBRD (2009).
21 World Bank (2002).
22 World Bank (2005).
23 UNECE (2005).
24 Special political relations between Belarus and the Russian Federation, as well as the geostrategic importance of Belarus, were options not necessarily available to other CIS countries (World Bank, 2002, 2005).

4 THE AUTOMOTIVE INDUSTRY

As illustrated in **Figure 4**, automotive industry production is divided into two broad categories: passenger cars (including SUVs) and heavy vehicles (including heavy duty vehicles and buses and coaches).

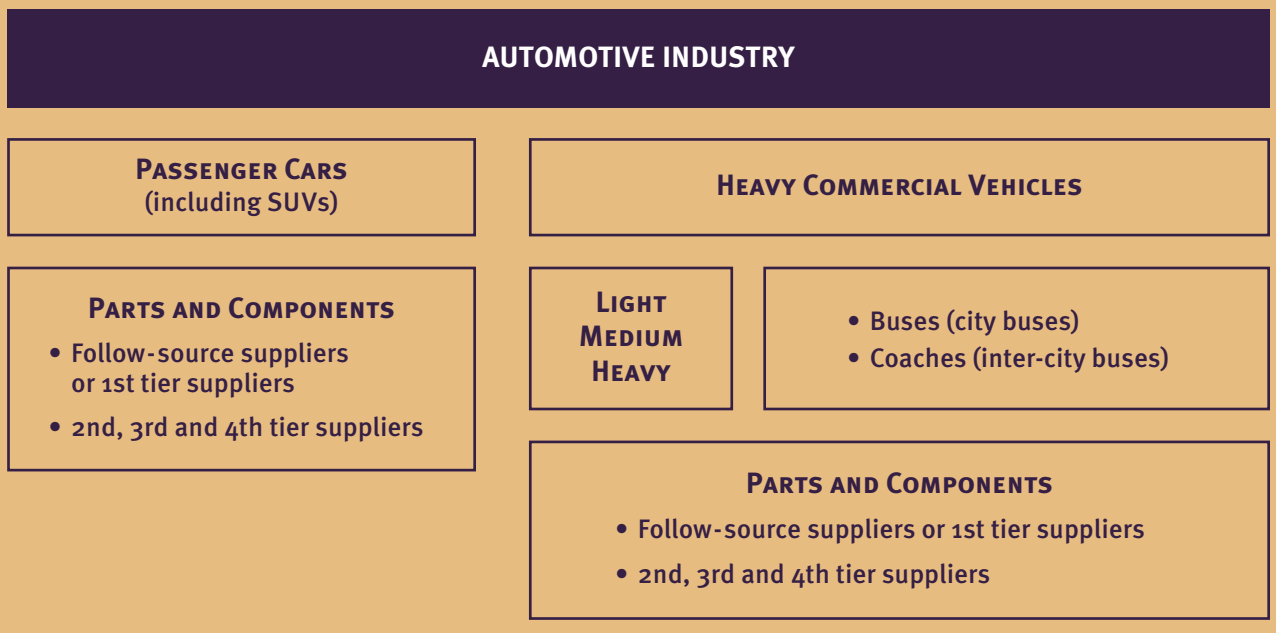
Besides size, structure and mass, a major difference between passenger vehicle and heavy commercial vehicle manufacturing is the level of production required. While the first segment requires high volumes of production, reaching a minimum of 250,000 units, the second requires much lower production volumes.[25] A second difference is the level of automatization in the production process. While the production of passenger vehicles is highly automatized (about 12-100 labor hours per vehicle), the production of commercial vehicles requires more labor hours (i.e. 1,500-3,000 hours per vehicle), which increases labor costs considerably.[26] The level of market fragmentation is also an important difference between the segments. Heavy commercial vehicles are directed towards much more fragmented markets.[27]

The automotive industry is mostly seen as a producer-driven value chain where the terminal industry plays a central role in coordinating the production network.[28] The key role is performed by the assemblers, manufacturers or OEMs, which are mostly multinationals that assemble or manufacture vehicles and sell them to both domestic and foreign markets.

25 Gwosdz, Guzik & Domanski (2011); Stanford (2010).

26 Gwosdz et al. (2011).
27 Gwosdz et al. (2011).
28 Dicken (2003).

FIGURE 4.
ILLUSTRATION OF AUTOMOTIVE INDUSTRY SEGMENTS



Source: Elaborated by the author.

TABLE 2.
MAIN HEAVY COMMERCIAL VEHICLE MANUFACTURES IN THE REPUBLIC OF BELARUS

Firm	Main Products	Year Started Operations
Minsk Automobile Plant (MAZ)	Vehicles and line-haul trains, truck tractors for inter-city and international transportation, tipper trucks, logging trucks, trailers and semi-trailers, buses and coaches	1944
MAZ-MAN	Heavy vehicles, truck tractors (with wheel arrangements of 4x2, 6x2 and 6x4), dump trucks (with wheel arrangements of 6x4 and 8x4) and chassis for equipments with wheel arrangements of 6x4, 6x2 and 8x4. Truck tractors and dump trucks are equipped with engines from MAN built to Euro III (Euro II) standards.	1998
Belarusian Automobile Plant (Zhodino) - BELAZ	Heavy and heavy-duty dump trucks, front loaders, bulldozers, air-tows	1948
Minsk Tractor Plant (MTZ)	Agricultural vehicles, universal tractors ranging from 50 to 280 hp (23 models), small-sized tractors ranging from 20 to 35 hp (6 models), walk-behind tractors and mini-tractors ranging from 8 to 12 hp (8 models), utility, loading, mining, forest exploiting equipment	1946
BelAgroMash-Bobruiskagromash	Agricultural vehicles, machines for liquid and solid mineral and organic fertilizer application, hay-making machines, complexes for transporting and distribution of forage, mobile universal cattle-feeders, flax harvesters	1991
Amkodor	Construction vehicles, loaders, aerodrome cleaning machines, snow plugs, pavement cleaning machines, road-rollers, forest industry equipment	1927
Neman	Buses and coaches	1990

Source: Ministry of Industry of the Republic of Belarus (2010).

In Europe, heavy commercial vehicle manufacturing is led by five main commercial groups: Daimler AG (Germany), the Volvo Group (Sweden), the MAN Group (Germany), Scania (Sweden) and Paccar Incorporation (USA headquarters).

According to the Ministry of Industry, there are seven automotive assemblers (including agricultural machinery manufacturers) in the Republic of Belarus. Among the main products assembled by these companies are: trailers and semi-trailers, buses and coaches, tipper and logging trucks, four-wheel-drive off-road cars, super-heavy mine trucks and tipper truck trailers, auto-loaders and self-powered scrapers. **Table 2** presents the automotive assemblers (including agricultural machinery) in Belarus.

Automotive parts and components are classified into two main groups: i) Original Equipment Manufacturer (OEM) or genuine parts manufacturers; and ii) non-original parts manufacturers (i.e. spare parts or aftermarket parts). OEM parts are those that are marketed under the brand name of the assembler for whom the supplier operates and sold through its distribution channels. OEM parts and components symbolize the reliability of the assembler and are the parts or components employed when the manufacturer's guarantee is required or when a vehicle is repaired in a manufacturer-associated shop.[29]

Traditionally the automotive industry organizes its parts suppliers in tiers according to the level of complexity of the products they are producing. Three different tiers of automotive producers are found under the assemblers.

29 Genuine parts are only available for a maximum of 7 to 9 years. They are expensive, involve more sophisticated technology in their production and have high commercial margins (e.g., pistons, steering mechanisms).

The first-tier suppliers, also called mega-suppliers or follow-source suppliers, are the first type of suppliers following the terminal industry. These are mainly multinational subsidiaries using their own production technologies to manufacture complex sets of automotive systems and sub-systems. There is an increasing preference by the assemblers to use the same suppliers in different locations (i.e. follow sourcing), which reduces the participation of local suppliers at this level of the chain.[30] In the heavy commercial vehicle industry, the main first suppliers in Belarus are Cummins (USA) and Deutz (Germany), producing diesel engines for export production; for local and regional production, diesel engines manufactured by MMZ (Belarus) are used. Next in line in the structure are the so-called second- and third-tier suppliers. These segments of companies are formed basically by domestic small and medium companies. Imported parts and components serve as inputs to all the tiers in the value chain, including the assemblers.

Only *approved suppliers* are part of the OEM supply chain. These are suppliers that are approved by the automotive assemblers. In practice, the assembler approves its first-tier suppliers, and they select and approve suppliers from the second and third tier.

Figure 5 presents an illustration of the OEM supplying chain.

Complementing the chain we also find the fourth-tier suppliers, commonly known as supporting industry. Fourth-tier suppliers are those companies whose core production specialization is located outside the range of the automotive industry (i.e. companies that are classified within other manufacturing industries).

An important sector of the automotive value chain is the after-market, or the market for replacement parts. Aftermarket or non-original parts are generally those parts that require relatively frequent replacement (e.g. batteries, light bulbs, fuel filters, spark plugs, tires).

30 Humphrey & Memedovic (2003).

4.1 Automotive Distribution Channels

There are two types of channels for parts and components distribution. One is the captive channel, used by automotive manufacturers (mostly distributors). The other is the independent channel, formed by independent service centres (e.g. multi-brand full service chains and fast repair chains). In general, spare parts are cheaper and of lower quality than original parts and are distributed by different channels than those for OEM parts.

In the case of agricultural machinery, parts and components are distributed by specialized companies that supply several brands or after-market pieces and advice their clients on which products are appropriate for the local agricultural conditions.

A new distribution channel that is growing rapidly is online distribution. This consists of independent dealers from whom parts and components can be ordered online. Currently, this segment of the market is mostly used for OEM parts, with increasing participation by the after-market, particularly in the case of parts for older automotive models. In the case of Belarus, most companies have their own trade houses in the Russian Federation and/or the CIS region.

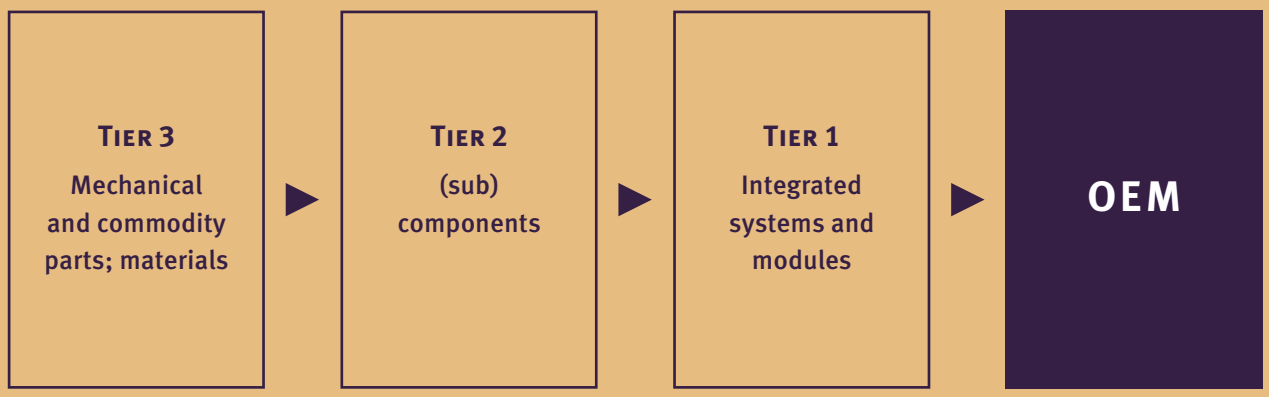
4.2 Main Sector Trends

There are several reasons why the automotive industry deserves attention, particularly in developing economies. First, it has a wide set of interrelations with other industrial activities in the economy. Its technological requirements and dependence on parts and components tend to foster technological development and the upgrading of its supporting industries.[31] Second, the sector is an important item in the Balance of Payments (BoP) due to its exports (but also its high levels of imports) and therefore a relevant element to consider for economic policy decisions. Third, the industry has undergone important export-production changes. Fourth, it is an important generator of employment that encourages the development of domestic automotive parts companies.[32] Fifth, it contributes significantly to the industrial output of host countries and has important impacts on their GDP.

31 Barnes & Kaplinsky (2000); Humphrey and Memedovic (2003) and Lorentzen (2005).

32 Humphrey & Memedovic (2003).

FIGURE 5.
OEM CHAIN STRUCTURE



Source: CBI (2010)

The automotive industry is a classic example of a supplier-driven chain, in which the whole range of activities involved in the design, production and marketing (i.e. its value chain) are influenced by the assemblers or OEMs.[33]

The industry has adopted a strategy of global perspective in its operations, and based on different production arrangements that allow it to use common platforms and interchange modules, the industry is present in almost in every country in the world. Although this strategy is more prevalent in the passenger vehicles segment, there is also an important level of consolidation and Internationalization in heavy vehicle manufacturing.

4.3 Supply-Driven Factors

Among the main supply-driven factors affecting the automotive industry are production schemes, organizational methods, suppliers' relationships (value chain integration) and Internationalization.

4.3.1 Production and Organizational Schemes and Methods

Over the last 20 years it has become increasingly rare to see a company that undertakes on its own the full range of activities required to bring a product from conception to the market. Therefore, increasingly we find various types of production systems that favor allocating different activities among different enterprises, often in separate locations but belonging to the same supplying chain.[34]

33 Gereffi (1999); Gereffi, Korzeniewicz & Korzeniewicz (1994).

34 Pietrobelli & Ravelloti (2009).

In the 1980s, Toyota Motor Corporation introduced the lean (Toyota) production methodology to automobile production.[35] Under this production scheme, the assemblers or OEMs prioritize three fundamental elements – namely cost, quality and delivery performance – and handle only a limited number of parts and components supplies (mostly first-tier supplies).

Lean production conjoins advanced manufacturing techniques with a set of organizational strategies that involve the development of an organizational culture with continuous learning and interaction as the pillars for success.[36] It is strongly supported by three fundamental elements, namely just-in-time inventories, quality control and standardization. [37] Gradually, with the introduction of lean production methods, the roles of the OEMs and their supply chain evolve. On the one hand, OEMs no longer own or produce all the parts necessary to assemble a vehicle while, on the other hand, the first-tier suppliers become system integrators and lead the wave of consolidation of output from the lower tiers of suppliers.[38]

The managerial and production tools promoted by the Toyota System are the basic elements behind the movement from mass production first to adjusted production and then to modular production systems (MPS). Under modularization, major parts suppliers set up shop close to the assembler's plants. A substantial number of parts and components imports characterize this production model.

4.3.2 Suppliers' Interaction and Value Chain Integration

Automotive production networks are coordinated by the assemblers, which are the key actors in terms of earnings as well as control over backward linkages with parts and raw materials suppliers and forward linkages for distribution and retailing.[39] During recent years the traditional structure of the automotive industry has changed greatly. The industry has engaged in constant restructuring, which since the onset of globalization has been particularly dynamic.[40] The whole industry has become less vertically integrated by outsourcing not only parts and components but also processes.[41] This process has increased competitive pressures and led to acceleration in the process of the consolidation of assemblers.

In recent years, important mergers among the main assemblers have taken place. Renault established an alliance with Nissan in 1999 and now owns Isuzu. It also engaged in a mutual exchange of capital stakes with Fiat.[42] In 2001 Neoplan (Germany) merged with MAN (Germany). In 2011, the Volkswagen Group acquired a major stake in MAN SE. This new arrangement will push for cooperation between VW, MAN and SCANIA AB (Sweden), which is also owned by the VW Group, and move the group towards surpassing Toyota Motor Corp., the world's biggest manufacturer, by 2018.[43] In 2011 Daimler AG and Robert Bosch GmbH signed a joint-venture agreement for the development, production and sale of traction motors for electric vehicles.

The effects of these changes have reached each supplying tier in the chain and consequently have had strong consequences in the organization of production processes, management and networks throughout the entire industry.

Regarding the relationship with suppliers, the industry is moving towards more dynamic arrangements. Assemblers are mostly focusing on design and assembly operations, and after-service providers tend to deal with fewer and fewer suppliers. First-tier suppliers are concentrating on system supply, module assembly and the management of other supplying tiers. Most cost pressure is pushed to tiers two and three, which concentrate mostly on the production of sub-components.[44] Design and innovation capabilities among first-tier suppliers are promoted under this production scheme.[45]

35 Chung (1995); Lara Rivero, Trujano & Garcia Garnica (2004).

36 Imrie & Morris (1992).

37 Establishing quality control (QC) in a company means that the company has already achieved quality consistency in its production steps. To obtain certifications that a product or a production process complies with a certain norm or standard, a company should undertake a process of "testing and inspecting" and on the basis of the results obtained, this process is followed by "evaluation and certification." The Just-in-Time (JIT) system allows minimal stockpiling of parts and components along the assembly line or in any part of the production processes, saving inventory costs. It involves securing a constant flow of work and reducing the lead-time for making things in the production line as well as enforcing high standards of quality control.

38 Bailey, de Ruyter, Michie & Tyler (2010).

39 Gereffi (1999).

40 The Economist (2005).

41 The Economist (2002, 2005).

42 International Organization of Motor Vehicle Manufacturers (2009).

43 In 2010, MAN and SCANIA together had 30% of the European heavy-truck market. VOLVO and Daimler each had 21% of the market (European Automobile Manufacturers' Association 2010).

44 Humphrey & Memedovic (2003); Nag, Saikat & Ritwik (2007).

45 Humphrey & Memedovic (2003).

4.3.3 Internationalization

In the late 1990s, the World Bank emphasized the relevance of exports in facilitating countries' abilities to obtain knowledge from abroad. It argued that exporting companies increase their productivity through learning from participating in international markets.[46]

By signing Free Trade Agreements, countries not only agree to engage in the purchase and sale of products with other countries; they institutionalize their entrance into the global market. In other words, they open their borders to international requirements and production standards, as well as to new actors and relationships in the international arena that will influence and possibly determine the development and strategies of their industries, as is the case of the assemblers engaged in global automotive parts production.

Globalization also implies that national actors are no longer in charge of the decision-making for all processes, as foreign companies begin to play relevant roles in the direction of industries. Globalization entails not only a set of new economic processes, but also political and technological ones which are driven by the actions of multinational corporations and states with uneven effects across space and time.[47]

The degree to which the assembler delegates the development and delivery of automotive parts and components to its suppliers has a strong influence on the Internationalization of the industry (e.g. the search for cheaper and more efficient providers of parts and components abroad).

The weight of buses and coaches restricts in certain ways the export opportunities for completely assembled vehicles to neighbouring countries. Therefore, for the Republic of Belarus the main competitors for neighbouring markets (but also the main potential consumers) are other CIS countries, Russia and some of the East European countries, namely Poland and the Czech Republic (now EU-27).[48]

46 Galina & Murat (2004); World Bank (1998).

47 Dicken (2003).

48 Poland is an interesting case of leapfrogging in bus production technologies. The Polish bus manufacturing industry was traditionally characterized by two monopolistic producers: Jelcz (city buses), which had a licence from Berliet and went bankrupt in early 2008 (Davies, 2007) and Autosan (inter-city buses and tourist coaches), with a licence from Skoda-Karosa. Now there are new actors and arrangements. On the one hand, there is Kapena, S.A., a representative of Irisbus in Poland with a joint venture with Scania (Scania-Kapena S.A) and a licence from Cacciamali S.p.A. (Italy) and IVECO (Italy). On the other hand, there is the interesting case of Solaris Bus & Coach, S.A. Solaris, which is the newest actor in bus manufacturing in Europe, founded in 1994. In 2005 Solaris and Neoplan (Germany) become a joint-stock company. In 2006 Solaris opened a new production facility and produced the first hybrid diesel-electric city bus in Europe, the Solaris Urbino 18 Hybrid Allison (MAN (Germany) produced its first hybrid bus in 2010). These buses are used by the city of Poznan in Poland and in Dubai. Currently, Solaris produces different types of buses and coaches to European environmental standards (with engines from Cummins, DAF and IVECO), trolley buses (with Pragoimex and Skoda engines), trams and other sorts of service vehicles. Solaris buses and trolley buses have an asymmetric windscreen that allows better visibility and has become one of its characteristic features.

49 Standard and Poor's (2005).

50 Malczyk (2006).

4.4 Demand-Driven Factors

There are other factors influencing the global development of the automotive industry. These include changes in consumer requirements, pressures to reduce prices and the introduction of environmental standards and regulations. Although this is an industry traditionally driven by supply-side factors, in the last years demand-driven factors are becoming increasingly important for the assemblers in determining and maintaining their market share.

4.4.1 Changes in Consumer Requirements

Since the implementation of the lean production model, the automotive industry has begun slowly moving towards an industry dictated by customer preferences. Influenced by the large variety of models in the market, assemblers are giving more and more consideration to customers' desires in product models and designs.

There is also an increasing demand for safer vehicles, which has led to the development and installation of airbags, antilock brakes and electronic stability programs on wheels (ESP). Consumer preferences for electronic features such as global positioning systems (GPS) and premium sound systems are also considered in today's automobile production.[49]

In the case of heavy vehicles, the EU has implemented several directives to introduce front and rear underrun protection in heavy commercial vehicles, aiming to reduce fatal effects in the case of collisions between these vehicles and passenger cars.[50]

Vehicles also have to be adapted to the local conditions of roads and fuel (e.g. strengthening body, suspension, steering, etc.).

4.4.2 Price

Price in the automotive industry depends largely on fixed costs, economy of scale and technology. Competition in the industry is playing an important role in the pricing of automobiles (including heavy commercial vehicles). However, price variations are mostly concentrated in mark-ups, variable costs, import duties and other trade barriers.[51]

Price reduction is now becoming a major strategy for survival. Since income is a determining factor in customers' requirements, price is one of the most important factors in determining sales. However, simply reducing the price is not enough to attract demand; quality, comfort and marketing are also important elements influencing consumers' decisions. In some cases, in lower-income countries the characteristics and add-on features in automobiles (including heavy commercial vehicles) are different than those in high-income countries.

4.4.3 Environmental Standards and Regulations

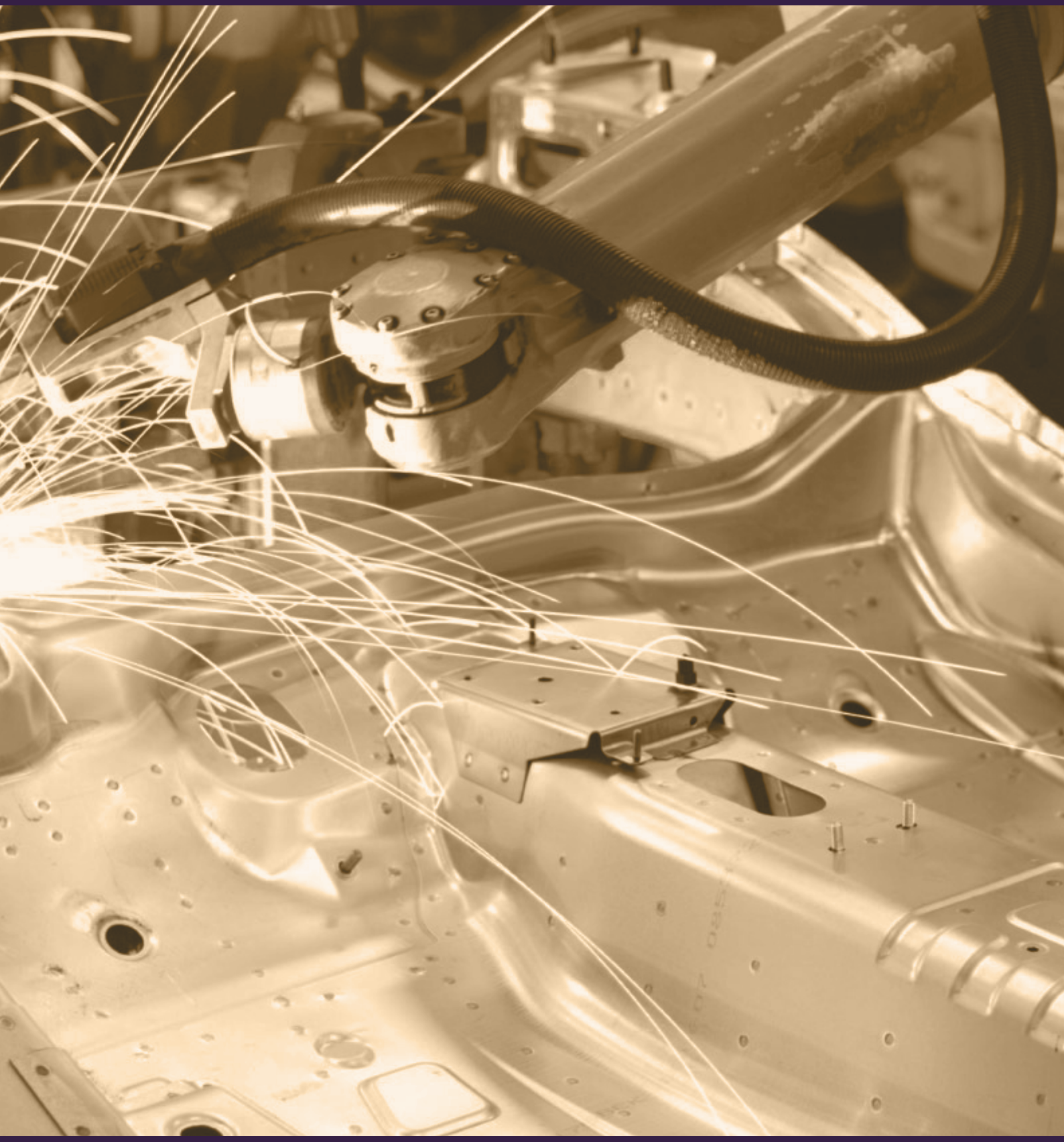
The influence of environmental policies on the industry's technological development is not just recent. At the beginning of the 1970s, the Muskie Act required the passenger vehicle industry to reduce its carbon monoxide, hydrocarbons and nitrogen oxides emissions by 90%. In order to comply with this regulation, automobile assemblers developed different engines (e.g. the CVCC engine by Honda and the 3-way catalyst by Toyota and Nissan).[52]

Air quality is one of the areas in which European and US legislation has been very active since 1998. Regarding the heavy commercial vehicle industry, Europe has implemented several emission regulations for heavy-duty diesel, natural gas (NG) or LPG engines. These regulations are referred to as Euro I to VI and aim to tackle a number of key air pollutants by 2020. In the area of non-road mobile equipment, such as agricultural machinery, environmental regulations (e.g. soil erosion, engine exhaust emissions, water pollution) in Europe came into force in 1997. In this sector the standards have been implemented from Euro Stage I (in 1999) to Euro Stage IIIB (to be implemented by 2013). [53]

The implementation of environmental regulations has moved the industry worldwide towards the production of cleaner automobiles. In the heavy vehicle industry there has been an important improvement in diesel engines (e.g. diesel engines Euro I to VI in the heavy commercial industry and Euro Stage I to Stage IIIB in the agricultural machinery segment). In addition to the Euro standards, there are also emission durability regulations which are being implemented since 2005. Under these regulations, manufacturers should demonstrate that an engine complies with the emission limits throughout its entire useful life period. In recent years, the German Environmental Agency has also suggested the implementation of noise emission standards.

Due to these increasing environmental regulations, during the last 10 years, the automotive industry has moved towards hybrid technologies and electric vehicles. In the bus and coaches segment, there are examples such as Solaris (Poland), which launched Europe's first hybrid bus prototype in 2006;[54] Van Hool (Belgium), which started mass production of this type of bus in 2009; [55] MAN (Germany), which in 2010 put its first serial hybrid bus into service;[56] and Volvo Buses, which, after years of trials, started the serial production of hybrid buses in 2010.[57] According to MAZ, the Republic of Belarus expects to have its first hybrid bus on the market by 2012.[58]

51 Pinolopi & Verboven (1998).
52 For more on cleaner technologies see Yarime, M. (2009; 2008).
53 A detailed description of these environmental regulations is presented in Annex 1.
54 Solaris Bus & Coach (September 11, 2011).
55 Van Hool (September 11, 2011).
56 MAN Truck and Bus (September 11, 2011).
57 Volvo Buses (2011).
58 MAZ (2011).



5 THE AUTOMOTIVE INDUSTRY: THE CASE OF THE REPUBLIC OF BELARUS

5.1 Heavy Commercial Vehicle Manufacturing

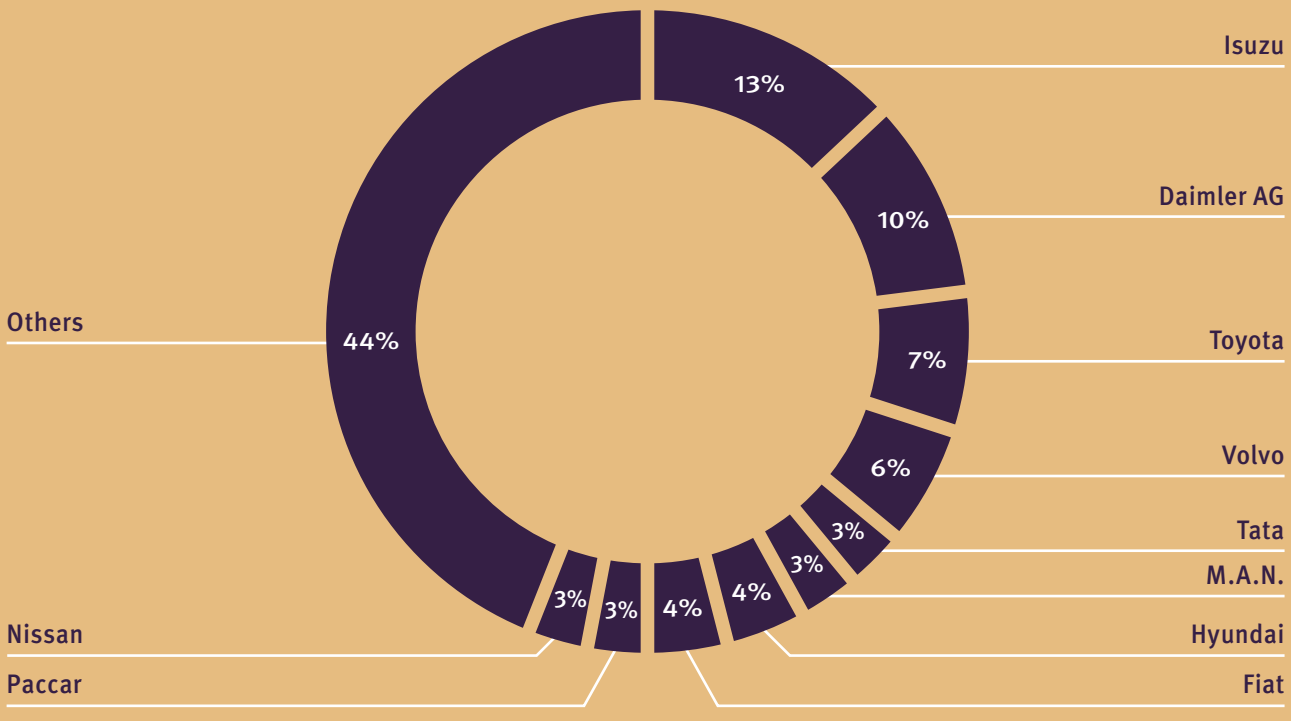
Figure 6 presents the degree of global concentration of heavy commercial vehicle production in 2008. The 10 assemblers presented here produced more than 130,000 units of heavy commercial vehicles in 2008 and accounted for about 56% of the global production volume.[59]

The major production of heavy trucks is located in Asia, where about 62% of heavy commercial vehicles are produced. The EU-15 is next with a share of about 18%, followed by the USA with 15%.[60] In the Republic of Belarus, more than 65% of total production volume in the heavy commercial vehicle category is manufactured by established assemblers (see **Annex 2**).

59 International Organization of Motor Vehicle Manufacturers (2008).

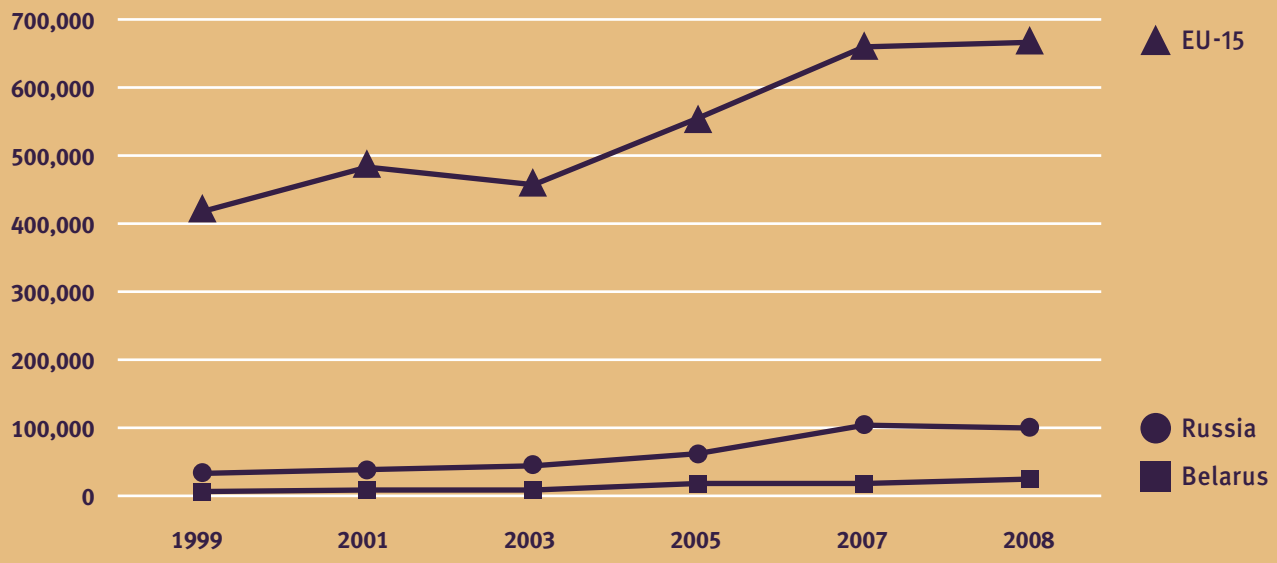
60 International Organization of Motor Vehicle Manufacturers (2007, 2009).

FIGURE 6.
PRODUCTION CONCENTRATION IN THE HEAVY COMMERCIAL VEHICLE INDUSTRY (% OF TOTAL PRODUCTION)



Source: International Organization of Motor Vehicle Manufacturers (2008).

FIGURE 7.
HEAVY COMMERCIAL VEHICLE MANUFACTURING (IN UNITS)



Source: International Organization of Motor Vehicle Manufacturers (2007, 2009).

Figure 7 illustrates that after the EU-15, the Russian Federation and the Republic of Belarus (with production at 25% of Russian levels in 2007 and 2008) are the main producers of heavy trucks in Europe.[61] The rest of the Eastern Countries and CIS do not reach sufficient production volumes to achieve economies of scale.[62]

In the Russian Federation, the main producers of heavy vehicles are Russian Buses – GAZ Group (including GOLAZ, PAZ, KAVZ, KAAZ and LIAZ) and KamAZ (partly owned by Daimler AG). In 2010 Renault Trucks (from the Volvo Group) started production of trucks in Kaluga (Russian Federation), and in 2011 MAN SE announced plans to build its first factory in St. Petersburg. Scania also produces heavy vehicles in the Russian Federation.

Belarus has a strong tradition in the machine tools industry that dates from the early 1920s, and its heavy vehicle production is concentrated in heavy trucks for construction and mining. The main assemblers in the country are MAZ, MAZ-MAN (the only assembler with foreign capital participation), BELAZ and MOAZ (a subsidiary of BELAZ).

61 BelarusDigest (2011).
62 A detailed table on the global production of heavy trucks during the last 12 years (in units) is presented in Annex 2.

5.1.1 MAZ

MAZ is the main member of the business group BelAvtoMaz. Established since 1944, its main production is concentrated on heavy commercial vehicles and on mobile engines for construction and mining. BelAvtoMaz consists of six subsidiaries located in different cities in Belarus, namely MAZ, Mogilevtransmash (Mogilev), OZAA (Osipovichi), Heavy Forging Plant (Zhodino), Litmash (Minsk) and DEMZ (Dzerzhinsk). BelAvtoMaz employs about 30,000 persons and exports to Russia (67% of the group's production), Ukraine, Serbia, Libya, Azerbaijan, Vietnam (assembly production), Iran, Syria, Egypt and Venezuela.[63]

5.1.2 MAZ-MAN

MAZ-MAN was established in 1997 when the Minsk Automobile Plant (MAZ) and MAN AG (Germany) signed a joint stock agreement. MAZ-MAN was the first heavy vehicle manufacturer in Belarus to comply with the EURO III environmental regulations and directives (including UN/ECE standards on levels of exhaust and noise). In 2005, MAZ-MAN established the manufacturing of wheel loaders for agriculture, construction and other types of public works.

MAZ-MAN produces truck tractors (with wheel arrangements of 4x2, 6x2 and 6x4), dump trucks (with wheel arrangements of 6x4 and 8x4) and chassis for equipment with wheel arrangements of 6x4, 6x2 and 8x4. Truck tractors and dump trucks are equipped with engines from MAN Euro III (Euro II). Since 2005, the company has also produced front wheel loaders (models BME 1560 and BME 1565). MAZ-MAN loaders use engines from the Minsk Motor Plant – MMZ (Belarus).

5.1.3 Belarusian Automobile Plant (BELAZ)

In 1946 the Peat Machine Building Factory was established and started manufacturing containers for transporting peat and agitators for peat drying. In 1951, the factory was restructured for the production of road and soil-reclamation vehicles. In 1958 the factory was renamed Belarusian Autoworks (BELAZ) and produced its first internally developed dump truck (MAZ-525). In 1960 BELAZ created an engineering department, and a year later it had designed a new mining dump truck with a payload capacity of 27 metric tons (BELAZ-540). Since then several modifications and models of heavy-load vehicles have been produced. In 1995 BELAZ become a Production Association (PA), and in 2005 it produced a dump truck with a payload capacity of 320 metric tons (BELAZ 75600). In 2008, BELAZ was already a Republican Unitary Enterprise (RUE)[64] and its production included dump trucks of 30 tons to 220 tons (mostly used in mining), as well as recovery tractors from 55 to 220 tons and hopper cars, all with engines from Tutaev Motor Plant[65] (Russia), Minsk Motor Plant – MMZ (Belarus), Cummins (USA) and MTU (Germany, Tognum Group). While BELAZ continues operating as a PA, it is also an Open Joint Stock Company (OJSC). Since 2008 BELAZ has met the national quality management standard STB ISO 9001:2001 and the international standard DIN EN ISO 9001:2000. The group BELAZ is formed by three subsidiaries, namely Mogilev Autoworks named after S.M. Kirov (MoAZ), Starodorozhski Mechanical Works (SMZ) and Mogilev Railway Car Building Plant Works (MVZ).

63 MAZ (2011).

64 According to the Civil Code of the Republic of Belarus, a Republican Unitary Enterprise (RUE) is a commercial organization whose property belongs to the Republic of Belarus. An RUE is liable for its obligations with all its property. The main document of an RUE is a charter approved by the government of the Republic of Belarus. An RUE can be reorganized or liquidated by the decision of the government of the Republic of Belarus. Unlike Joint Stock Companies (JSC) and other commercial organizations, an RUE is required to disclose all the information on its purchases on the official websites. An RUE is created for an indefinite period of activity, unless otherwise stipulated by its charter and legislation. An RUE sells its products (services) itself, unless otherwise stipulated by legislative acts. The government of the Republic of Belarus controls the terms of use and preservation of property owned by an RUE.

65 JSC Tutaev Motor Plant is one of the biggest companies in CIS (based in Russia), and it is specialized in the production of multipurpose [8 cylinder V] diesel engines (350-500 hp), gear boxes, clutches and spare parts.

5.2 Bus and Coach Manufacturing

In the bus and coach segment, production volumes are smaller and there is strong dominance by a smaller number of companies in the market. For example, in 2008 only two companies produced more than 100,000 units (i.e. Toyota and Hyundai), jointly accounting for about 47% of the global share of bus and coach production.[66]

In Europe, most production is located in the EU-15, followed by Russia (the largest producer from Europe and within the CIS countries) and Turkey (where production began in 2003). Within the EU-15, the main manufacturers of buses and coaches are Volvo Trucks (Sweden) and Scania (Sweden and Germany) and EvoBus GmbH (Germany). Among the CIS countries, the Russian Federation is the manufacturer of buses and coaches with the highest production volume. In the bus and coach segments, the main Russian producer is the GAZ Group, with PAZ in the segment of small buses, KAVZ for medium-size buses and LIAZ in the large and extra-large segments (including trolley buses).[67]

Bus and coach production in the Republic of Belarus is pursued by two companies, MAZ and Neman. However, MAZ is the leader in this segment, as Neman only reaches a very small production volume and is mostly locally oriented.

66 International Organization of Motor Vehicle Manufacturers (2008).

67 Other important manufacturing plants of the GAZ Group are: i) Gorky Automobile Plant (GAZ), the main Russian manufacturer of light commercial vehicles (i.e., GAZelle and Sobol), medium-duty trucks (i.e., Valdai and Sadko) and passenger cars (i.e., Volga Siber); ii) Ural Automobile Plant (Ural), producer of on-road and off-road heavy-duty all-wheel-drive Ural trucks; iii) Tver Excavator Plant (TvEx), the main Russian manufacturer of crawler excavators and wheel excavators; iv) Avtodizel Yaroslavl Motor Works (YaMZ), manufacturer of diesel engines and power plants.

5.2.1 MAZ

It was not till 1993 that MAZ started to explore bus production with model MAZ-103 (first marketed in 1996). MAZ produced its first articulated bus, the MAZ-105, in 1997, and in 1999 it started producing trolleybuses, model MAZ 103T. In 2004, MAZ produced the first small city bus with a body made of fibreglass materials, model MAZ 256. In 2005, MAZ produced its first airfield bus, MAZ-171, designed for the transportation of passengers at airports. In 2007, MAZ met Euro IV standards with an adaptation to the city bus MAZ-203 (originally manufactured in 2005), equipped with a diesel engine from Deutz (i.e. Deutz-2013). In August of the same year, MAZ received the approval of the Intersectoral Fund (Certification SATR vehicles) to incorporate domestically manufactured Euro III engines if their consumers requested them. Until then, all engines complying with the Euro III standards had been imported. In 2008, as a result of a joint project between MAZ, RUP-MAZ (the official dealer for MAZ in the Czech Republic) and JSC Trado Holding, the first gas engine meeting Euro IV standards became available. Although this engine was originally produced for tractors, in 2009 the first MAZ bus operating with an engine running on compressed natural gas (model 203) made its debut in Serbia.[68]

5.2.2 Neman

OZ Neman started to manufacture buses in 1994, and MAZ started bus and coach production in 1995. In 2001 Neman started the production of urban and suburban buses. In 2011 Neman and Cacciamali S.p.A. (a bus body producer from Italy) signed an agreement to produce minibuses for both city and inter-city use.[69] Under this agreement, Neman would manufacture the complete body for the new minibuses and would assemble them with IVECO (Italy) spare parts and engines complying with Euro IV standards.[70]

5.2.3 GAZ Group Activities in the Republic of Belarus

In April 2011, the GAZ Group (Russia) and the RusAvtoProm company opened a plant in Belarus to assemble small and medium-size PAZ buses (models PAZ 3205 and PAZ 4234), including school, cargo, four-wheel drive and passenger adaptations. The production capacity of the plan is calculated at 600 buses per year. The level of local content expected in the production is 25%.[71]

68 http:// www.maz.by accessed on July 14th, 2011.

69 In 1993 Kapena formed a joint venture with the Swedish group Scania (in which Scania was the main investor) to assemble Scania tractors and buses (Scania-Kapena SA). In 1998, Kapena and Cacciamali Spa of Italy started working together in the production of buses. In 1999 Kapena started producing minibuses under a licence from Cacciamai (which by that time was already related to IVECO). In 2000, Cacciamali Spa acquired the majority of Kapena stocks.

70 The project is estimated at 6 million EUR for a duration of six years.

71 BelTA (2011).

5.3 Agricultural Machinery

Based on the Harmonized System (HS) 8-digit product classification, agricultural parts for agricultural machinery are classified as: equipment, parts and components for planting and fertilizing machinery, ploughs and cultivators, harvesting machinery, hay-making and mowing machinery, pig and poultry equipment, tractors, agricultural sprayers, barn and barnyard machinery, agricultural trailers and other machinery.

A decreasing number of farmers in the Triad, namely Europe, the USA and Japan, and an increasing demand for agricultural commodities (due to an increase in the global population) may explain an increasing demand for agricultural machinery (including parts and components) in recent years. The market is dominated by three global companies: John Deere (USA), Agco (USA) and Case New Holland (Fiat Group, Italy). There are two main commercial groups manufacturing agricultural machinery and vehicles in Belarus: Minsk Tractor Works (MTZ) and BelAgroMash.[72]

72 These two companies did not participate in the project interviews and survey exercise. However, some of their suppliers did participate in our survey, and we considered it important to add some contextual information about these assemblers.

5.3.1 Minsk Tractor Works (MTZ)

MTZ was established in 1946, and it is one of the largest assemblers of agricultural machinery in Belarus. It was one of the best Soviet plants of its type and before 1991 exported a significant share of its production to East Europe and other developing countries outside the Soviet republics. During the early years of the transition, MTZ performed better than similar companies in the region mainly due to established customers outside the CIS area and tractors-for-energy bilateral agreements with Russia. By 1995, although MTZ production had declined four-fold, the company preserved most of its operational capacity.[73] The strong bilateral cooperation between Belarus and Russia benefited MTZ by maintaining a critical level of demand for its products. During the period 1995-2004, the production of tractors increased by 50% and reached 35,000 units a year. Almost 30% of this production was exported to non-CIS countries. At the domestic level, MTZ is required to supply tractors to local farmers at a low regulated price. However, the company receives partial compensation for its losses through government subsidies and tax benefits. MTZ has remained fully state-owned, and it is the largest producer of agricultural vehicles (mainly tractors) in Belarus. In 2000 MTZ achieved ISO 9001 standards, and since then its tractor production for the European Union is certified at the international level.[74] In 2002 its production accounted for about 60% of the total tractor production in the CIS area.[75] The MTZ group consists of 11 companies, namely Minsk Tractor Works (MTZ), Smorgon Assemblies Plant, Vitebsk Tractor Spare Parts Plant, Minsk Gear Plant (MPZ), Gomel Factory Hydroprivod, Bobruisk Tractor Parts and Assemblies Plant, Khoiniki Hydraulics Plant, Narovliany Hydraulics Plant, Mozyr Machine Works, Lepel Electromechanical Plant and Minsk Special Tools and Industrial Equipment Plant. Together, the 11 companies in the group employ about 30,000 workers.[76]

5.3.2 BelAgroMash

The State Production Engineering Holding Company "BelAgroMash" is a state-owned production association that started operations in 1965. It produces a wide range of agricultural machinery and equipment. Currently the company comprises 17 organizations (16 of them open joint stock companies). The structure of the group BelAgroMash consists of six subsidiaries (which also have other subsidiaries), namely Bobruiskagromash (Bobruisk), Hydroselmash (Minsk), Plant of Hydraulic Engineering (Kobrin), Lidaagroprommash (Lida), Lidselmash (Lida) and Slutsk Plant of Handling Equipment. The main manufacturer of agricultural machinery in the association is Bobruiskagromash.

73 World Bank (2005, p. 46).
74 Minsk Tractor Works (2011).
75 World Bank (2005).
76 MMZ (2011).

5.4 Automotive Parts and Components

The automotive industry requires a large number of different parts and components. It is in the parts and components segment that developing economies profit from hosting an automotive industry, not only because of the levels of employment generated, but also due to its linkages with other supplying sectors of the economy, the technological and innovation capabilities generated in upgrading suppliers and the effect on the trade balance.

Changes in the global industry during the last decade have generated important restructuring in the automotive parts and components industry, demanding the continuous technological upgrading of supplying companies.

Table 3 presents the main automotive parts suppliers in Belarus, according to the Ministry of Industry. As illustrated in the table, in the case of the Republic of Belarus, most automotive parts companies date from the early 1940s, with fixed capital equipment that is about 19 years old on average.

TABLE 3.
MAIN AUTOMOTIVE PARTS SUPPLIERS IN THE BELARUS AUTOMOTIVE INDUSTRY

Company	Main product	Year started operations
Minsk Motor Plant (MMZ)	Four- and six-cylinder diesel engines for the automotive and tractor industry, engines with boost-pressure charge	1963
Belshina	Tiers	1968
Mogilev Automobile Plant named after S.M. Kirov (MOAZ)	Self-powered scrapers, motor-vehicle trains for underground mines and tunnels, trucks for aircraft towing, auto-loaders for mining work, mixer trucks, dump trucks	1935
Belkard	Axle drive shafts	1951
Borisov Plant Avtogidrousilitel	Steering boosters, oil pumps	1967
Grodno Automobile Unit Plant	Shock absorbers, brake chambers	1884
Borisov Plant for Automobile and Tractor Electrical Equipment	Starter units and other electrical equipment for heavy vehicles and tractors	1958
Minsk Gear Plant	Splined shafts and wheels for automobiles, tractors and other equipment, blackwork, tractor ploughs	1952
Mozyr Machine-Building Plant	Attached implements of ameliorative and road construction equipment (bulldozers, extractors, rippers), rotor road grass-mowing machines, attached implements of agricultural loaders	1953
Gomselmash	Self-powered combine harvesters, universal utilities, fodder-harvesting and beetroot-lifting equipment, seeding machines, grass-mowing machines, reaping machines, mini-tractors, grain combine harvesters and flax harvesters	1930
Lidselmash	Potato planters, cultivator-cum-ridgers, potato combine harvesters, potato-diggers, disk tillers, tractor ploughs, pneumatic planters, grain dryers and other agricultural equipment	1901
Brest Electromechanical Plant	Pneumatic grain seeders, till-plant outfits	1963

Source: Ministry of Industry of the Republic of Belarus (2010).

BOX 1.
MAIN PUBLIC POLICIES AFFECTING THE AUTOMOTIVE INDUSTRY (2011-2015)

The project identified several public programmes in which the automotive industry is targeted. Among the most relevant are:

A. The Programme of Activities of the Government of the Republic of Belarus for 2011-2015. The main objective of the programme is to improve the efficiency of industries (including productivity) to not less than 70% over 5 years, and to increase the industrial gross value added to 60%. The objectives of the programme related to the automotive industry include: radical renewal of the production equipment used and the introduction of innovative technologies; and the development of competitive export- and import-substituting industries based on the processing of local raw materials, with the attraction of major international companies.

B. The Programme of Socioeconomic Development of Belarus for 2011-2015 (concerning industrial production). The main task of the programme is to increase the technical and technological level of Belarus, based on the rapid renewal of fixed assets, the creation and development of competitive industries and the increased production of high-quality, marketable products. The programme includes meeting the requirements of Euro V and Euro VI.

C. Presidential Decree No. 175 (April 4, 2009). The decree grants tax and customs privileges to automotive entities related to the Ministry of Industry and exempts them from paying import customs duties and value-added tax on imports of processed equipment and components for the production of automotive products.

D. Presidential Decree No. 35 (January 24, 2011). It aims to supply agro-industrial complexes with more than 40,000 units of modern machinery and equipment during 2011–2015. The machinery and equipment are to be bought only from domestic enterprises.

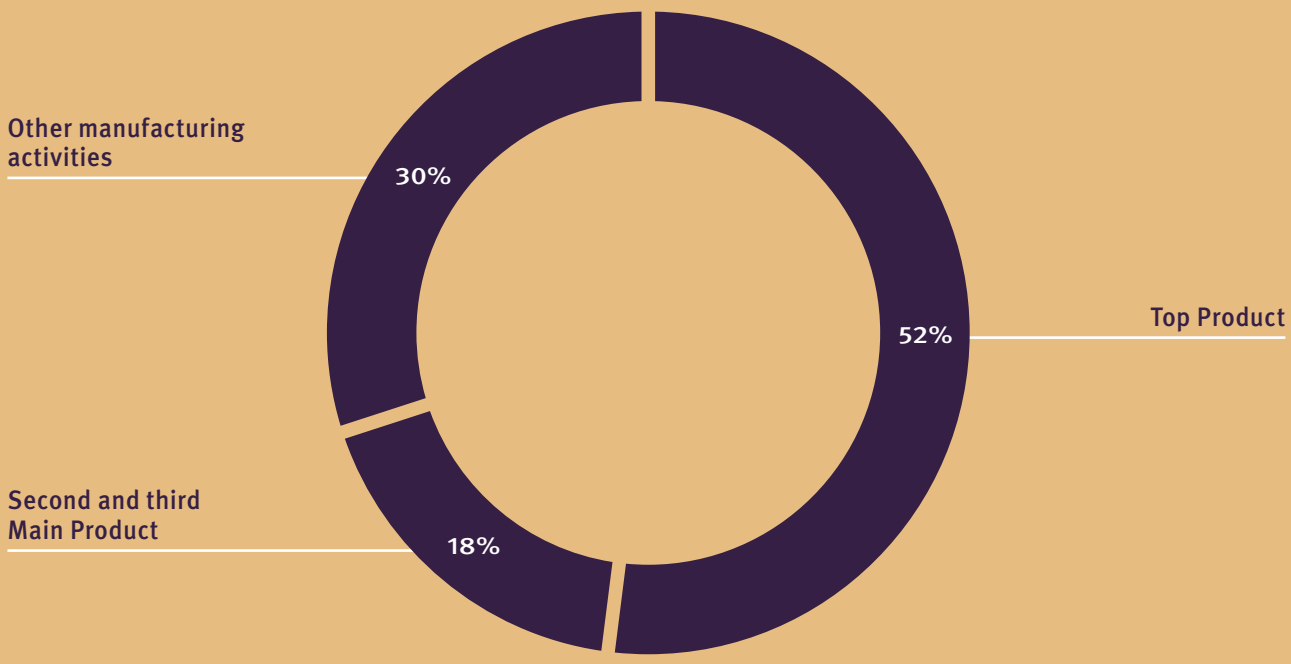
E. Resolution of the Council of Ministers of Belarus No. 116, 01/02/2011. It promotes modernization in the areas of heavy commercial vehicles, tractor, agricultural and special mobile equipment and an increase in the technological level of urban electric vehicles

F. The State Programme for the Development of Road Transport for 2011-2015 (Decision of the Council of Ministers No. 1886). Under this programme particular attention is paid to the upgrading of public buses and trucks.

During the past 5 years the automotive parts segment has undergone a major modernization process, mostly motivated by state initiatives such as those reflected in the Programme of Social and Economic Development of Belarus for 2005-2010, which will continue being promoted for 2011-2015.[77] See **Box 1**.

77 According to our survey, about 84% of automotive parts companies have invested in renewing fixed assets (mostly during 2008). About 97% of companies reported having plans for domestic investments and an expansion of operations during the period 2011-2013. Only about 20% of companies have plans to invest in operations in neighbouring CIS countries.

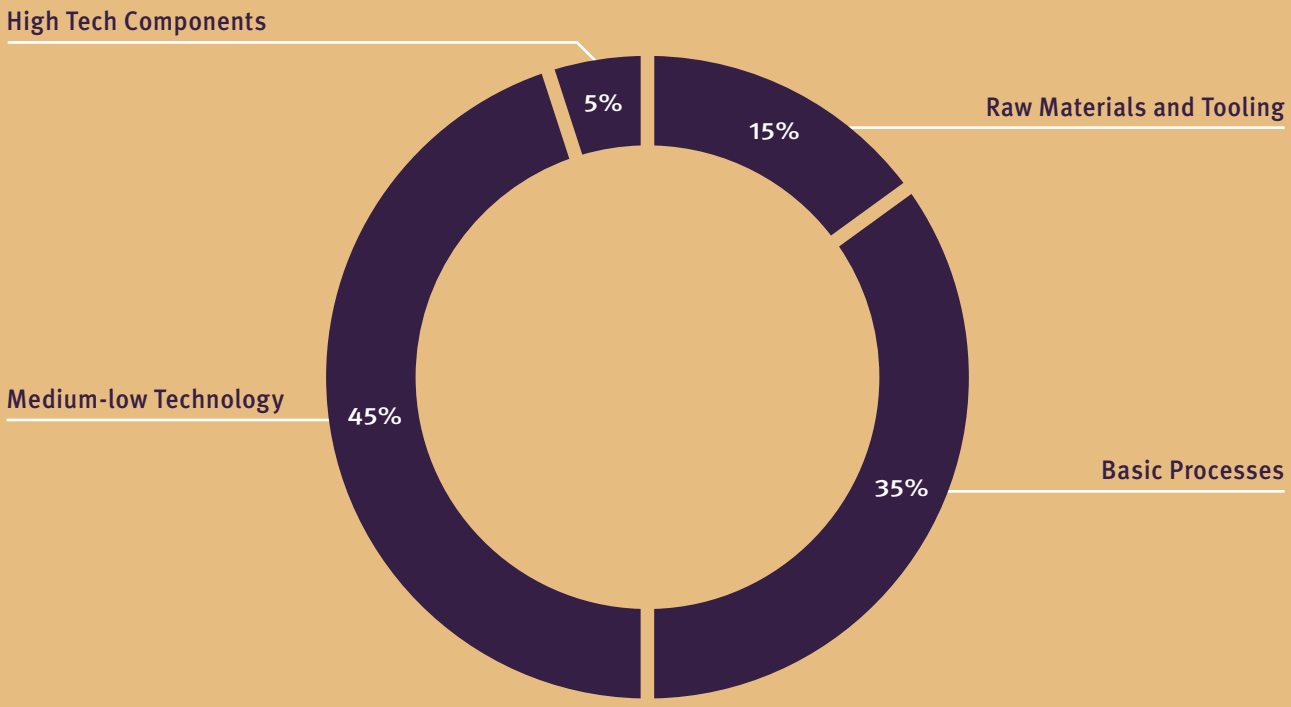
FIGURE 8.
COMPANIES' SPECIALIZATION DISTRIBUTION (% OF TOTAL)



Source: Elaborated by the author with data from the surveys.

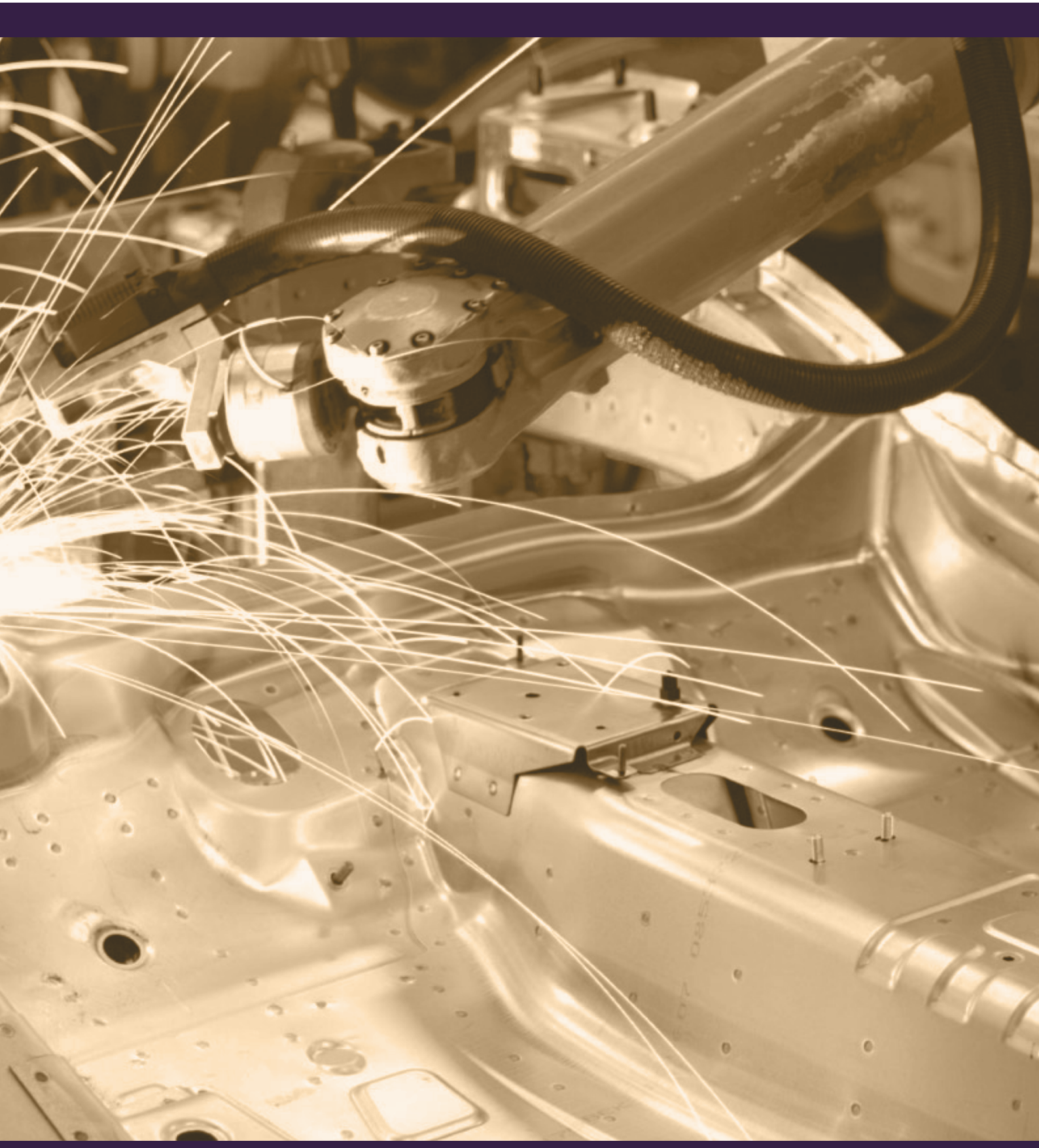
Automotive industrial production in the Republic of Belarus is concentrated on a narrow range of products. However, the research conducted found that in general, companies have more than one main product. In the case of the assemblers, MAZ, for example, produces heavy vehicles (i.e. trucks), and as a secondary product, it manufactures buses and coaches. In the case of automotive parts production, companies do not specialize in only one product, but concentrate about 52% of their production on their top product, 18% on a second and possibly third main product and the rest on other manufacturing activities. See **Figure 8**.

FIGURE 9.
BELARUSIAN AUTOMOTIVE PARTS ACTIVITIES ACCORDING TO TECHNOLOGICAL REQUIREMENTS (2011)



Source: Elaborated by the author with data from the surveys.

About 70% of automotive parts companies sell to more than one assembler and to an average of 16 companies, including other automotive parts manufacturers or commercial companies. **Figure 9** presents the distribution of companies among the main products manufactured by the automotive parts sector according to the technological requirements.



6 SUMMARY OF SURVEY FINDINGS

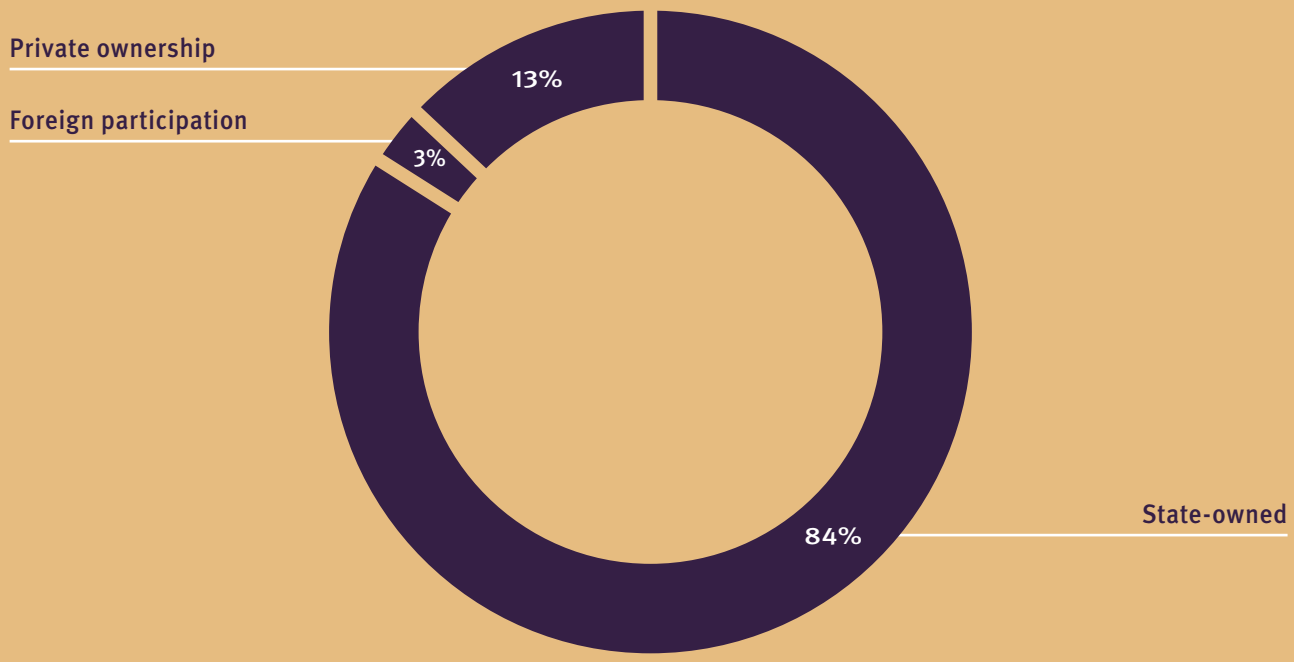
The following sections present a review of the current situation of the automotive industry in the Republic of Belarus (including assemblers and automotive parts companies). The information presented is based on the survey questionnaires administered to automotive parts and components companies and the interviews with the assemblers.

6.1 Ownership Structure

In 2004, the Belarusian Institute of Privatization and Management (IPM) reported that about 23.1% of industrial companies in Belarus were state-owned, 48% formerly state-owned, and 28.9% new.[78] In the case of the automotive industry, we found a remarkably higher percentage of state ownership in companies than that reported in 2004. In the case of the assemblers (with the exception of MAZ-MAN, which is a joint-venture with MAN from Germany) all

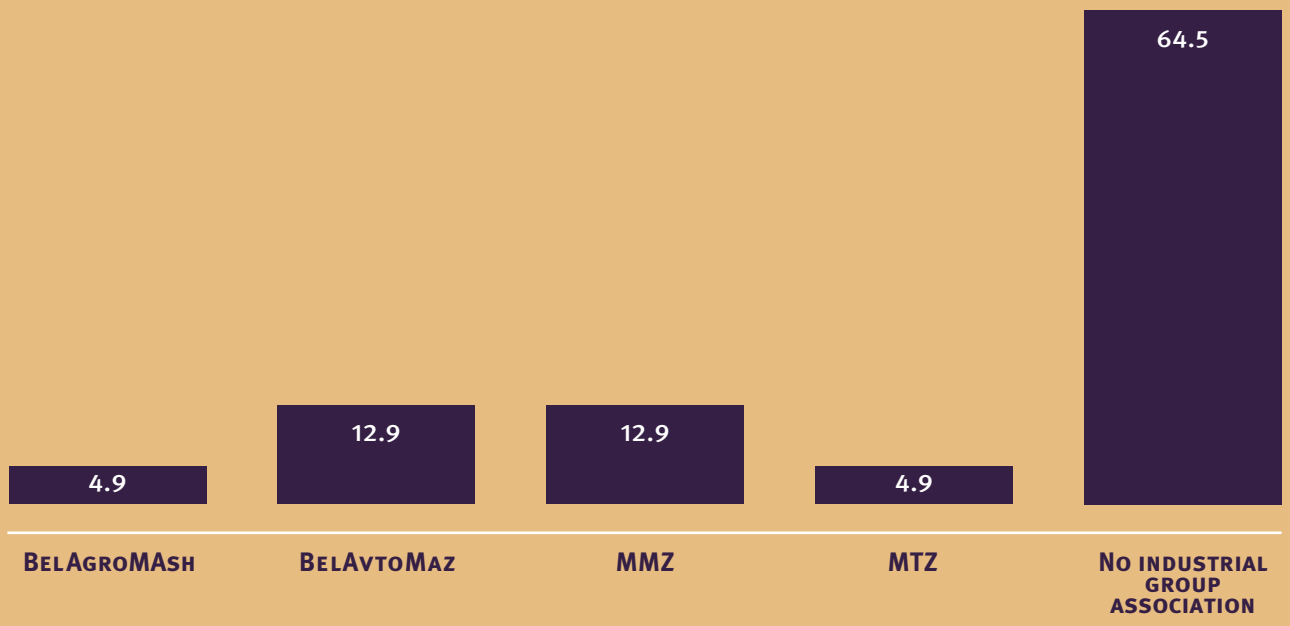
78 Bakanova et al. (2006).

FIGURE 10.
AUTOMOTIVE PARTS INDUSTRY OWNERSHIP ILLUSTRATION (2011)



Source: Elaborated by the author with data from the survey.

FIGURE 11.
DISTRIBUTION OF COMPANIES WITHIN INDUSTRIAL GROUPS (%)

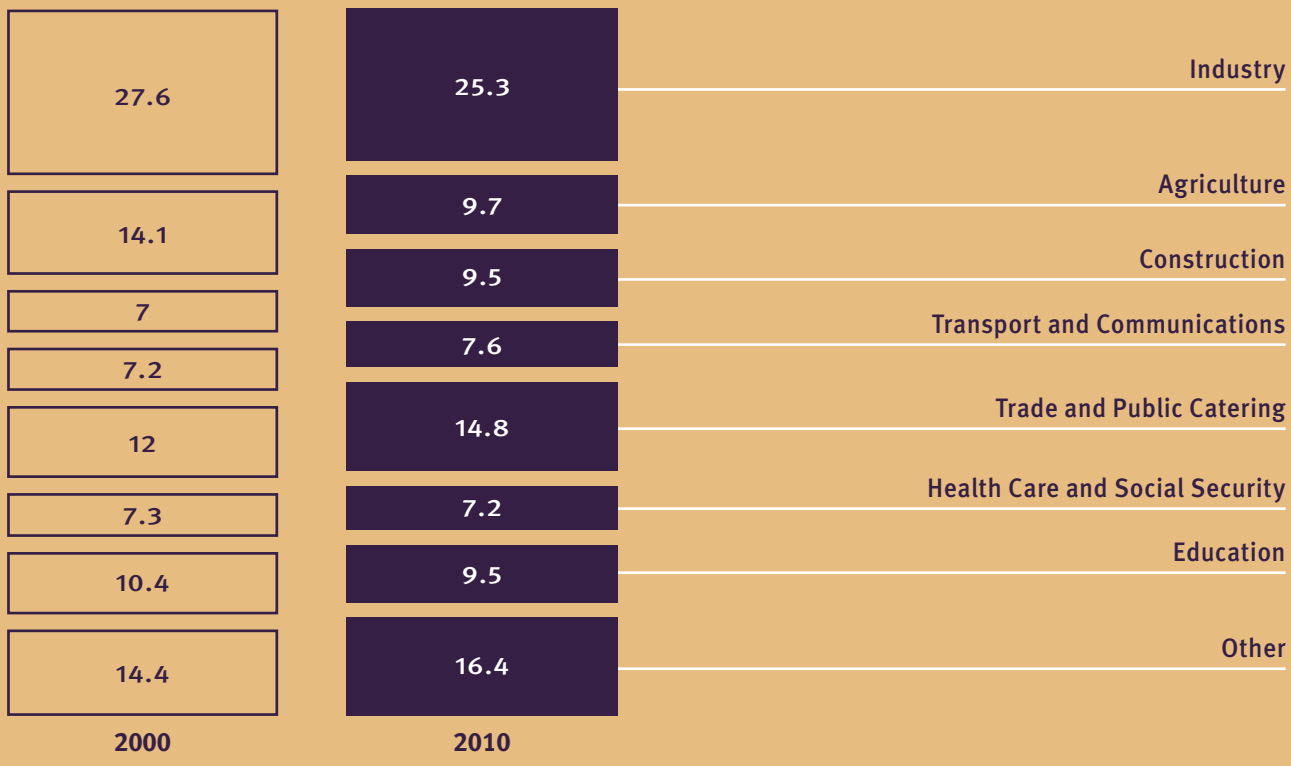


Source: Elaborated by the author with data from the survey.

companies are state-owned, and in the case of automotive parts companies, about 84% of companies reported state participation of more than 50% in their ownership. As illustrated in **Figure 10**, only about 3% of companies reported foreign participation of more than 10%. This illustrates on the one hand the large involvement of the state in this manufacturing activity, which facilitates benefiting these companies with tax and import-duty exceptions (see Presidential Decree 175 in **Box 1**) and, on the other hand, the low Internationalization levels of the industry.

There are four main industrial groups in the automotive industry in Belarus, namely BelAvtoMaz (heavy vehicles, buses and coaches), MMZ (diesel engines), BelAgroMash and MTZ (both in the agricultural machinery segment). Together these industrial groups constitute about 36% of automotive parts companies, of which 90% are state-owned. The rest of the companies operate individually. **Figure 11** illustrates the distribution of the total number of companies within industrial groups.

FIGURE 12.
EMPLOYMENT BY BRANCHES OF THE ECONOMY (IN % OF TOTAL)



Source: National Statistics Committee of the Republic of Belarus (2011d).

6.2 Employment

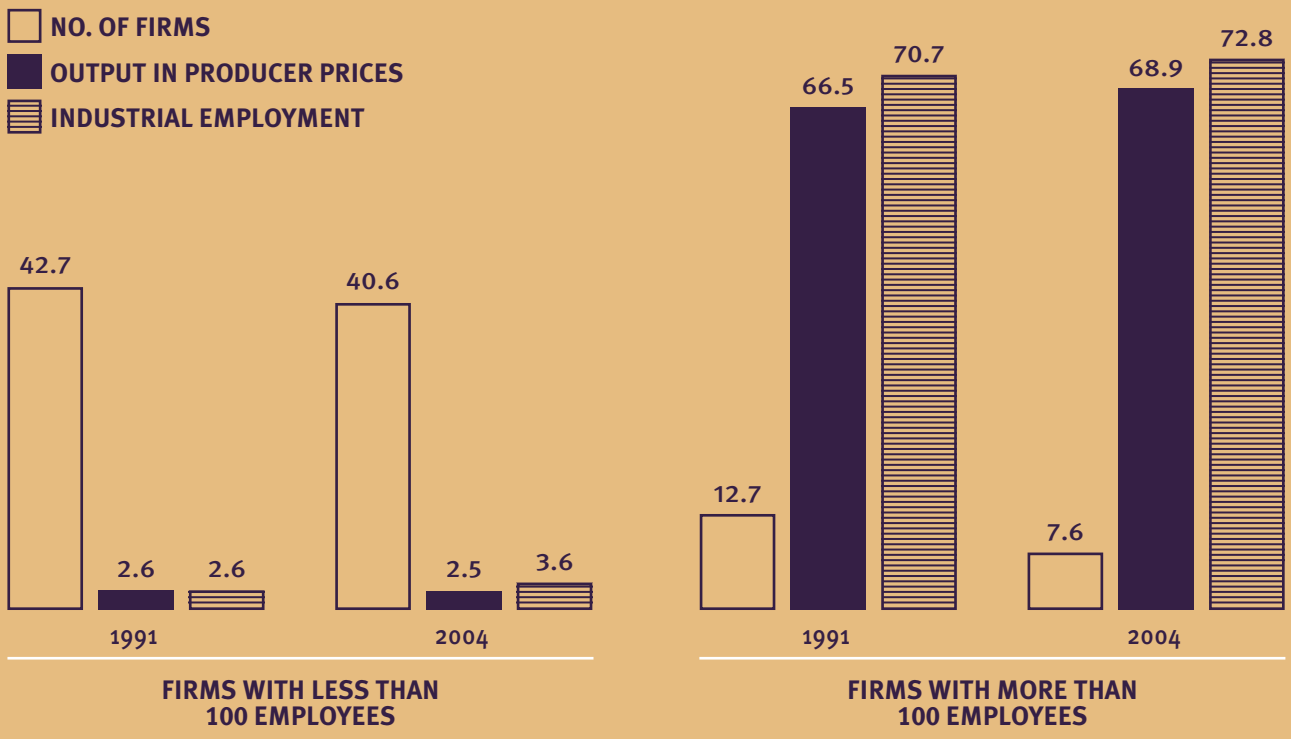
Growth in employment in Belarus has not followed the positive trend of its economic growth (illustrated in **Figure 1**) during the transition years. Although Republic of Belarus underwent fewer structural reforms than other countries in the region, it presented a trend of employment reduction similar to other transition economies.[79] During the last 10 years there has been a slight shift in employment from industry to services but not as pronounced as in other transition economies.[80]

While industrial employment in 2000 was about 27.6% of total employment, in 2010 it accounted for about 25.3% (see **Figure 12**). In the Russian Federation and the Ukraine, industrial employment accounts for about 20% of total employment.[81]

Since the Soviet era, the industrial structure of the country has been dominated by very large companies, the 10 largest of which produced about 36% of the total industrial output.[82] **Figure 13** shows that the distribution of industrial output share among companies of different size has not changed significantly since the early 1990s.

79 World Bank (2005).
80 For more on employment and productivity trends see World Bank (2005).
81 World Bank (2005).
82 World Bank (2005).

FIGURE 13.
DISTRIBUTION OF INDUSTRIAL COMPANIES BY SIZE (% OF TOTAL)



Source: World Bank (2005, p. 34).

TABLE 4.
AUTOMOTIVE PARTS AND COMPONENTS SUPPLIERS' SALES AND EMPLOYMENT

Year	BYR	Official exchange rate	EUR	Employment (average)	No. of companies
2001	14 billion	1,550	9 million	1,643	20
2003	21.5 billion	2,700	8 million	1,499	20
2005	34.1 billion	2,681.49	12.7 million	1,312	24
2006	55.8 billion	2,937.06	18.9 million	1,347	25
2009	56.3 billion	3,885.38	14.5 million	1,252	26
2010	70.6 billion	3,949.89	17.9 million	1,188	29

Source: Elaborated by the author with data from surveys. Official exchange rate from National Bank of the Republic of Belarus (2011e).
Note: Amounts are expressed in current values.

On the basis of an industrial survey conducted by the Belarusian IPM, similar results to those presented in Figure 13 were found.[83] According to the survey questionnaires about 42.6% of companies in the industrial sector have less than 100 employees.[84] However, only about 2.7% of industrial output and 1.2% of industrial employment comes from these companies; on average, state-owned enterprises employ about 1,200 employees, formerly state-owned about 565 and new companies about 146.[85] In the case of the automotive industry, the research found that both the terminal and the automotive parts segments are characterized by the presence of large companies, mostly state-owned.

Table 4 illustrates that although the automotive parts industry is characterized by large companies, in the last 10 years there has been a significant reduction in employment within these companies. In 2001, the average number of employees was 1,643; by 2009 the average was 1,252 employees, about 76% of the 2001 average. In 2010, companies reported an average of 1,188 employees.

Table 4 also shows large increases in current sales from about 9 million EUR in 2001 (1,550 BYR/EUR) to about 17.9 million in 2010 (3,950 BYR/EUR). If we consider sales as a proxy for output, we could suggest an increase in labor productivity in the automotive parts sector. This would be in line with the programme of upgrading investments undertaken by the state during the last 5 years.

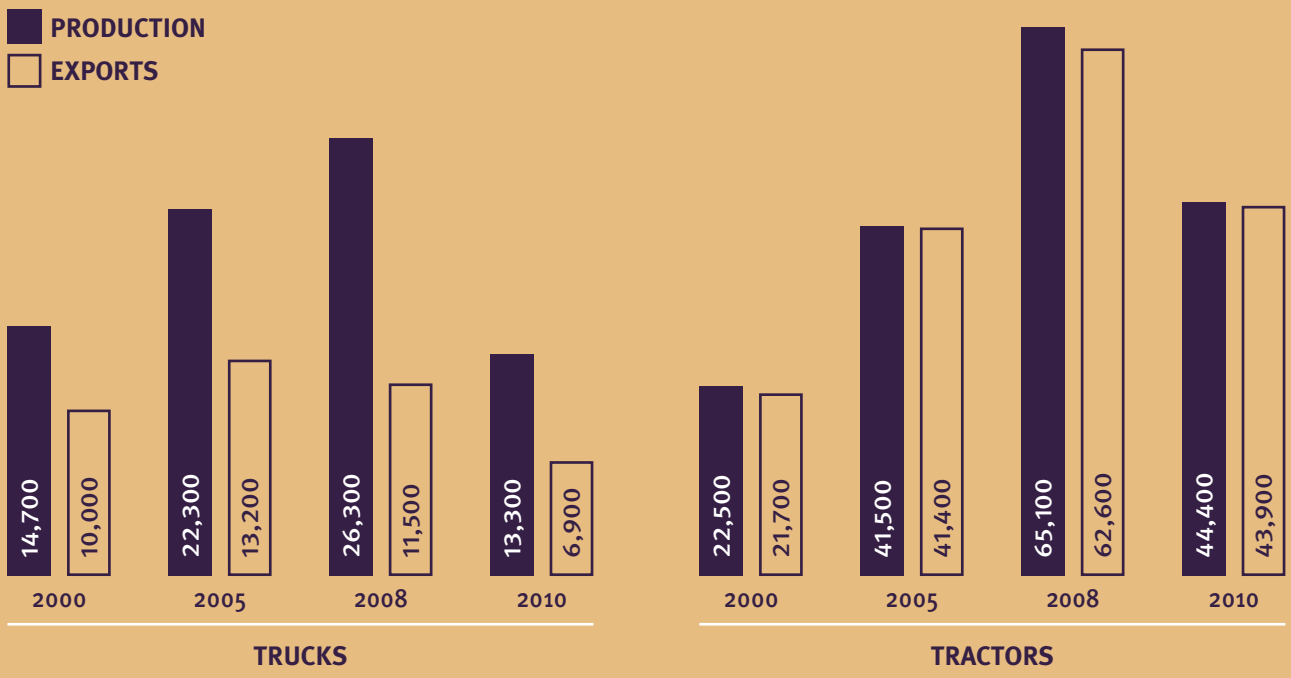
About 70% of automotive parts production goes directly to the assemblers and industrial groups, with only about 30% sold to commercial companies, suggesting an important aftermarket business.

83 Bakanova, Estrin, Pelipas and Pukovich (2006).

84 Bakanova et al. (2006).

85 According to Bakanova et al. (2006), Belarus employment figures in state-owned companies are higher than the average in other transition economies (e.g. state-owned companies in Poland report an average of 700 employees), but similar to those reported in the Russian Federation, where average employment in state-owned companies ranges between 2,000-5,000 workers (Earle, Estrin & Leschenko, 1996; Ioffe, 2004).

FIGURE 14.
TOTAL PRODUCTION AND EXPORTS OF TRUCKS AND TRACTORS (IN UNITS)



Source: National Statistics Committee of the Republic of Belarus (2011a, 2011b, 2011c).

TABLE 5.
AUTO PARTS TRADE BALANCE (2009-2010)

	Exports (USD m.)	% of total exports	Imports (USD m.)	% of total imports
2009				
Automotive parts and components	215.6	1.0	225.4	0.8
Tires	346.4	1.6		
2010				
Automotive parts and components	311.6	1.2	304.0	0.9
Tires	464.0	1.8		

Source: National Statistical Committee of the Republic of Belarus (2011).

6.3 Internationalization of the Value Chain

The automotive industry in general is considered an important source of economic growth, mainly due to its ability to interact with other industries in the economy and its export capability.

In the case of the Republic of Belarus, tractors and heavy commercial vehicles (trucks) are among the main industrial products manufactured and exported. The main importer of Belarusian automotive production is the Russian Federation, acquiring about 65% of completely assembled heavy commercial vehicles and tractors.[86]

Figure 14 illustrates that although global heavy commercial vehicles production has increased by about 1 million units during the last 5 years, Belarusian production has decreased by about 40% for heavy trucks compared with the 2005 level. However, tractor production in Belarus has increased about 7% compared to the 2005 level. In the case of tractors, almost 99% of the production is exported. Figure 14 illustrates that in the last 10 years there has been a decrease in not only truck production but also the share of truck production that is exported. While in 2000 about 68% of truck production was exported, in 2010 this share had fallen to about 52% of total production. No significant imports of trucks and tractors are reported during the last 10 years.

The use of installed capacity has declined during recent years. In the case of heavy vehicle manufacturing, the reduction in production presented in Figure 14 illustrates this issue. In the automotive parts sector, companies reported that in the last 3 years (2007-2010) only about 68% of their installed capacity has been used. Most companies attribute this underutilization of production capacity to a low demand by the assemblers. Aspects such as a lack of necessary specialized technology, machinery and spare parts were also mentioned by about 35% of automotive parts companies.

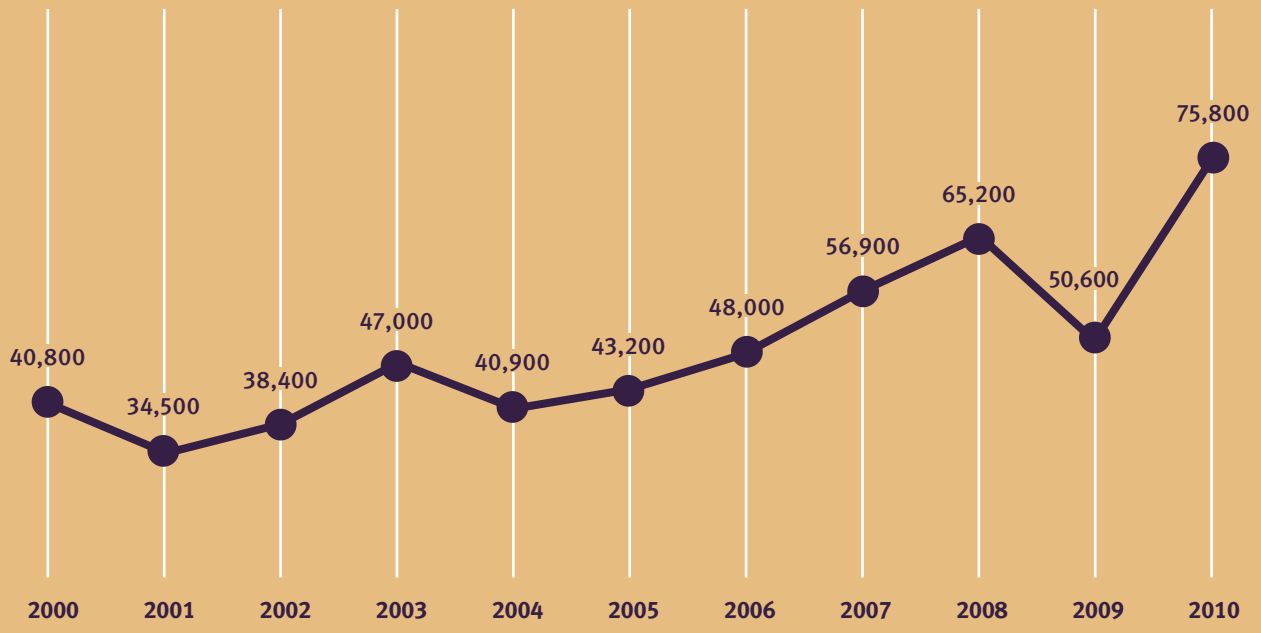
In the case of automotive parts, exports account for about 3% of the country's total exports and 1% of total imports (see **Table 5**). According to the Belarusian IPM less than 30% of industrial companies' revenue in Belarus comes from exports.[87] In the case of the automotive parts industry, our analysis indicates that only about 23% of companies' output is designated for exports, which confirms that a very small proportion of auto parts output is exported.[88] Table 5 presents the extent of automotive parts exports and imports in the total trade balance of Belarus. Tires are the main product exported in this segment of the industry, with Belshina (operating since 1968) as the main producer.

Although imports of automotive parts and components only account for less than 1% of total imports (see Table 5), there is an important amount of imports in the production of automotive parts and components in Belarus. About 64% of companies either directly import or acquire their raw materials, parts, components and knockdown kits from national suppliers of imported products in 2010. No considerable trend changes were noticed with respect to the information provided for 2005.

According to information from the interviews conducted, imported diesel engines [e.g., Cummins (USA), Deutz (Germany)] are mostly used in the production of vehicles (i.e. heavy commercial vehicles and tractors) for the export market.89 Diesel engines account for a large share of imports of automotive parts and components. According to information from our interviews, the increasing environmental regulation established in the European Union and recently in the Russian Federation is an important reason why imports of diesel engines have increased significantly during the last 10 years. See **Figure 15**.

86 National Bank of the Republic of Belarus (2011a).
87 Bakanova et al. (2006).
88 Bakanova et al. (2006).
89 Belarusian Chamber of Commerce (2011); BELAZ (2011); MAZ (2011) and MMZ (2011).

FIGURE 15.
IMPORTS OF DIESEL ENGINES



Source: National Statistics Committee of the Republic of Belarus (2011b).

6.4 Technological Upgrading

Some of the most important aspects behind the analysis of technological capabilities in developing economies are the processes involved in the adoption, adaptation and mastering of imported technologies and the learning processes and mechanisms needed to renew an existing knowledge base or to build a new base of technological knowledge.[90]

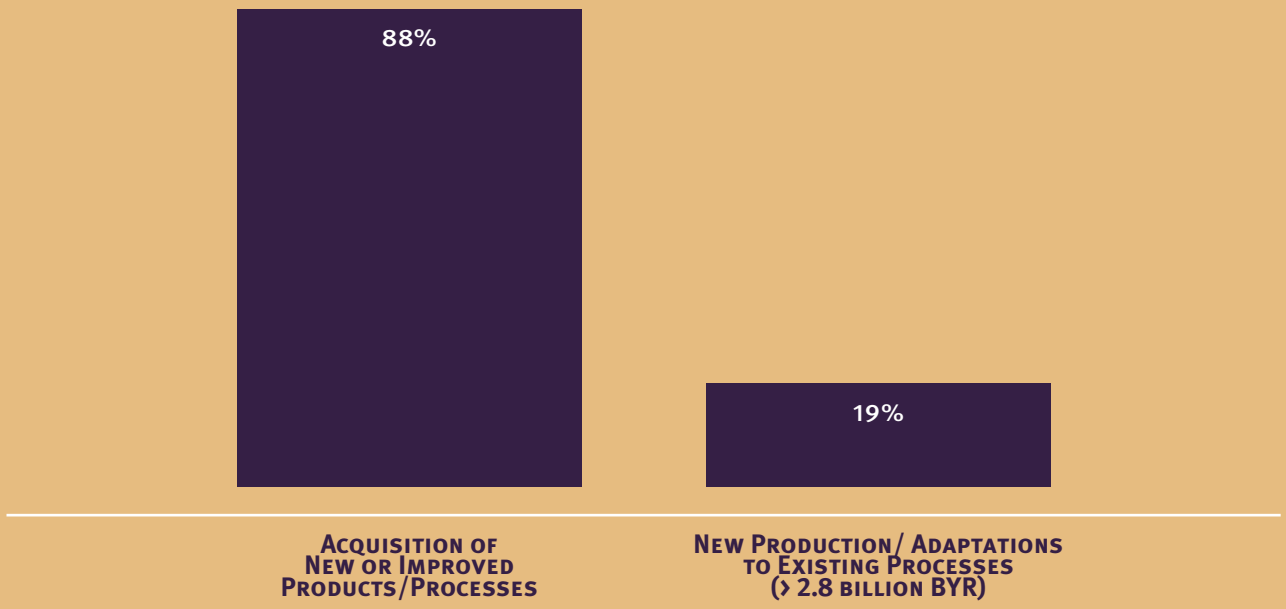
In order to acquire the necessary technological capabilities to compete, companies need an intensive process of explicit and deliberate investment in activities aimed at technology learning and mastery.[91] These processes (or technological efforts) are carried out through diverse channels. Some of these channels are the introduction of new products or processes, training and R&D activities and technological upgrades.

In the case of the automotive parts industry in the Republic of Belarus, there have been important technological efforts to strengthen the sector's production capacity during the last years. The main efforts in this regard are characterized by technology acquisitions and the renewal of capital equipment. In the automotive parts segment, about 88% of companies declared that they had spent money on the acquisition of capital goods related to new or improved products and/or processes. About 19% of companies said they spent an average of 2.8 billion BYR (ca. 800,000 EUR) on new production and business process adaptations during the same period (2007-2010). See **Figure 16**.

The research found evidence that companies in the sector do have the ability to adapt and improve their products and processes, with about 67% of companies introducing new or significantly improved products into the domestic market during 2007-2010. Regarding processes, 60% of companies have introduced new or significantly improved processes (including methods of supplying services and ways of delivering products). However, when examining the type of process and product innovations reported, we

90 Katz (1973) Lall (1987).
91 Dahlman & Westphal (1982); Jonker, Romijn & Szirmai (2006); Katz, Gutkowski, Rodrigues & Goity (1987); Lall (1987).

FIGURE 16.
CAPITAL EXPENDITURES (2007-2010) - BELARUS PARTS SUPPLIERS



Source: Elaborated by the author with data from the survey.

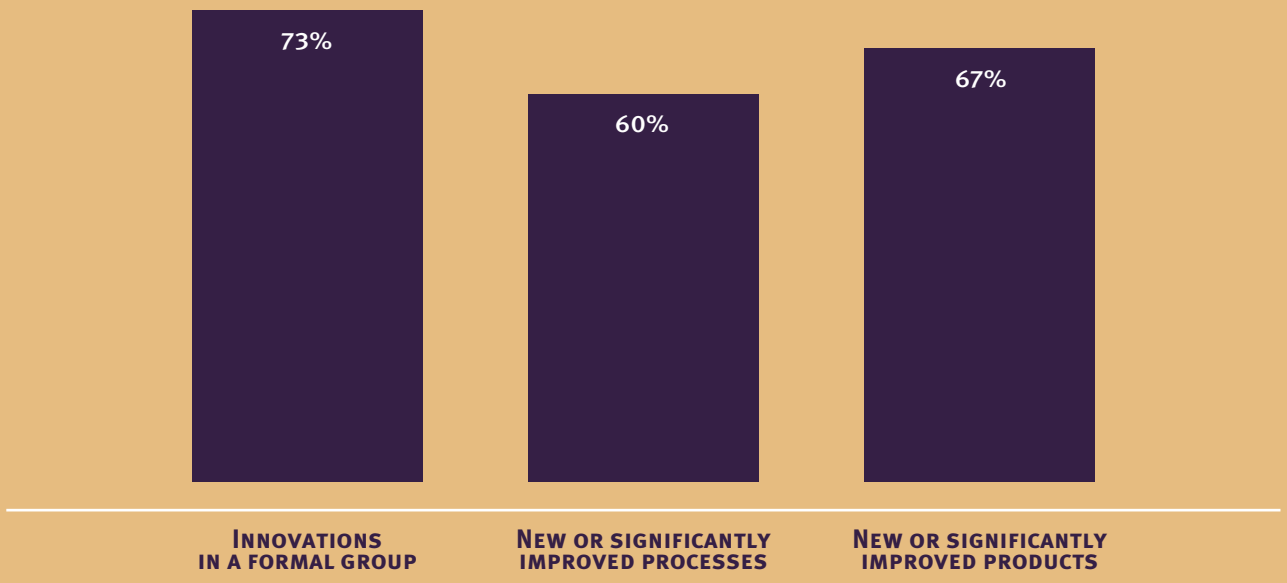
find that few of them are of relevance to increasing competitiveness at the international level. According to surveyed companies, the most important aspects related to process and product innovations are the variations in the degree of complexity of functions, costs and number of personnel.

Nearly all automotive companies (assemblers and automotive parts) declared that they have design activities in-house. About 63% of automotive parts companies reported having R&D activities. However, no clear distinction is made between R&D and design activities. The chief constructor and technical departments were reported as the main specialized areas for both these activities. There is very weak collaboration between companies and other entities regarding R&D activities. Only about 27% of automotive parts companies have participated in R&D activities with their suppliers and clients. About the same percentage (28%) have allowed their suppliers to use their infrastructure, such as labs or machinery (see **Figure 18**). We found no strong evidence of major change capabilities or the ability to create new technology and develop patentable ideas in the sector.

At present, there are no well-developed linkages in the sector. Although about 80% of companies reported to have carried out their own training activities, we found no evidence of a dynamic and integrated relationship with the domestic science and technology (S&T) and educational (vocational) infrastructure. From the interviews with the companies, it was clear that there is not a dynamic relationship between the industry and domestic knowledge centres (e.g. universities, technological centres, etc.). Inter-company collaboration for design and R&D activities is equally weak.

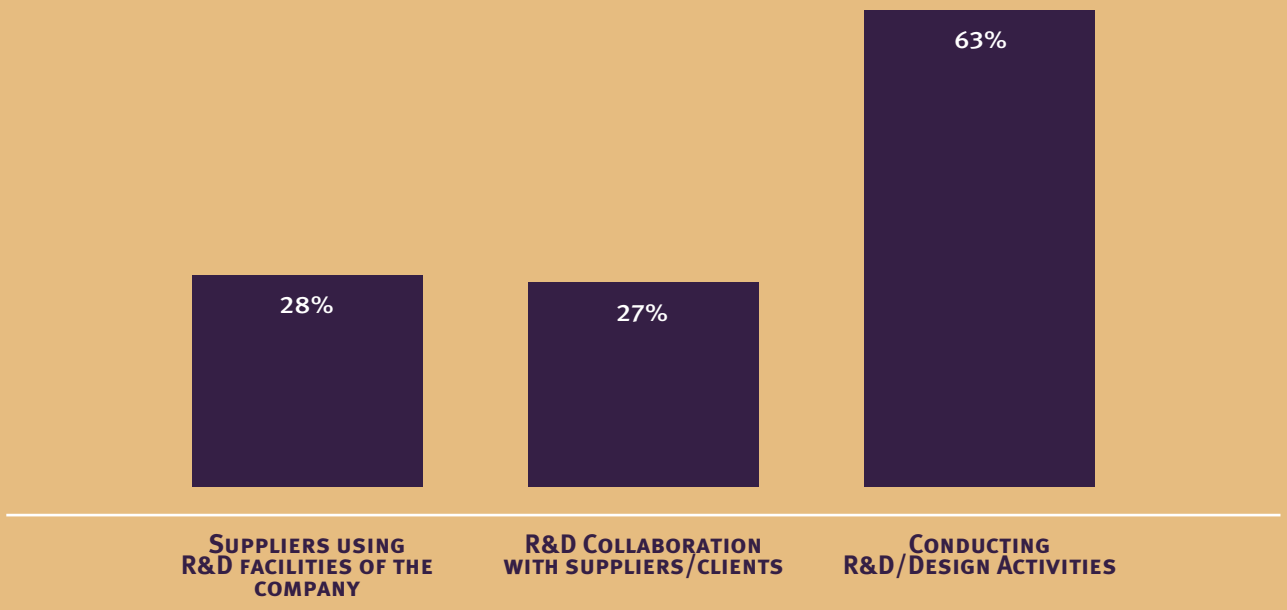
The results of our survey and interviews indicate that most of the companies' efforts are focused on production, while organizational and commercial changes are largely neglected. In the context of developing countries, the inclusion of marketing capabilities (i.e. the establishment of distribution channels and the development of new markets) is a technologically essential aspect for successful innovation activities between companies. Thus, our inquiry reveals that there is ample scope and need for developing and facilitating linkages and joint activities across the value chain.

FIGURE 17.
DISTRIBUTION OF COMPANIES CONDUCTING INNOVATIVE ACTIVITIES (2007-2010)



Source: Elaborated by the author with data from the survey.

FIGURE 18.
AUTOMOTIVE PARTS SUPPLIERS CONDUCTING R&D ACTIVITIES (2007-2010)



Source: Elaborated by the author with data from the survey.

We find that if all the efforts are concentrated on Russian market requirements (which are lower than those required in the EU), there is not much pressure for upgrading technologically at the international level. From the interviews with the companies, we perceived that companies are comfortable lagging behind the European market's entry requirements as long as they are complying with those required by the Russian Federation.

6.5 Production and Organizational Methods

Although technological upgrades are less frequent in the heavy vehicle manufacturing segment than in that of passenger cars, the former is more frequently required to move towards clean technologies than the latter. Moving towards more complex organizational strategies implies that the previous lean production organizational requirements (e.g. JIT, QC, standardization) have been achieved. Therefore, in order to succeed with new models of production, focus should be placed on implementing lean production methods in the companies and capacitating the workforce through training programmes to facilitate companies' efforts to upgrade their capabilities as required.[92]

There is extensive literature describing the technological and organizational transitions undergone by this industry in its transition towards newer forms of production, such as integral design and modularization. Quality standards are a crucial area that supports domestic companies' competitiveness within the global automotive parts industry. Quality certification is essential for automotive parts companies supplying OEMs and certified replacement parts companies. In the case of Belarus, almost all automotive companies (assemblers and automotive parts) reported having specialized areas in quality control, concentrated in the departments of technical monitoring and quality management.[93]

During 2007-2010 about 27% of automotive parts companies conducted continuous improvement programmes. About 30% of automotive parts supplying companies have had their products or processes certified by a national certification agency. This illustrates the support provided by national institutions in raising quality awareness and diffusing the adoption of these standards among domestic companies. **Table 6** presents the main quality management standards achieved by Belarusian automotive parts suppliers.

Initially, the adoption of ISO 9000 standards demonstrating that a company can provide a consistent standard of quality in its products was sufficient. However, at the global level, supplying companies are expected to meet increasingly demanding standards (such as QS 9000). Environmental regulations in developed economies have also affected standard

92 Sako (2004).

93 Humphrey and Memedovic (2003).

TABLE 6.
NATIONAL AND INTERNATIONAL QUALITY MANAGEMENT STANDARDS (AUTO PARTS COMPANIES IN BELARUS)

National Certifications	International Certifications
BY/112 05.01.021.0111	ISO 9000
BY/112 05.01.003.00128	ISO 9001
BY/112 05.01.0020055	ISO 9001:2001
BY/11205.01.00200103	ISO 9001:2008
BY/11205.01.00401172	ISO 9001:2009
BY/11205.01.01000992	ISO/TS 16949
BY/11205.01.0772072	

Source: Elaborated by the author with information from our surveys.

requirements among suppliers, as is the case with ISO 14000. Most automotive parts companies in Belarus have ISO 9001 management standards. However, only a minority of companies also reported having adopted ISO/TS 16949:2009, which is a new standard in quality management for the automotive industry supply chain. This is a standard that includes detailed requirements for employee competence, awareness and training, design and development, production and service provision, control of monitoring and measuring devices, analysis and improvement (International Organization for Standardization). No specialized quality standards for the safety and quality of tractors and agricultural vehicles (e.g. ISO 500, ISO 23205, ISO 23206, ISO 26322) were reported to have been met by companies in the sector.

Interaction with other automotive companies is high compared with other developing economies (i.e. Mexico, Brazil). All assemblers and about 95% of automotive parts suppliers reported having interaction with their parts suppliers (domestic and local) and/or with other companies in order to upgrade their efficiency in production processes, the quality of their products and their workforce. More than half of automotive parts companies interact for technology transfers with other domestic companies through participating in design or learning about how processes work (joint-product design/product development, etc.). About 35% of automotive parts perform these activities with foreign companies outside Belarus. There is regular communication with clients to find out changes in their requirements.

No significant investments in commercialization and services were reported. 60% of marketing activities are contracted domestically and about 40% from the Russian Federation. Environmental improvements in production during 2007-2010 have been undertaken by about 47% of companies in the industry. This is not surprising considering that Belarus has not moved very far in environmental policy. Most treatment and disposal of waste and polluting waste are done within the company.

6.6 Integration of Domestic Suppliers in the Value Chain

One of the key characteristics of the automotive industry is the level of interaction it develops with other industries, which promotes industrial development in general. In a developing country context, the discussion should not necessarily be focused on developing a national vehicle manufacturing industry but rather on integrating the local companies into the international standards of production reached by the global supplying value chain.

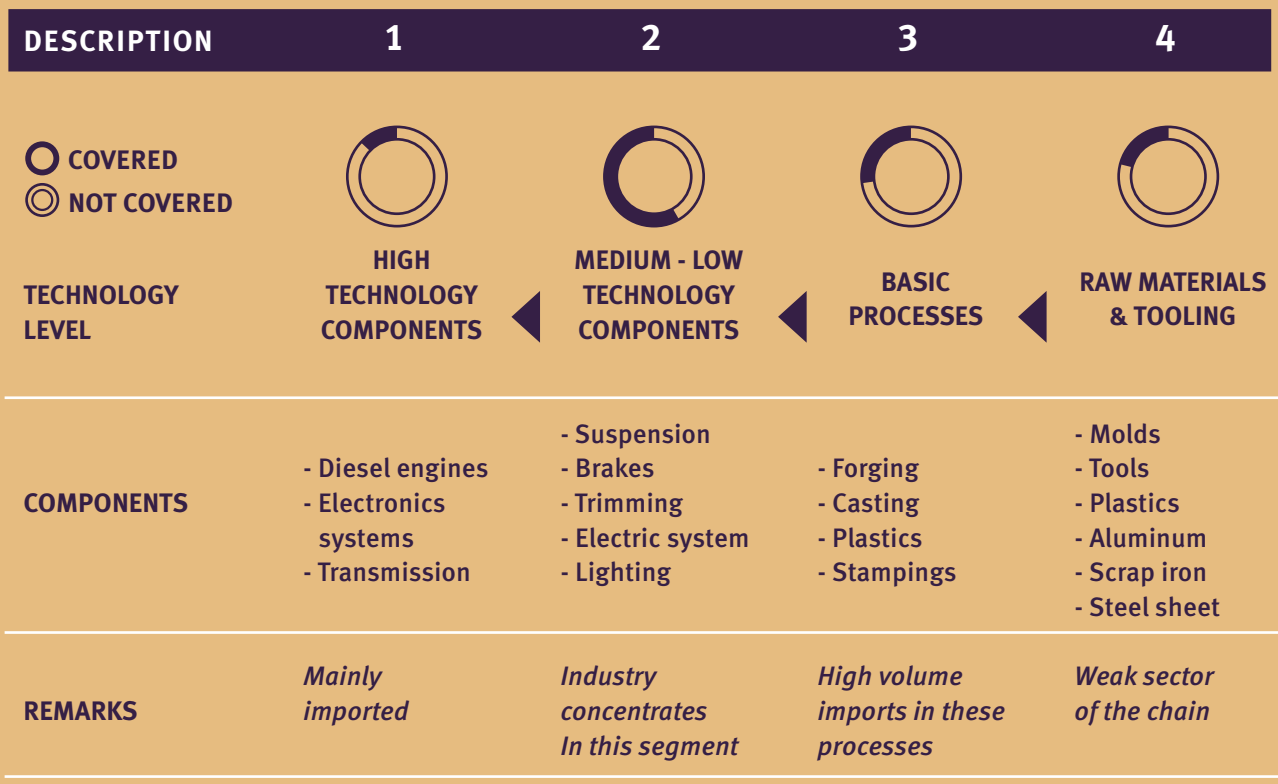
The global trend in automobile manufacturing is towards reducing vertical integration and concentrating the assemblers' core activities in designing, engineering and marketing. The assemblers' headquarters remain the *governors* of the value chain; they take responsibility for assisting and satisfying the demands of their customers in this buyer-driven chain. Due to the expensive learning required in automobile production, the first-tier suppliers are closely linked with the assemblers, manufacturing the key parts and components of the automobiles. Other domestic companies supply the first-tier suppliers and the assemblers with parts and components.

In the case of many developing countries, there has been a significant improvement in quality standards and the integration of new technologies and management practices in production. However, this industrial upgrading has largely been based on the development of the capabilities of multinationals' subsidiaries, such as in the case of the Czech Republic or Mexico.[94] More and more, we see in the global automotive industry that assemblers are relying on their first-tier providers for the design and improvement of parts and components. This has led to a growing consolidation and restructuring of the automotive parts industry worldwide, with foreign companies increasingly replacing local suppliers. In the case of the Republic of Belarus we find a different trend. The assemblers have formed production associations through which they have actually acquired their main parts suppliers, resulting in increasingly vertical integration and the concentration of automotive parts production within the assembler.

Foreign assemblers are absent from the domestic market. In April 2010, the GAZ Group and RusAvtoProm (Russian Federation) formed a joint venture and started assembling buses in Belarus, however, for the time being their production is marked by a very low volume. [95] Still, industry's dependency on foreign markets remains large. In particular, the percentage of imported inputs used in export production is higher than that used for domestic production - there is in particular dependency on some key foreign inputs such as diesel engines complying with Euro standards. This suggests that the most internationalized companies find it more efficient and profitable to imports parts and components than to produce them or to acquire them (if available) in the national market. About 45% of

94 BelTA (2011); Amsden (1989).
95 Schmitz & Knorringa (2000).

FIGURE 19.
SUPPLY CHAIN INTEGRATION IN THE BELARUSIAN AUTOMOTIVE INDUSTRY



Source: Elaborated by the author with information from the survey questionnaires (2011).

automotive parts companies reported that their primary competition comes from imports.

Figure 19 presents the technological levels of production achieved by the automotive industry in Belarus, its imports dependency and its consequent supply chain integration.

Increasing imports of inputs in production slows down local learning in the industry and its related sectors.[96] The evidence in the case of Belarus indicates that export production uses a significant amount of imported inputs. Certain parts and components domestically produced do not achieve international standards in price and/or quality, and therefore they are only used for domestic production or are simply not produced. This suggests a significant influence of imported inputs in exports, supported by the recognition of the insufficient development of the automotive parts industry – especially regarding raw materials and high-tech components. We find that a considerable proportion of imported parts and components is significantly preferred in production over those that are domestically supplied, which has in fact weakened the domestic supply chain.

This dependency on key imported parts and components for its export production makes the industry vulnerable to changes in the price of these inputs and to changes in the BYR exchange rate. This situation also has direct effects on the Balance of Payments of the country.[97]

As regards political factors regulating the value chain of the industry nationally, we conjecture that the level of learning

96 Lara Rivero et al. (2004) and Vallejo (2010).

97 New actors in heavy automotive production, such as China, are slowly entering the Russian Federation and European markets. If the industry does not continuously update to comply with changes in imports requirements for automotive production, it may lose its share of these markets.

and capabilities acquisition by automotive companies is an important factor in the disruption of the national supply chain. This raises important questions about the industry's level of dependency on foreign inputs and its integration with the national supply chain. It raises even more questions about the levels of local learning, the acquisition of innovative capabilities by local companies (particularly those non-exporting suppliers) and knowledge spillover effects to other sectors of the economy.

Existing global environmental regulatory frameworks may lead international automotive companies to accelerate their modular innovations in existing components and systems, and/or lead to the emergence of market niches for low-emission vehicles based on new technical architectures (i.e. hybrid-electric trucks and buses). All these choices have important technological and marketing implications, as well as requiring strategic decisions regarding the appropriation of value in the supply chain. All of this has managerial implications as well. There is strong environmental pressure in the industry that introduces a potential need for alternative powertrains and low-emission diesel engines. This pressure may eventually encourage a restructuring of the industry around more environmentally friendly technologies and automobiles with enhanced comfort and efficiency.

7 CONCLUSIONS

The automotive industry in the Republic of Belarus is centred on the production of heavy commercial vehicles and can be considered a key strategic sector as it significantly contributes to national employment and balance of trade. The importance of the sector is additionally reflected in the social and industrial development targets set out in a number of policy documents and explicitly targeted in various presidential decrees. The industry has long-standing tradition and is recognized especially amongst former Soviet states for its competence in machine building and manufacturing. This observation is mainly due to existing and well qualified labor force in the area of engineering that is also to be considered a major strength of the current industry set up.

However, the technological efforts and product specifications are directed towards region specific automotive norms and requirements while, more broadly speaking, the industry continues to lag behind globally accepted production requirements by several years - most of all regarding the production of diesel engines compliant with Euro V and VI and IIIB emission standards. This apparent gap prevents the national producers from competing in more advanced international markets, such as the neighbouring EU, while there seems to be a certain degree of complacency amongst companies in terms of adopting the international standards as long as they are complying with standards accepted in the Russian Federation and other former Soviet republics.

Moreover, there is an apparent lack of foreign participation in the market which is contrary to commonly observed global trend in the industry. Considering the proliferation of alliances and joint ventures between domestic firms and foreign manufacturers in the neighbouring countries this could be a disadvantage for the Belarusian industry in that partnerships with foreign companies can be an important source of technology and knowledge transfer and therefore help upgrade obsolete industrial structures.

Although Belarusian production of heavy vehicles is the highest in the CIS region, it is still too low to create sufficient economies of scale. The existing concentration of companies has the potential to facilitate reaching higher levels of production; however, production volumes have to increase significantly before the national industry can broaden its participation in international markets.

Nevertheless, our research indicates that opportunities for reaching higher levels of industry competitiveness do exist.

In particular, we define three main areas of potential policy intervention. First, there is an ample need for stimulating efforts that will lead to upgrading of existing production structures bringing them in line with those commonly observed in more competitive markets. In particular, we recommend the adaptation and introduction of lean manufacturing techniques at the company level based on best practice approaches from other transition economies. Yet, doing so one should keep in mind that the application of lean manufacturing methods can only be efficient ones the sector as a whole has mastered its core elements. Therefore, a comprehensive upgrading programme should aim at OEMs as well as lower tier component suppliers as the main beneficiaries of the intervention.

Second, there is a strong need for policy action in terms of establishing or reinforcing linkages among main industry stakeholders. The report findings suggest a weak interaction pattern among the different industry actors. This fact is at the same time assumed to be the main barrier to wider knowledge diffusion within the sector. Thus the previously mentioned policy of industry upgrading can be viable only if it goes hand in hand with a policy of network creation that is to have as its centre piece encouragement of inter-firm collaboration. A possible policy may consider creation of an automotive cluster association that is to conduct needs assessment, articulate and promote interests of its members domestically and abroad in close collaboration with research and educational institutions as well as regional and national policy making bodies.

The third recommendation complements the preceding two in that we suggest focusing policy efforts on support and development of alternative and environmental friendly production processes and products. OEMs such as MAZ have already signalled their interest in producing vehicles using hybrid technologies by presenting prototypes to wider audiences. Policy makers should regard this as an opportunity to clearly articulate their own strategy on how to support

these niche markets at their early development stages. A potential strategy may be to further encourage collaboration between industry and research through targeted R&D programmes, such as grant competitions. Alternatively, policy makers could encourage the proliferation of strategic alliances and partnerships with foreign companies and/or investors in the field of environmentally friendly technologies through more targeted investment promotion or through the creation of a more favorable investment environment. In sum, if the target is to expand national production to reach beyond the already established markets, policy action should aim at supporting collaboration in the area of green technologies, since that is the path the automotive industry in developed economies has already taken.

8 ANNEXES

Annex 1. Heavy Commercial Vehicle Environmental Regulations

Air quality is one of the areas in which European and American legislation has been very active in recent years. In the case of Europe, several emission regulations referred to as Euro I to VI for heavy-duty diesel, natural gas (NG) or LPG engines have been implemented. These regulations aim to tackle a number of key air pollutants by 2020. Among the main pollutants are: carbon monoxide (CO), hydrocarbons (HC), methane (CH_4), non-methane hydrocarbons (NMHC), particulate matter (PM), ground level ozone, ammonia (NH_3), nitrogen oxides (NO_x), sulphur dioxide (SO_2) and volatile organic compounds (VOCs).

The first regulation (Euro I) was introduced with *Directive 1988/77/EEC* and amended several times before its approval in 1992. Euro II standards were introduced in 1996 for truck engines and on a voluntary basis for urban bus engines.

In 1999 *Directive 1999/96/EC* established the standards for Euro III (implemented in 2000), Euro IV (implemented in 2005) and Euro V (implemented in 2008). These rules established stricter emission limits and voluntary extra low emission vehicles (also known as enhanced environmentally friendly vehicles or EEVs).

In 2005, *Directive 2005/55/EC* reopened discussion on the emission limits for Euro IV and V and introduced durability and Onboard Diagnostic System (OBD) requirements as well as provisions for emission systems that use consumable reagents (described in *Directive 2005/78/EC*).

Lastly, in 2009, *Regulation 595/2009* introduced Euro VI standards with a series of technical details (some of which were adopted at the end of 2010) and a full implementation date of 2013.[98]

Euro VI includes additional provisions, such as:

- An ammonia (NH_3) concentration limit of 10 ppm for diesel (ESC and ETC tests) and gas engines (ETC test).
- A limit in particle number (in addition to the mass limit) that prevents the possibility of engines meeting Euro VI PM mass limits by using technologies like open filters (which enable a high number of ultra fine particles).
- The use of world harmonized test cycles (WHSC and WHTC). These tests will be implemented based on correlation factors with the current ESC/ETC tests.
- A maximum limit for the NO^2 component of NO_x emissions.

Table 7 presents a summary of the emission standards and their implementation dates for heavy duty diesel engines.

In 2000, the ECE R-49 test was replaced by two cycles: The European Stationary Cycle (ESC) and the European Transient Cycle (ETC). Smoke capacity is measured with the European Load Response (ELR) test. With these new tests, conventional diesel engines under Euro III are tested with the ESC/ELR test and EEVs and diesel engines with advanced after-treatment (i.e. NOx after-treatment or DPFs) require ESC/ELR and ETC. Euro IV, V and VI require the three tests: ESC/ELR and ETC. Euro III and later require only the ETC cycle for engines with natural gas and LPG. **Table 8** presents the emission standards for diesel and gas engines tested in the ETC test cycle.

In addition to the Euro standards there are emission durability regulations (implemented since 2005). Under these regulations, manufacturers should demonstrate that an engine complies with the emission limits during its entire useful life period (which depends on the vehicle category). **Table 9** presents the emission durability periods in kilometres and in years (whichever occurs first).

In addition to emission regulations, the German Environmental Agency has suggested implementing noise emission standards. According to these, noise emissions must not be higher than 75 dB (A) for vehicles with an engine power between 75-150 kW and 77 dB (A) for vehicles with an engine power above 150 kW.

98 Euro VI standards are comparable in stringency to US 2010 standards.

TABLE 7.
EU EMISSION STANDARDS FOR HEAVY DUTY DIESEL ENGINES, g/kWh (SMOKE IN m^{-1})

	Date	Test	CO	HC	NO_x	PM	Smoke
Euro I	1992	ECE-49	4.5	1.1	8.0	0.612	
	1992	ECE-49	4.5	1.1	8.0	0.36	
Euro II	1996	ECE-49	4.0	1.1	7.0	0.25	
	1998	ECE-49	4.0	1.1	7.0	0.15	
Euro III	1999 (EEVs only)	ESC & ELR	1.5	0.25	2.0	0.02	0.15
	2000	ESC & ELR	2.1	0.66	5.0	0.10/0.13*	0.8
Euro IV	2005	ESC & ELR	1.5	0.46	3.5	0.02	0.5
Euro V	2008	ESC & ELR	1.5	0.46	2.0	0.02	0.5
Euro VI	2013	ESC & ELR	1.5	0.13	0.4	0.01	

*Notes: *For engines of less than 0.75dm^3 swept volume per cylinder and a rated power speed of more than 3,000 min^{-1}.*

TABLE 8.
EMISSION STANDARDS FOR DIESEL AND GAS ENGINES (ETC TEST, g/kWh)

	Date	Test	CO	NHMC	CH_4	NO_x	PM
Euro III	1999 (EEVs only)	ETC	3.0	0.40	0.65 [A]	2.0	0.02 [C]
	2000	ETC	5.45	0.78	1.6 [A]	5.0	0.16 [C]/0.21 [D]
Euro IV	2005	ETC	4.0	0.55	1.1 [A]	3.5	0.3 [C]
Euro V	2008	ETC	4.0	0.55	1.1 [A]	2.0	0.3 [C]
Euro VI	2013	ETC	4.0	016 [E]	0.5 [B]	0.4	0.01

Notes: [A] For natural gas engines; [B] for natural gas and LPG engines; [C] not applicable to gas engines; [D] for engines of less than 0.75dm^3 swept volume per cylinder and a rated power speed of more than 3,000 min^{-1}; [E] THC for diesel engines.

TABLE 9.
EMISSION DURABILITY PERIODS

Vehicle category (maximum technically permissible mass)	Period	
	Euro IV and V	Euro VI
N1 and M2	100,000 km / 5 years	160,000 km / 5 years
N2; N3 <= 16 tons ; M3 Classes I, II, A and B <=7.5 tons	200,000 km/ 6 years	300,000 km / 6 years
N3 > 16 tons; M3 Classes III and B > 7.5 tons	500,000 km / 7 years	700,000 km / 7 years

Annex 2. Global Production of Heavy Trucks, Buses and Coaches

TABLE 10. PRODUCTION OF HEAVY TRUCKS BY COUNTRY (IN UNITS)

	1999	2001	2003	2005	2007	2008
Global Production	**1,928,840**	**2,216,614**	**2,523,632**	**2,980,619**	**3,262,784**	**3,785,534**
EUROPE	**498,383**	**555,498**	**544,204**	**684,362**	**839,143**	**856,772**
A.1 EU-15	418, 719	480,085	457,344	549,502	660,387	662,039
A.2 EU-27					669,600	681,501
B. East and Central Europe	68,816	65,730	69,394*	92,792*	*	*
Czech Republic**	3,004	2,719	2,327	2,044	3,168	2,737
Hungary**	1,307	2,108	2,655	2,473	3,566	3,067
Poland**	831	2232	905	324	2,324	13,381
Romania***	868	333	237	242	155	277
Serbia***	418	560	419	568	420	350
Slovak Republic**	250	158	181			
A. CIS	49,937	57,620	54,387	92,129	134,579	138,471
Russia	36,275	39,612	50,019	65,965	103,932	102,393
Belarus	12,846	15,996	16,856	22,500	25,548	26,291
Ukraine	816	2,012	863	3,664	4,175	9,437
B. Turkey	23,049	9,683	19,041	37,227	34,544	36,800
AMERICA	**625,850**	**416,630**	**419,907**	**686,815**	**588,904**	**551,241**
NAFTA	558,218	331,150	341,037	548,974	405,301	342,873
South America	67,632	85,480	87,870	137,831	186,603	208,368
ASIA-OCEANIA	**804,607**	**1,041,782**	**1,527,930**	**1,582,715**	**1,806,159**	**2,348,711**
Japan	626,023	595,403	772,927	723,663	718,901	734,923
Other countries in Asia-Oceania	178,584	446,379	755,003	859,052	1,087,258	1,613,788
AFRICA	**0**	**12,321**	**15,948**	**26,727**	**28,578**	**28,810**

Source: Compiled by the author with information from International Organization of Motor Vehicle Manufacturers (2007, 2008, 2009).
*Notes: *Included in the production of the EU-15; **One of the EU-25 members since 2003; ***One of the EU-27 members since 2007.*

TABLE 11.
PRODUCTION OF BUSES AND COACHES BY COUNTRY (IN UNITS)

	1999	2001	2003	2005	2007	2008
Global Production	**139,521**	**172,948**	**221,436**	**459,431**	**587,109**	**369,163**
EUROPE	**51,438**	**59,618**	**69,293**	**78,552**	**88,839**	**96,199**
A.1 EU-15	34,779	34,321	34,098	31,033	29,797	31,076
A.2 EU-27				39,635	37,022	39,076
B. East and Central Europe	14,272	22,796	19,941	26,402		
Czech Republic	1,269	1,552	1,785	2,193	3,182	3,496
Hungary	990	1,804	1,123	1,009	479	629
Poland (est.)		1,372	1,373	5,400	3,554	4,572
Romania	78	40	1	0	10	11
Serbia	60	224	162	353	149	360
C. CIS	11,849	17,768	19,778	26,049	36,418	37,869
Russia	11,226	16,633	17,224	21,348	25,604	25,872
Belarus	380	429	480	650	2,160	2,220
Ukraine	243	756	2,074	4,051	8,654	9,777
D. Turkey	2,327	2,501	10,967	12,515	16,250	18,186
AMERICA	**54,395**	**23,728**	**55,036**	**35,988**	**68,270**	**67,470**
NAFTA	38,284		27,943		28,419	21,400
South America	26,111	23,728	27,093	35,387	39,851	46,070
ASIA-OCEANIA	**33,688**	**88,765**	**96,078**	**340,916**	**424,489**	**199,273**
China		59,665	66,700	175,390	344,005	119,888
Other countries in Asia-Oceania		29,100	29378	165,526	80,484	79,385
AFRICA	**0**	**837**	**1,029**	**3,975**	**4,511**	**6,221**

Source: Compiled by the author with information from the International Organization of Motor Vehicle Manufacturers (2007, 2008, 2009).
*Notes: *Included in the production of the EU-15; **One of the EU-25 members since 2003; ***One of the EU-27 members since 2007.*

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