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Logistics Strategies

Project Report

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Contents

Executive Summary

For the automobile industry, which features more complicated supply chain and pioneering technology applications, logistics and technology mutually reinforce and encompass each other. There are different layers of technology trends shaping the logistics of automotive industry with a breadth of applications. Since automotive industry and logistics sector are strongly interconnected, specific trends transforming each, indirectly transform the other. Therefore, automotive and logistics cannot be dissociated in terms of technological progression. In addition to the technological trends in logistics, connected, autonomous, shared and electric (CASE) technologies disrupting automotive, also disrupt logistics. The Turkish automotive industry has been shaped by technological trends in automotive logistics at different levels and Turkey, while supporting automotive industry's transformation with disruptive technologies, should also support the transformation in automotive logistics.

As disruption transforms automotive industry, the geographical organization and the extent of outsourcing within the automotive industry changes depending on different operational and organization set-ups across the globe. New battery technologies in electrical vehicles are driving the main trend in integrating inbound and outbound logistics. Raw material resources and intermediate input production facilities are located far away from Turkey's Global Value Chains network and China, currently accounting for a third of global demand for battery cells, is expected to speed up its expansion and outpace its global competitors. Therefore, Turkey should look out for new opportunities for investment and trade integration with Europe and Asia through further integration to TEN-T and BRI.

OEMs have shifted their investments in assembly plants from core-EU countries to periphery countries within the last ~40 years. While Turkey recorded one of the biggest improvements in overall infrastructure, the extent of its improvement was lagging behind its East European competitors. Automotive giants in Europe such as Germany and the UK have an increasing amount of vehicle logistics risk while Asian giants increasing amount of logistics risks in the automotive industry.

The relatively weak performance of Turkey in logistics creates a sequential impact on the receipt of additional FDI in the Turkish automotive industry's supply chain. The Turkish automotive industry's export flow is mainly concentrated in Europe but still Turkey still struggles to turn this established commercial relations into decrease in logistics cost due to insufficient intermodal transportation infrastructure. Under-developed railway connections to ports and the apparent dominance of road transportation against under developed rail freight transportation system, hinder intermodal transport performance in Turkey. Increasing the capacity utilization of existing ports in Turkey is also important to improve intermodal transportation in and increase competitiveness of the Turkish automotive industry. There are several ongoing investment projects on different modes of transportation in Turkey. The opportunity to connect these modes to OEMs and their routes should be taken into consideration to improve industry-specific connectivity across regions in Turkey.

Introduction

Automotive industry and logistics industry have a unique relationship in terms of the way they interact and transform each other through technological progression. As technology progresses with disruption, the automotive and logistics industries are simultaneously transforming each other through mutually reinforcing triggers. Therefore, in order to prepare and design strategies to comprehensively cope with the disruptive technologies in automotive industry, it is also vital to understand the way these two industries stimulate each other.

Automotive Industry Transforming Logistics:

- Rise in the annual mileage for vehicles of the future in terms of capacity than is the case with traditional vehicle use today, leading to the cars replaced much sooner. This leads to a new logistics structure to provide rigorous efficiency and differentiating offerings.
- M&A mega deals between OEMs and outside competitors such as software start-ups, have increased sharply in order for OEMs to chase their technological capabilities. This will lead to vertically integrated supply chains for both logistics and automotive industry players
- The disruptive trends (CASE) in automotive industry will push OEMs and Tier 1 suppliers toward integrating technologies into and streamlining their operations. This transformation will result in interconnected and horizontal supply chain in logistics.

Logistics Transforming Automotive Industry:

- The future of logistics will evolve into delivery of anything, anytime and anywhere with omni-channel logistics. Therefore, increasing complexity in operations in logistics and cost sensitivity will demand more logistics-oriented solutions from automotive industry's product portfolio
- Autonomous logistics has been on the rise for both air and land transportation solutions. This will lead to the increasing integration of autonomous vehicles and other auto-related techs in automotive industry.
- Fair, responsible and efficient logistics driven by megatrends such as sustainable consumption, digitalization and globalization have become more and more important. Thus, OEMs are expected to focus more on supply chain traceability and transparency.

On the other side, logistics is also an important component of automotive industry's business dynamics as approximately 10% of OEMs' total costs are related to the production and distribution of vehicles. Therefore, logistics costs have important consequences for competitiveness within the automotive industry. However, logistics cost have also very complex sub cost-drivers which can be classified in following main components, exwork & assembly costs, transport costs, packaging costs, customs & duties cost and other logistics cost

- **Exwork & Asssembly Costs:** During the outbound logistics in which the shipment is made from the production facility towards the final destination, in certain cases the assembly of the vehicle continues as the shipment is being made. Therefore, these additional costs emerging within the outbound logistics are classified as exwork & assembly costs.

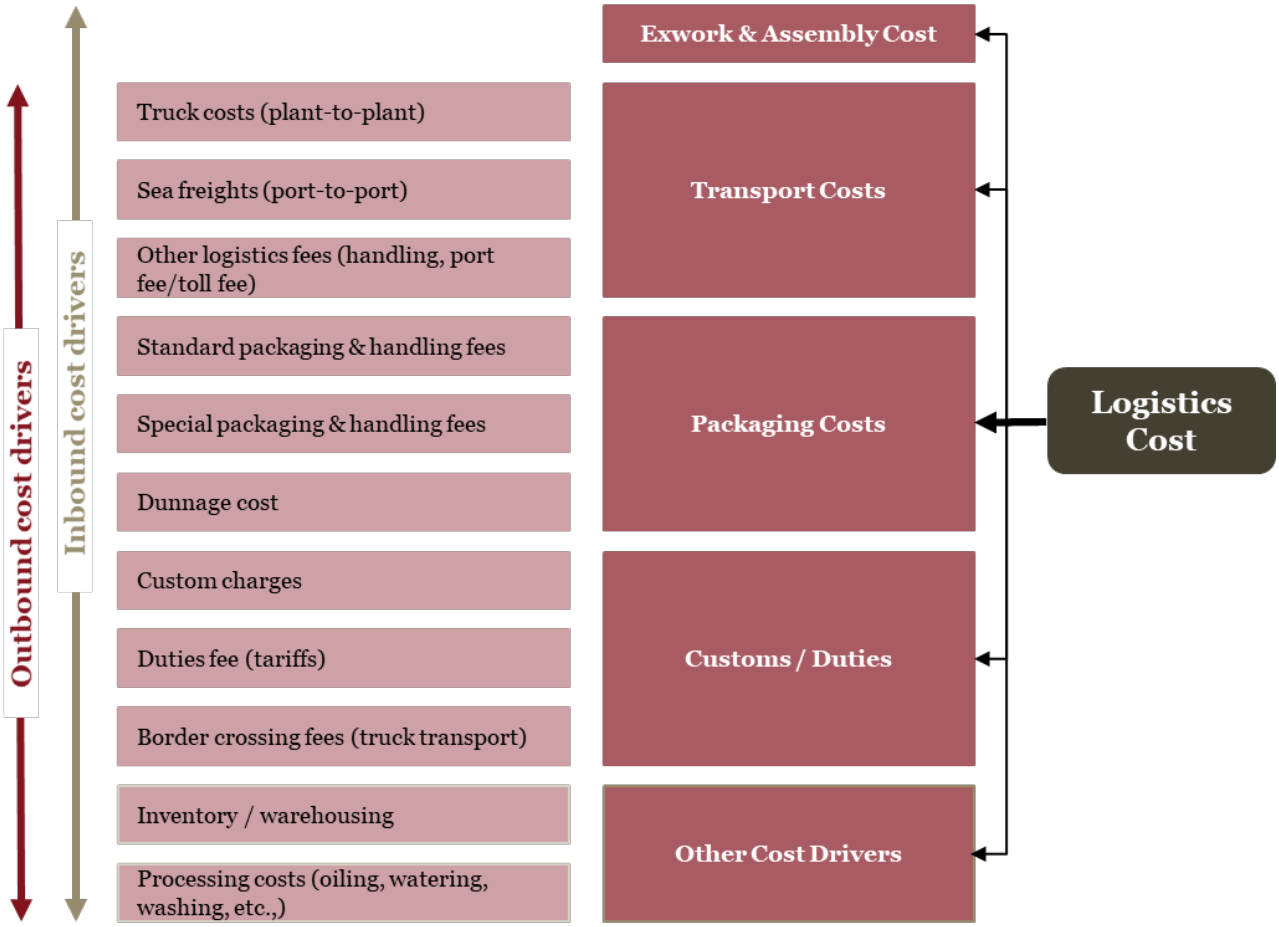
- **Transport Costs:** Transport costs are the most recognized cost driver in logistics operations in all industries. These costs include truck costs, freight transportation costs, fuel costs, port handling costs and etc.

- **Packaging Costs:** Packaging costs include protection costs to protect vehicles from damaging during the shipment. Standard and special packaging techniques, handling fees and dunnage costs make up the packaging costs in the automotive industry.

- **Customs & Duties:** Since automotive industry is highly integrated to global value chains, customs and duties costs emerging in international trade are an important consideration for automotive industry players' supply chain management and investment strategies. This component mainly includes custom charges, tariff and border crossing fees.

- **Other Cost Drivers:** All other sub-cost drivers which are not classified in any of the titles above are classified in this component. These include inventory & warehousing costs, processing costs like oiling, watering, washing and etc.

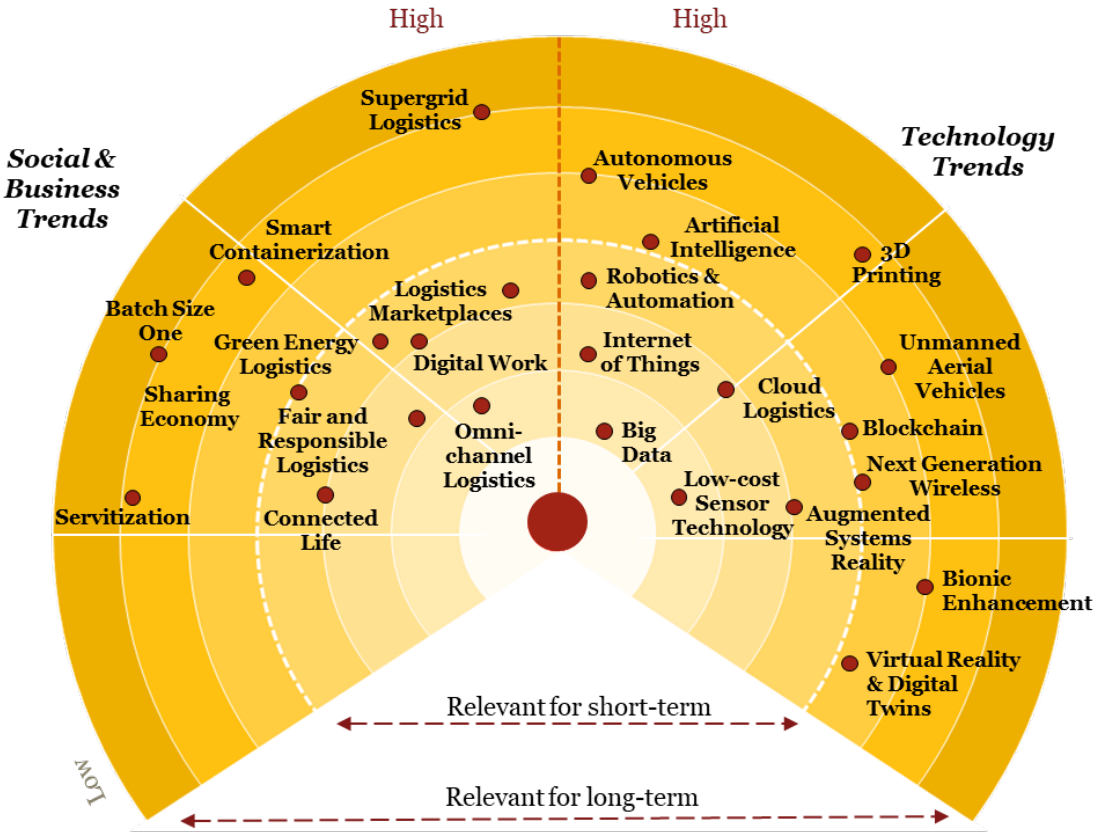
Figure 1: *Logistics Cost Structure for Automotive OEMs*



1. Logistics Technologies

Main technological trends which transform almost all industries also transform the logistics industry. Among these trends, blockchain, Big Data, IoT, and cloud logistics are of particular importance. As these trends have already started to transform the automotive industry radically with connected, autonomous, shared and electric vehicles, they will also indirectly intensify this transformation through disruptions in logistics industry. New cost reduction methodologies will arise, lead time reductions will happen, new delivery modes and business models will show up and create new ways of doing business in both automotive and logistics industries. Therefore, along with the technological trends, social & business trends will also influence the future of automotive logistics. However, the implications of these trends will come forward in different time intervals and it is important to have and understanding of short-term and long-term relevancies of these technologies.

Figure 2: *Logistics Trend Radar with Selected Technologies for Automotive Industry, 2018/19*



Companies not only in automotive industry but across many different industries have also been transforming their traditional supply chain planning model into an integrated form of supply chain model. As a strongly inter-connected concept with supply chain, logistics will also need to respond to the transformation in supply chain management models. In the transition from traditional supply chain model to integrated supply chain model, radical changes come along in terms of transparency, synchronism, extendibility & cooperativity and flexibility.

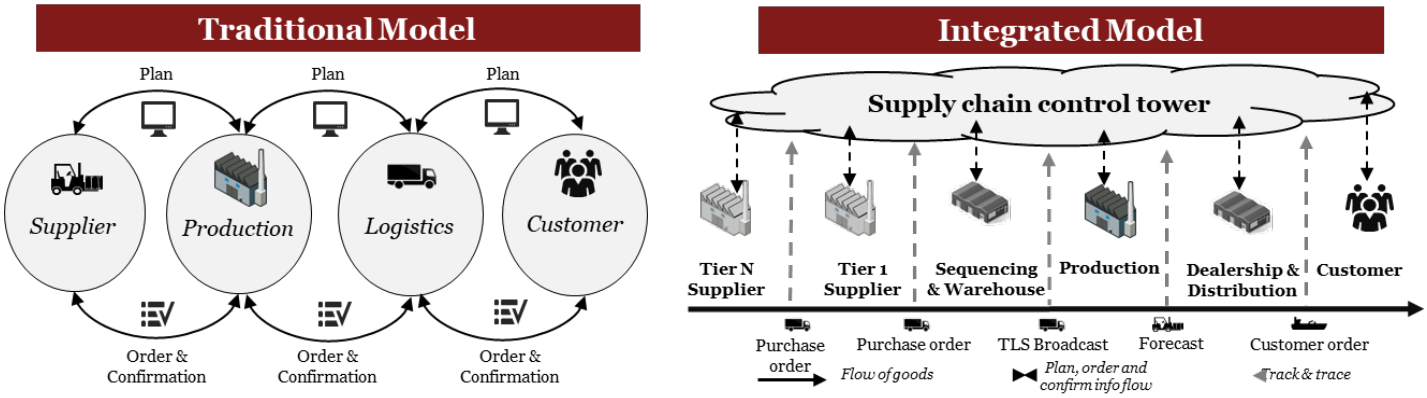
- **Transparency:** Limited visualization of supply chain has started to turn into a completely transparent supply chain panorama.

- **Synchronism:** Information used to be transferred with delays among supply chain parties but with the integrated model, information for all members in the chain have started to be transferred simultaneously.

- **Extendibility & Cooperativity:** Traditional supply chain model used to prevent parties from having multilateral relationships as they could only form unilateral and bilateral relationships. However, the integration along the chain has led to a deepened cooperation and started contributing to more internal value of supply chain.

- **Flexibility:** As extendibility and cooperativity were more limited in traditional supply chain model, it was harder for the chain to show agile responses to changing customer needs. However with the integration of the chain with a supply chain tower, the chain has become more agile to the demands of customers in the end.

Figure 3: *Traditional and Integrated Supply Chain Model Comparison*



2. Disruptive Technologies of Automotive Industry & Logistics

In order to be more specific to examine the interaction between logistics and automotive industries and understand the impacts of disruptions happening in automotive industry on logistics industry, CASE framework, which stands for connected, autonomous, shared and electric, should be applied to logistics industry. All disruptions lead radical changes, and with respect to the readiness of different parties to the disruption, disruptions create new winners and losers in the ecosystem. As the dynamics in automotive industry is expected to change fundamentally, logistics industry will also respond to these disruptions.

For **Connected Transportation:**

- **Changes:** Digitization of every moment that logistics is active in automotive and new tech-driven services such as vehicle availability, tracking, smarter maintenance, high system reliability, increased customer satisfaction
- **Readiness:** Easily integrable to existing system landscape in the industry and the transformation is known to be inevitable for autonomous trucking
- **Winners:** Digital tech firms and OEMs penetrating connected car services and technologies into their business
- **Losers:** Auto makers and suppliers unable to compete with new players, including technology companies

For **Autonomous Trucking:**

- **Changes:** Across-the-board cost savings of ~30 % beyond 2025, potential to render trucking operations more efficient, ecosystem surrounding driver-based trucking may change (i.e. roadside amenities and services)
- **Readiness:** Most likely to be widely adopted over short-to-medium term but regulatory provisions around system as driver needed
- **Winners:** Suppliers with compatible built-in capabilities/facilities and OEMs involved in tests and trials being conducted on highways
- **Losers:** Total (eventual) replacement of drivers – substantial job losses for workers in locations with significant port operations, and OEMs that do not participate in commercial trucking may be squeezed out

For **Shared / On-Demand Logistics:**

- **Changes:** On-demand business model will change supply & value chains and competitive price set not only for the distance but also the properties of the package to be carried, size, weight and others
- **Readiness:** They will not face too restrictive regulations and regular shipment contracts will protect the market share of big players
- **Winners:** It will catalyze the digitalization of channels for booking, tracking & payment and Irregular shippers and small manufacturers will benefit
- **Losers:** EBIT margins have already been low, will go down further and market players with high capital investment will face bankruptcy

For **Electric Freight Transport:**

- **Changes:** The vehicle that carries and the vehicle that is carried and, cost structures and profit margins of the industry will change
- **Readiness:** Global charging infrastructure readiness is a question mark and emission regulations and government incentives will be important
- **Winners:** The atmosphere will benefit with the reduction of gas emissions, reduced spending on maintenance and fuel will be profitable for both logistic providers and demanders
- **Losers:** Traditional manufacturer sticking to ICE trucks and traditional logistics providers not converting their fleets in the long term will lose

New solutions and models brought by disruptive technologies to logistics industry have boosted the importance of outbound logistics in many industries. As supply chain models have started to transform into integrated models with supply chain control towers, inbound logistics has managed to renovate its structure. For automotive logistics, inbound logistics has traditionally been an important area but this focus is currently shifting towards outbound logistics.

Inbound Logistics:

- With emergence of low cost country (LCC) manufacturing, raw material got shipped to the country with lower labor and production costs.
- Countries with availability of raw material got shipped to the country with lower labor and other infrastructure leap-frogged into manufacturing of goods.
- In this process, inbound logistics networks were enhanced with IT and infrastructure support.
- OEMs from different regions in the world incur significant tough varying level of costs (as percentage of their sales)
- The new thinking around manufacturing is lowering cost arbitrage of LCC. Hence, leverage of US and Mexico as export bases is emerging as an approach among certain Japanese and European OEMs.

Outbound Logistics:

- Over the course of time, the industry has realized that outbound logistics would also need equal attention and investments in order to enhance the overall supply chain.
- Manufacturers adopt postponement approach to make finer value addition almost at the end of the logistics value chain and as close to customer delivery as possible.
- Outbound logistics is an important part of the supply chain to manage demand fluctuations and optimizing costs through standardization of core manufacturing processes.
- Managing the logistics involved in moving finished vehicles from factory to dealers requires an extensive transportation and intermittent storage network.
- The outbound logistics process involves a large number of entities. Vehicles are constantly changing hands (and ownership) at various places and transportation modes.

Disruptive technologies, changing business models and evolving automotive industry products have one simple common implication for both inbound and outbound logistics, what is carried by the logistics services changes. Battery electric vehicle (BEV) volumes are increasing and OEMs begin setting up new factories and dedicated assembly lines or renewing existing factories and assembly lines to enable BEV production. Asia is the region with the highest expected growth in BEV sales and lithium-ion battery production capacity, especially in China. This makes a clear business case for setting up BEV factories in Asia. Therefore, with the disruption in automotive industry, the routes where the logistics industry serves also change. Electrification of automotive fleets increases the centralized production in Asian automotive facilities. As DHL highlights that ‘these relatively centralized production setups reduce complexity of inbound flows; however, they also lead to increased logistics complexity and cost in outbound flows as well as to higher lead times compared with a more decentralized production setup.

Investors who have had the foresight to invest in lithium-ion battery production are well-positioned to benefit from emerging trends that are changing trade patterns and re-shaping automotive industry and logistics. As the manufacturing of electric vehicles is expected to accelerate in the near future, investments in lithium-ion battery production have also accelerated. Tesla's Gigafactory in Nevada will be the largest investment of lithium-ion battery production. When construction is completed, it will produce lithium-ion batteries for Tesla Model S and Model 3 and it will singularly enlarge lithium-ion battery industry turnover by 5% between the years 2016-2021. According to predictions, the number of electric vehicles will exceed the number of ICE vehicles in US in 2030. That is the reason why suppliers in the industry need to attach importance on innovative technologies such as lithium-ion battery in the long-run. Among the reasons for the increase in imports of battery from APAC in 2016, there are investments of giant manufacturers who are moving production from the US to the APAC region. For instance, Johnson Controls Battery Group Inc. plans to double the battery production capacity with recent investments to China until 2020.

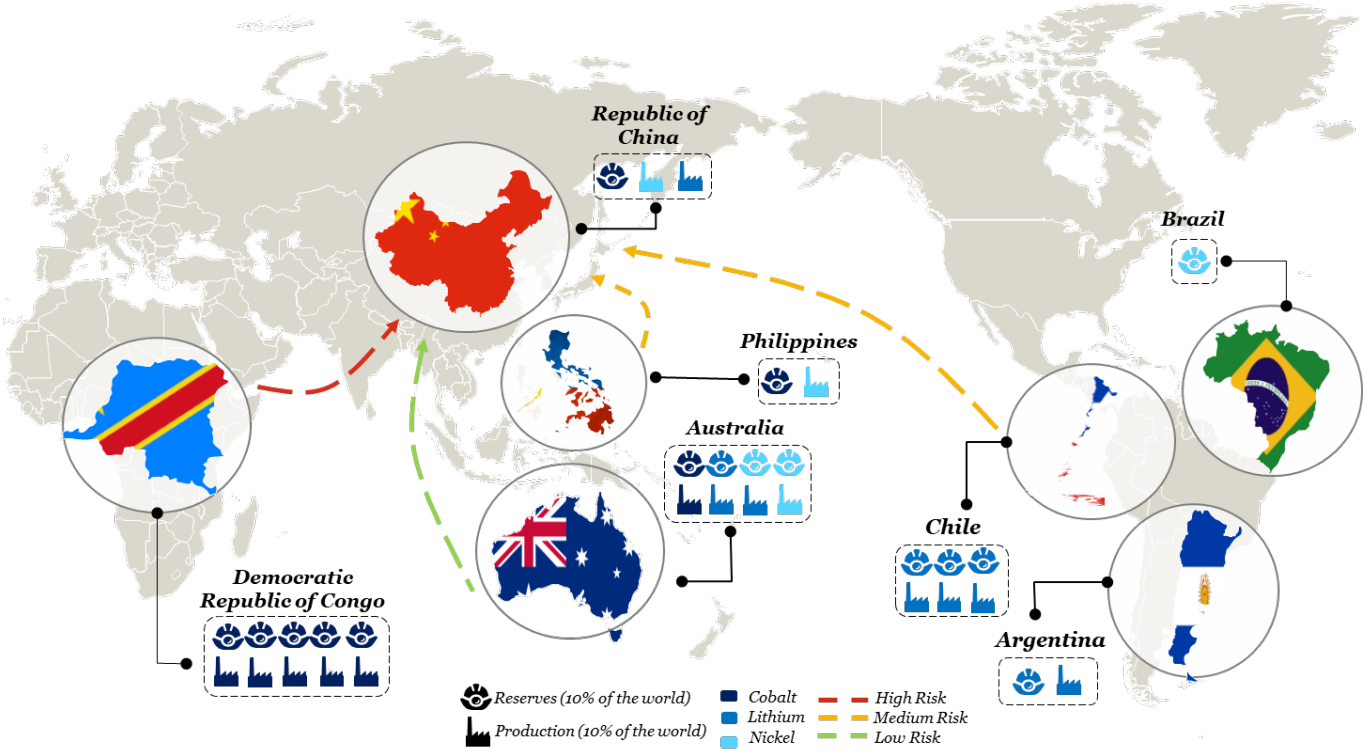
However, li-on battery packaging logistics is more complex than conventional automotive logistics, and therefore automotive inbound logistics needs to adapt to the new supply chain. BEV batteries are large in size, heavy to easily carry, sensitive to environmental changes and damages, classified as dangerous goods and subject to strict safety regulations. Because of these reasons, inbound logistics cost of BEV batteries is high. Therefore, is expected that BEV factories and battery factories will be co-located. The all-electric SUV announced by Audi for 2018 is produced in Brussels, Belgium in a partnership with LG Chem and Samsung SDI. There is a dedicated battery assembly facility in Brussels, where battery casing is build, cell modules are installed etc. And once the vehicle's technical and power unit are fully assembled, the battery system is installed in a timely and automated manner. Even so, battery logistics still carry risk of explosion. There are some possible causes for explosion of BEV batteries.

- **Overcharging / Overcurrent/ Short current:** Thermal interrupter is used to mitigate the risks occurring in such circumstances
- **Internal Pressure:** Tear-away tabs are used to regulate internal pressure
- **Overheating:** Shut-down separators are being used to halt the system in overheating
- **Fire fueled by oxygen generated at electrodes:** Different type of electrode materials are being experimented to absorb the potential risks caused by the fire

On the other hand, regular inspections are required to avoid other safety hazards such as chemical leak, and li-on NCA is expected to be substituted with li-on nano phosphate batteries as technology enables.

Changing powertrains in automotive industry means new raw materials to be supplied to the factories for productions. As the new powertrains and batteries for the xEVs are examined, it is founded out that importance of raw materials such as lithium, cobalt and nickel has risen sharply. Moreover, the reserves of these elements are actually far from the global value chains of traditional automotive industry. Majority of global cobalt reserves are located in Democratic Republic of Congo, Argentina, Chile and Australia hold reserves for lithium and Brazil, Philippines and Australia have nickel. On the other hand, major routes for the transportation of these elements are directed towards Far East. In these new emerging routes passing through territorial waters of developing economies, factors like global political risk become more important for the industry. Major access-to-resource routes from Africa are still perceived as high risk, while another major route from South America crossing the Pacific Ocean is regarded as medium risk while the connection between Oceania and China is seen as the safest. However, besides the political status-quo within the aforementioned regions, it is more important to realize that this network is moving far away from the current production network of automotive industry. As many OEMs have already taken action in advance to set up new networks for the upcoming disruption, countries, particularly developing economies, in which automotive industry is dominant, will be more susceptible to the shifts in the automotive value chain.

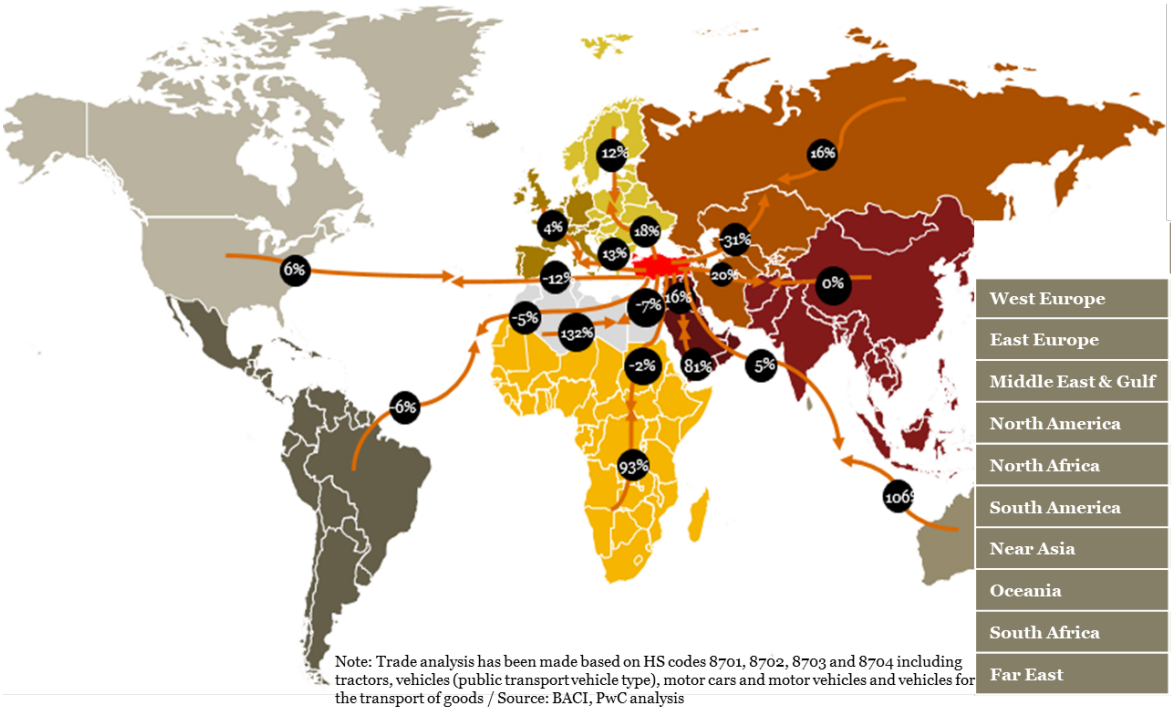
Figure 3: *Raw-Material Suppliers and Transport Network Risks on EV Battery Value Chain*



3. Turkey's Logistics Competitiveness

Turkey is one of the economies which will be affected by the disruptive technologies in automotive industry. Total exports of automotive industry in 2018 have reached $20.9 billion, covering 12.9% of Turkey's global exports, making it the biggest exporter industry. When Turkey's exports are decomposed to destinations, Europe shines out as almost 85% of Turkey's all automotive exports are made to European countries. However, vast majority of Turkey's automotive production is focused on traditional vehicles, powered by internal combustion engines. With disruptive developments in Europe, new central policies are designed in these countries to stimulate local demand to electric vehicles and this results in more vehicles sold in xEVs and more saturated sales for ICE powered vehicles. In the long run, this is expected to result in a significant mismatch between Turkey's production capabilities and local demand in Turkey's major export markets. Besides, when Turkey's intermediate automotive product imports are studied, it is seen that Turkey has weak global value chains connectivity to the networks in which supply chains for xEV production are established. Turkey's intermediate product imports from the rising origins such as Far East, Africa, Oceania and South America are almost negligible. This means, in addition to implementing industrial policies to develop new competencies for the production of batteries, powertrains and other intermediate products for the xEV value chain, Turkish logistics industry should support the automotive industry with increasing connectivity to the rising networks.

Figure 4: *Turkey's CBU Export and Import in CAGR (%, 2012-2016) and Regions' Share in Turkey's Export and Import in %, 2016*



	Turkey's export	Turkey's import
West Europe	69.2%	63.2%
East Europe	17.7%	16.9%
Middle East & Gulf	4%	0.1%
North America	3.1%	1.4%
North Africa	2.5%	4.7%
South America	1.1%	2%
Near Asia	0.8%	0%
Oceania	0.6%	0%
South Africa	0.5%	3.4%
Far East	0.4%	8.2%

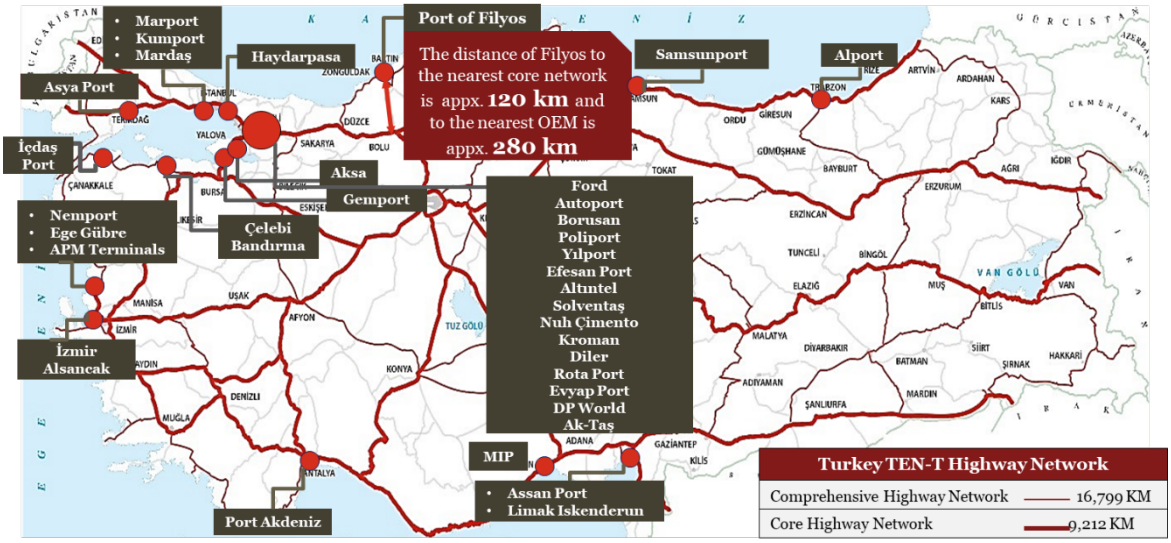
Note: Trade analysis has been made based on HS codes 8701, 8702, 8703 and 8704 including tractors, vehicles (public transport vehicle type), motor cars and motor vehicles and vehicles for the transport of goods / Source: BACI, PwC analysis

International connectivity is an important aspect for the global competitiveness of logistics industry. As Turkey's automotive logistics competitiveness is investigated in the global context, it can be observed that almost all OEMs in Turkey are located on TEN-T core highway network which connects Turkish industries to Europe through highways. Since majority of OEMs in Turkey are export-oriented towards Europe, they are mainly located in Marmara region although there are also some OEMs located in Central Anatolia and Mediterranean region.

Figure 5: *Turkey TEN-T Highway Network by Network Categories and Their Total Length, 2017*

However, Turkey's international connectivity should not be limited with highway networks. Sea transportation is an important mode of transportation in automotive logistics. Marmara region is a concentrated region in terms of ports. There are tens of different ports which are international trade oriented and act as a gateway for Turkey in international trade. It can be seen that many OEMs which generate majority of their revenues from exports to Europe, are placed at locations accessible to these ports. These ports are also located close to TEN-T highway network and thus, Marmara region functions as Turkey's export hub to Europe.

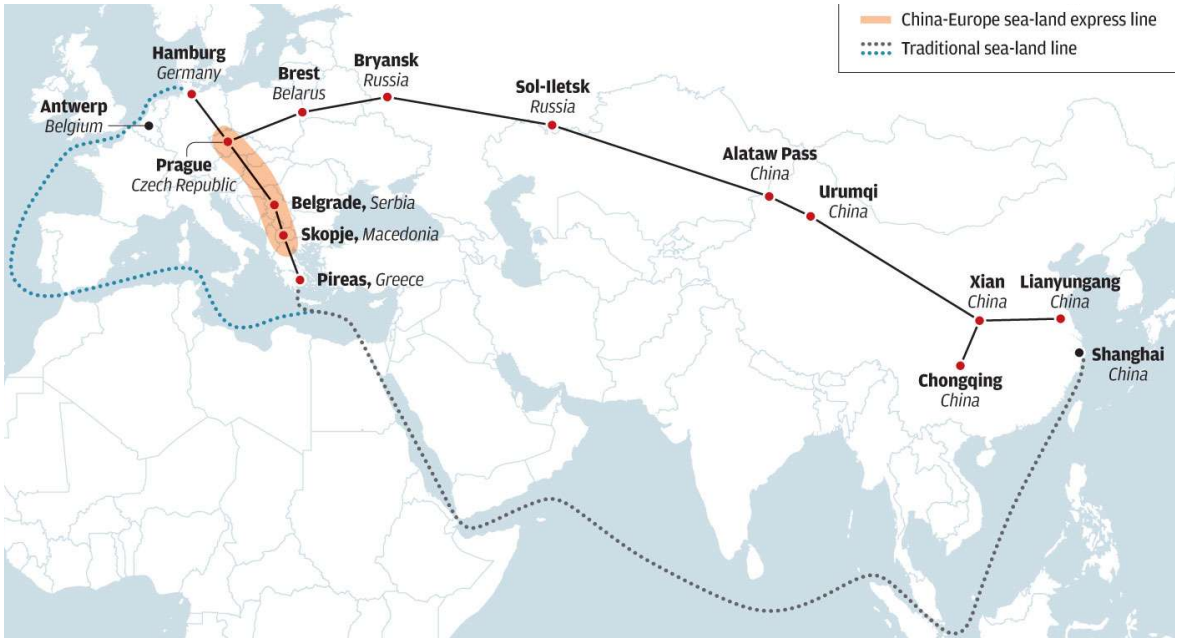
Figure 6: *Selected Container Terminals in Turkey*



Yet still, there are some port infrastructure investments for regional development purposes which would not increase Turkey's international connectivity further since these regions do not have developing industrial hinterlands. For instance, the distance of Filyos port to the nearest core network is approximately 120 km and to the nearest OEM is approximately 280 km. The case is also similar for Çandarlı port investment. Different from this strategy, port infrastructure investments should aim to increase export-orientation and international connectivity of regions which have mature or developing industrial capacities, instead of aiming at industrial development from the bottom with high-budget port investments.

On other half of the world, in Far East, China is shifting the gravitational center of world economics. After the declaration of Open Door Policy in 1978, China has shown an industrial leapfrogging and the country has become the key provider in international trade with inexpensive labor force and vast production capacity. However, in recent years as wealth of the nation has increased, cost of production in China has also increased. Thus, with central policies, China has decided to increase the technology content in its production portfolio and also extend the capacity of its international trade volume. In order to accomplish the goals aligned with these policies, China has designed an economic corridor spanning whole Eurasia, from China to West Europe, which is called Belt and Road Initiative (BRI). In the initiative, numerous infrastructural projects including highway, railway and port construction, are initiated by Chinese finance. However, these investments flowing to Turkey's region is currently bypassing Turkey as Turkey is not included China's 16+1 Initiative in Eastern Europe and Balkans which aims the development of a corridor connecting Piraeus Port to industrial centers of Europe. Up to now, only Kumport is financed under BRI, however the port is expected to become a logistics hub for Chinese container ships travelling to Black Sea region. Turkey has not yet obtained a role to become a logistics hub on Europe-China axis. If Turkey does not undertake an active role in the initiative, Turkey's geopolitical influence will be negatively affected. Turkish ports should involve in such economic corridor initiative complete the road and railway connections on its East-West axis in order to propose a competitive logistics route for international trade on Europe-China axis. In this way, Turkey should expect to strengthen its forward and backward connections with value chains of Asian markets.

Figure 7: *China's Belt and Road Initiative and Selected Economic Corridors under the Initiative*



In the modern logistics, another factor is becoming dominant for logistics connectivity, intermodality. Intermodal transportation is the use of two or more modes, or carriers, to transport goods from shipper to consignee. Special standardized containers are used for intermodal transport of cargo on trucks, freight trains, and ships. In Turkey only very few ports have railway connections to terminals and railway lines are rarely used for international trade. Many OEMs also lack of railway lines connecting their production facilities to ports. Thus, they have chosen locations with dense highway connections. Despite the intermodal infrastructure is not mature enough, Turkey's geopolitical advantages still make Turkish companies competitive in terms of logistics. However, in order to unlock the potential of the country's geopolitical position in international trade, Turkey should also support its industries with increasing intermodality in Turkey's logistics infrastructure.

Figure 8: *China's Belt and Road Initiative and Selected Economic Corridors under the Initiative*

Regarding all factors that contribute to Turkey's logistics competitiveness in global and local landscapes are captured in World Bank's studies for logistics performance. Turkey's LPI score and ranking have slightly deteriorated in the recent years but still the country performs better than regional averages. Yet still, Turkey has shown improvements in many fundamental areas of logistics capabilities. Programmed investments and completed projects in the last 10 years have become observable in these scores as infrastructure comes forward as the most improved area under Turkey's overall LPI score. However, on the other hand, customs procedures remain as a barrier against Turkey's logistics competitiveness as some heavy procedures applied to some countries for national security, rising from regional geopolitical dynamics, also affect the overall performance of the customs. This problem is scaled up with the logistics competence of the workforce in the sector. Thus, due to such dynamics, although it manages to remain slightly over the regional averages, Turkey lag behind in European top performer like Germany.

Table 1: Turkey's LPI Score over the years

Criteria	2007	2010	2012	2014	2016
LPI Rank	**34**	**39**	**27**	**30**	**34**
LPI Score	**3.15**	**3.22**	**3.51**	**3.50**	**3.42**
Customs	3.00	2.82	3.16	3.23	3.18
Infrastructure	2.94	3.08	3.62	3.53	3.49
International Shipments	3.07	3.15	3.38	3.18	3.41
Logistics Competence	3.29	3.23	3.52	3.64	3.31
Tracking & Tracing	3.27	3.09	3.54	3.77	3.39
Timeliness	3.38	3.94	3.87	3.68	3.75

Figure 9: *Turkey vs. Top Performer Germany, 2016*

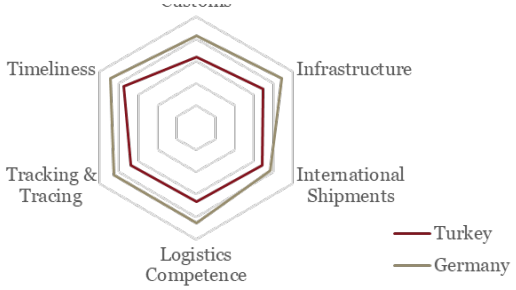
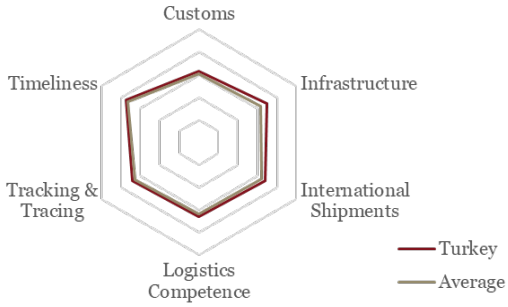
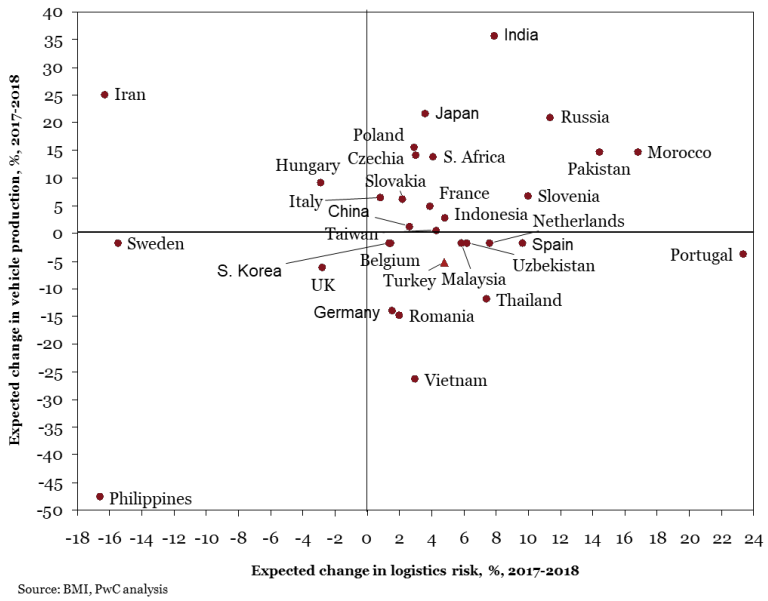


Figure 10: *Turkey vs. Europe & Middle East 2016*



Turkey's geopolitical issues, affecting not only country's foreign policies but also its sectoral logistics attractiveness. According to BMI (Business Management Institute) Logistics Risk Index which assesses the level of supply chain risks, focusing on transport network, trade procedures, governance, market size and utilities of countries, Turkey appears to have increasing logistics risk in the automotive industry. One of the main reasons behind the situation is that Turkey's competitors in the industry are either developed economies of the West or high performing developing economies. On the other hand, Asian giants, Japan, China and India, which have started to implement sharpest policies to realize the disruptive transition in the automotive industry, are expected to perform better than their European counterparts in terms of logistics risk.

Figure 11: *Change in vehicle production and logistics risk of selected European and Asian countries*

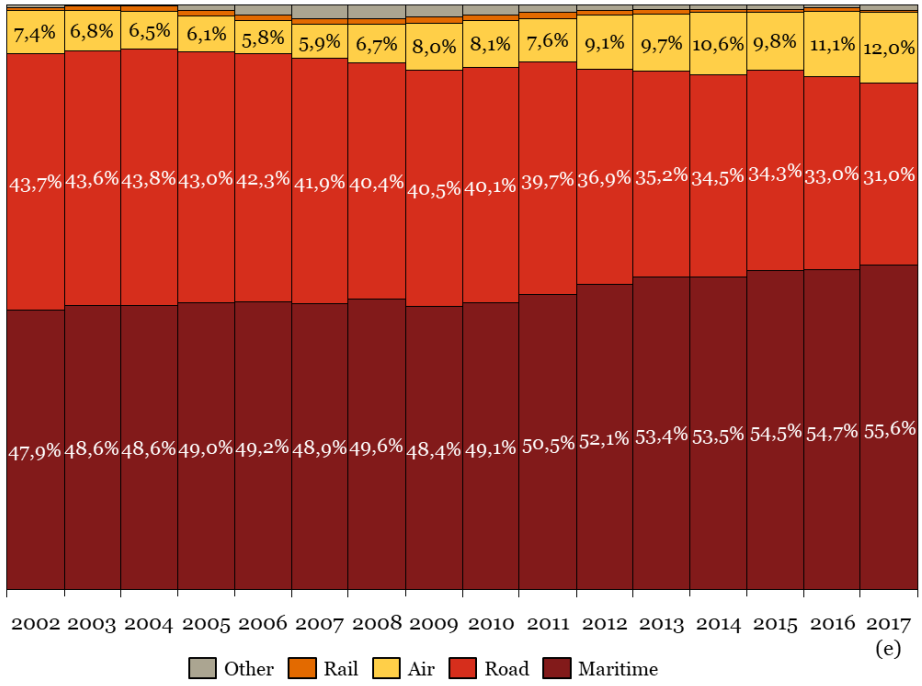


Source: BMI, PwC analysis

4. Turkey's Logistics Infrastructure

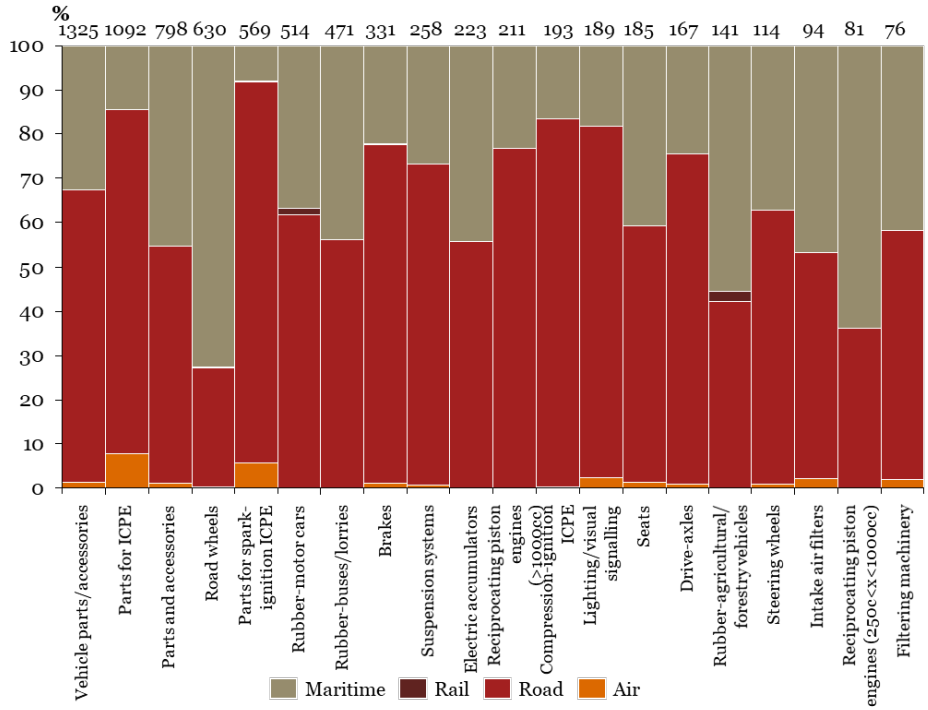
In the status quo, Turkey's global competitors in the automotive industry are not primarily Western European countries or Asian giants but the countries which export to European markets. Therefore, Turkey's logistics competitiveness in the global automotive industry is primarily driven by its export capabilities to main destinations. When Turkey's modes of exports are investigated over the last 15 years, it can be seen that modes of transport have slowly shifted in the past decade with increases specifically in maritime and air transport but still land transport's and maritime transport dominate Turkish exports mode of transport. However, with increases in maritime and air transport, the share of land transport has decreased considerably, down from 44% in 2002 to 31% in 2017. However, railroads remain as the main improvement area in Turkey's logistics capabilities. Turkey's main competitors, developing economies of Central Europe and Eastern Europe, such as Czechia, Slovakia, Romania and Poland, have strong railroad connections to Western European countries. Majority of production facilities have railroad capillaries passing through the facility. On the other side, Turkish exports are liged to use intermodal transportation modes as maritime transport is the main mode of transport for Turkey's CBU (Completely Built Unit) exports. Therefore, Turkey's CBU exports have foreign logistics value add since intermodality is provided by European ports importing Turkey's CBUs.

Figure 12: *Distribution of Turkey's total exports by mode of transport, 2002-2017*



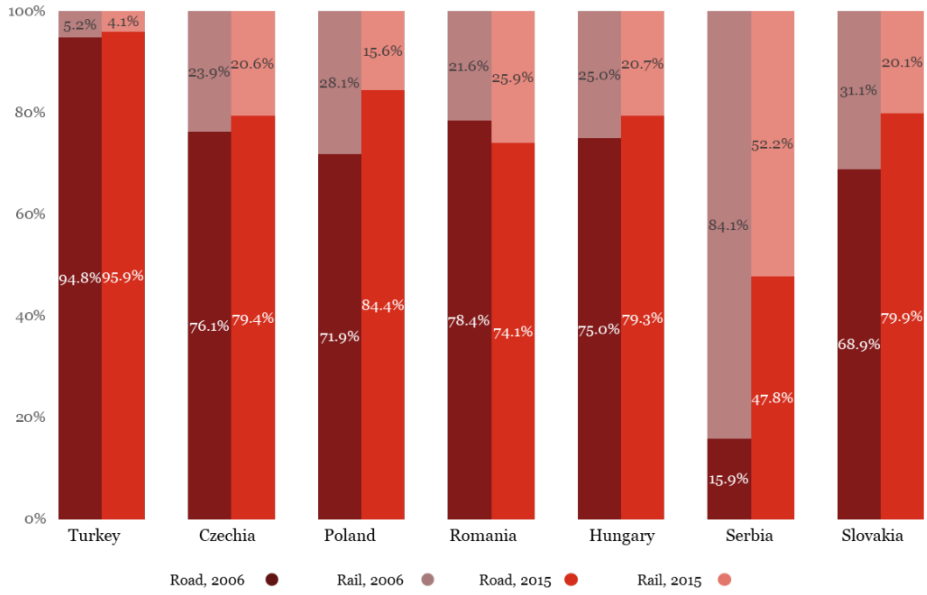
As for Turkey's automotive parts and components exports, road transport is preferred as the main mode of transport. Vehicle parts and accessories; in heading no. 8708 is the part and components with the highest volume of export by Turkey. %66 of these vehicle parts and accessories in value are exported by road transportation, followed by %32 by maritime transportation. The top 20 parts and components exported by Turkey are mainly dependent on road transportation except for road wheels and reciprocating piston engines of a cylinder capacity exceeding 250cc but not exceeding 1000cc.

Figure 13: *Distribution of Turkey's total exports by mode of transport, 2002-2017*



Dominance of road transport is a genuine for Turkey's CEE (Central and Eastern European) peers, as well. However, for CEE countries, rail transportation make up more than 20% of all land transportation, while this ratio is less than 5% for Turkey's land transportation. Road dominant transport results in high transport costs due to poor intermodal transportation. Under-developed railway connections to ports hinder intermodal transport performance. Only Evyap, Bandırma, Derince, Tekirdağ, Yılport Yarımca and Haydarpaşa ports have railway connections in Marmara Sea, Turkey. Interfaces such as well-functioning port-hinterland connections, connections between major railways and manufacturing sites are essential in maintaining competitive transport networks.

Figure 14: *Distribution of Turkey's total exports by mode of transport, 2002-2017*



European Port Survey, evaluates ports through the assembly services offered in addition to finished vehicle logistics. In 2016, Turkey had 7 ports included in the Survey, which was the highest number for any single country. In terms of automotive CBU exports, Turkey ranked 5th among the countries included, and 7th in terms of CBU export per port. However, none of the Turkish ports was ranked in the top 20 in terms of CBU exports, indicating automotive exports from Turkey are distributed across multiple ports. Whereas this finding may be interpreted as availability of viable alternative ports for OEMs, it also emphasizes that there is no single port in which Turkish automotive industry can benefit from economies of scale for reduced costs. Meanwhile, two countries, Slovenia and Greece, with one single port, act as a gateway for European Union borders. Unlike Turkish ports in Marmara Sea, these ports exploit the economies of scale. In addition, although Slovenia and Greece are not automotive producer countries, Port of Koper in Slovenia and Port of Piraeus in Greece are in the list of European ports ranked by the number of CBUs handled and they are ranked higher than the highest ranked Turkish port in the list. On the contrary, Turkey is the 5th largest exporter of vehicles in its neighbourhood and 7th largest exporter of vehicles per port, but its largest port is ranked outside of the top 20 in terms of handling volume. Therefore, handled CBU per port in the Turkey's listed ports is only one third of Port of Koper's.

Table 2: Country-Level performance in European Port Survey, 2016, Handled CBU Export Volume

Country	# of Ports included	Exported CBUs (000)	Export CBUs per Port (000)	% of Total CBU Exports	Highest Ranked Port (1-44)	Lowest Ranked Port (1-44)
Germany	3	2,942	981	25%	2	16
Belgium	3	2,076	692	17%	1	37
Slovenia	1	505	505	4%	9	9
Spain	6	2,105	351	18%	7	35
UK	5	1,357	271	11%	4	14
Greece	1	266	266	2%	21	21
Turkey	7	1,145	164	10%	22	42
Italy	5	664	133	6%	13	41
Netherlands	3	370	123	3%	11	36
France	2	185	93	2%	25	34
Sweden	2	166	83	1%	30	40
Denmark	2	152	76	1%	20	39
Portugal	1	71	71	1%	33	33
Poland	1	1	1	0%	43	43
Finland	1	-	-	0%	38	0
Russia	1	-	-	0%	44	44

This situation results in low capacity utilization ratios in Turkish ports. According the statistics provided by Port Operators Association of Turkey (Türklim), capacity utilization rates for Turkey's biggest CBU handling port for exports and third biggest CBU handling port for exports operate with less than 60% of their capacities. For the other three of Turkey's top 5 CBU handling ports, capacity utilization ratios are at around 80%. When the capacity utilization rates for these ports are compared to the capacity of parking area in their hinterland, it is shown that capacity utilization of ports in Turkey is relatively inadequate due to insufficient investments in parking areas. Borusan Port and Gemport have larger areas within their hinterland, compared with Ford Otosan Port, Efesan Port and Autoport but their parking area are smaller than the three ports. This leads small parking areas to become bottleneck for export capabilities provided by these ports.

Figure 15: *Capacity Utilization vs. Parking Area*

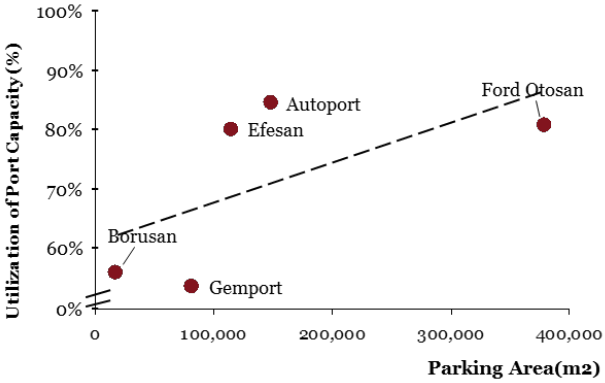
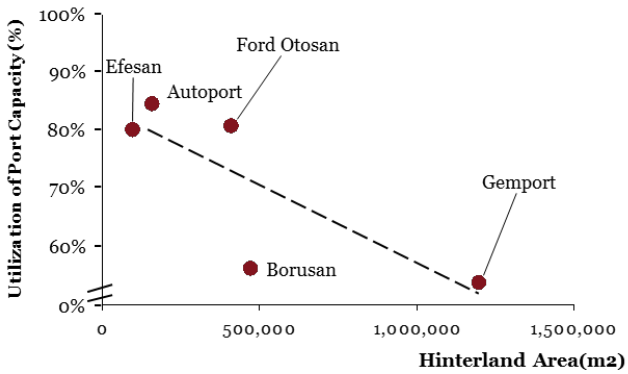


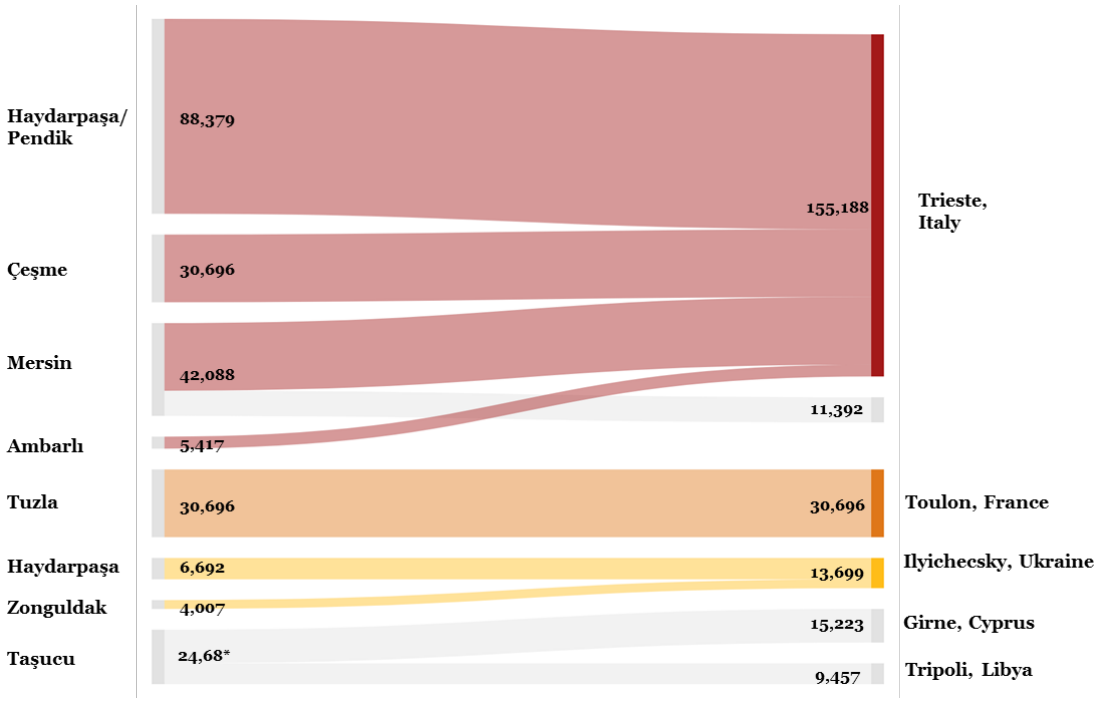
Figure 16: *Capacity Utilization vs. Hinterland Area*



* Capacity information for Safi Derince Port was not used due to the outdated nature of data

As misguidance in the strategic planning of ports lead to bottlenecks in Turkey's international trade gateways, bilateral and multilateral connectivity of Turkish ports to international trade hubs are also significant Turkey's export capabilities. However, amongst Turkey's top automotive export markets, it is only Italian and French ports that have Ro-Ro (Roll-on Roll-off) connections with Turkish ports. Ro-Ro ships are ferries designed to carry wheeled cargo, such as cars, trucks, semi-trailer trucks, trailers, and railroad cars, that are driven on and off the ship on their own wheels or using a platform vehicle. They substantially facilitate intermodality required in maritime transportation. Around 60% of all Ro-Ro exports are targeted to Port Trieste of Italy. Turkey has Ro-ro connection with countries which are not Turkey's target automotive export markets, pointing out that the Ro-ro connections are commonly used for intermodal transport.

Figure 17: *Turkey's vehicle exports on Ro-Ro lines, 2016*

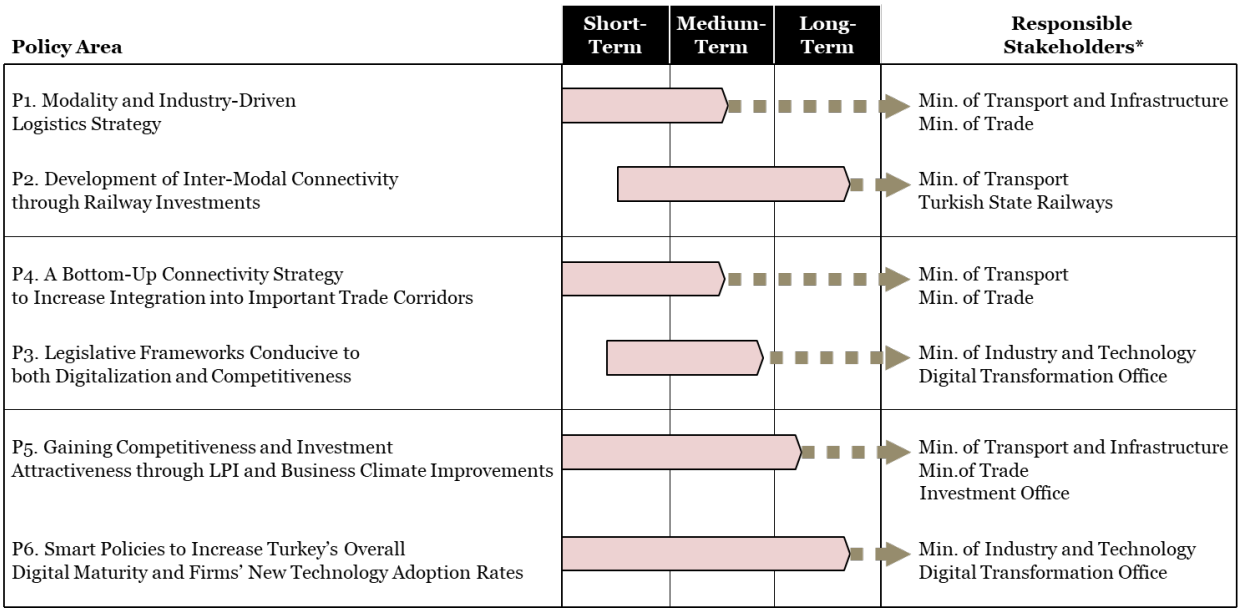


5. Policy Recommendations

Logistics is one of the key enabler factors for all industries to function properly in a commercial ecosystem. Therefore, a strong logistics infrastructure and a strong logistics industry operating the links between the industries are very important for economies. Moreover, for a country like Turkey drawing its strength from its geopolitical position, one should maximize the logistics advantages provided to both local and national investors, to become more attractive as an economic hub. In order to sustain competitiveness, policy makers should design industrial policies to prioritize logistics improvement in Turkish industries integrated to global value chains. Considering automotive industry's dominance in Turkey's economy and its strong linkages to global value chains, automotive logistics steps forward as an important concept for decision makers.

Policy areas to improve Turkey's automotive logistics competitiveness, themselves being associated with long-run effects, should be implemented from the immediate short-term onwards. In Turkey, there is still no sector specific modality strategy or logistics master plan. Therefore, Ministry of Trade (MoT) and Ministry of Transport and Infrastructure (MoTI) should collaborate on the design of sector specific strategies for logistics and transportation infrastructure. On the other hand, strategies to strengthen logistics at national level should be enhanced with a bottom-up connectivity strategy to increase integration into important trade corridors. This should also be linked to Turkey's national investment attraction strategies and Investment Office should also be involved in the design of policies to gain competitiveness and attract foreign investments through improvements in logistics performance and business climate. On the other hand, in order to reap the benefits of policies designed to absorb technological disruption, policy makers should decisively continue the implementation of their strategies by further enriching them. Policies to increase Turkey's digital maturity and transform Turkey's business ecosystem into a more technology-oriented environment will be the key for realizing Turkey's economic leapfrogging potential.

Table 3: Policy Framework for Turkey's Automotive Logistics Strategies



After defining the policy areas to improve Turkey's automotive logistics competitiveness, needs of concentration must be determined to rationalize the governmental strategies. Overall, policy recommendations should cover physical infrastructure, connectivity, legislation amendments, technology assessments, and regional spatial dynamics.

Table 4: Policy Dimensions for Policy Framework

	Needs of Concentration	Justification
1	Technology-Driven Logistics Trends	Newly emerging technologies are disrupting logistics operations in addition to their impacts on the automotive industry itself
2	Shift in Automotive Manufacturing Dynamics	Changes in material and technology-related factors are bringing about a shift in the automotive supply chain
3	Trade Corridors, Connectivity, and Infrastructure	Global developments related to intermodal connectivity and trade corridors necessitate a swift response from Turkey as regards its long-term strategies
4	Improvement Areas for Infrastructure and Legislation	The ever-expanding infrastructure needs of Turkey require the enactment of an accommodating and flexible regulatory framework

- **Technology-driven logistics trends:**
    - A task force dedicated to data sharing arrangements and progress, and formulation of research projects to incentivize deployment of data sharing technologies needs to be established, with concrete objectives set.
    - Platforms to encourage and incentivize knowledge- and experience-sharing should be set up and facilitated.
    - Infrastructure enabling the advanced traceability of freight movements should be developed and expanded upon.
    - A dedicated forum on the digitalization of logistics should be designed to prepare Turkey for digital disruptions in the automotive supply chain.
    - One of the SME Capability Centers ('Model Fabrika') should be allocated to frontier digital technologies of automotive logistics.

- **Shift in Automotive Manufacturing Dynamics:**
    - Potential candidates for localized production should be identified; renewal as necessary.
    - A new supply chain control tower with support from the private sector should be established.

  - Customs warehouses and ports should be restructured in order to accommodate rapid charging locations.
  - Roads on which xEV logistics could be piloted should be started to be allocated.
  - Highways should be organized to be able to adapt to platooning, with a robust signalization infrastructure.

- **Trade Corridors, Connectivity and Infrastructure:**
  - Interconnectivity of transport modes should be increased through targeted investments: increasing railway and highway connections to main arteries, initiating negotiations on connectivity with international corridors (e.g. Bursa Railway Project, railway connectivity of Tekirdağ-Bandırma and Tekirdağ-Derince ferry lines).
  - The technical compatibility of infrastructure of TCDD with other networks such as the European Rail Network should be assured (legislations on interoperability).
  - To support the logistics infrastructure of Turkey's eastern borders, the establishment of a train ferry network passing through Lake Van should be expedited.
  - New railway connections to the TEN-T Project, e.g. modernization of Samsun-Kalın railway, Halkalı-Kapıkule Railway, should be constructed.
  - The new Edirne-Kars Railway Project should be integrated into the Baku-Tblisi-Kars Railway on the middle corridor.
  - The connectivity of the following ports should be increased through additional railway and highway arteries and connecting roads for better integration into the BRI Project: (Iskenderun Port, Mersin International, Port Akdeniz, Çandarlı Port, Bandırma Port, AsyaPort, Kumport, Filyos, Samsunport, DP World Yarımca, Galata Port).

- **Improvement Areas for Infrastructure and Legislation:**
  - An automotive industry-oriented transport master plan should be established
  - Real-time quality assessment should be made for routes frequently used by OEMs
  - For infrastructure projects, a common rulebook that renders the suitability of infrastructure projects dependent on intermodal integration should be established, being stipulated in official documents such as the government's investment plans.
  - Improvements should be made to current railroad networks (where possible) to integrate emerging technologies.
  - Planned and potential investments should have a mandate to integrate and accommodate emerging technology initiatives.

- A taskforce dedicated to the overhaul of customs should be set up, with a clear mandate to expedite clearance-related operations and processes.

- Customs checks involving Authorized Economic Operators (AEO) should be fast-tracked, with more organizations incentivized to adhere to the requirements surrounding AEOs in order to relieve border operations.

- Use of enabling technologies (e.g. Blockchain) at customs checkpoints should be accelerated and expanded.

Concluding Remarks

Bridging the economic and geographic gap between the West and the East, Turkey has strong natural competitive advantages in terms of logistics. With its weight varying across industries, logistics is an important component of cost structure which businesses strive to reduce to become more cost competitive in their sectors. The more industries get integrated to Global Value Chains, the more important logistics get in business operations. With wide range of intermediate inputs and demand rising in parallel with wealth across all over the world, automotive industry is one of the most integrated industries to the Global Value Chains. In the last 20 years, Turkish automotive industry has managed to become the production hinterland of European countries with investments from Automotive OEMs due to competitive advantages provided by the country, logistics advantages making up an important part of the advantage. However, as disruptive technologies have started to transform automotive industry, competition dynamics also started to change.

Before starting to build up strategies to sustain competitive advantage in automotive industry, the way competition dynamics have started to change should be understood. On one side, countries and business which take up the benefits of technology and manage to reduce cost and increase value of logistics services provided, become more competitive regardless of the industry. On the other side, as electric vehicles have started to move towards the core of automotive industry, raw materials and battery providers have started to obtain strong competitive advantage in the industry. Considering that majority of battery production and investments are made in Far East and the resource of fundamental raw material for electric vehicles and batteries are also far from Turkey's international trade network, Turkey's competitive advantages in automotive industry are at stake.

Implementing strategies to develop competencies in disruptive technologies is an important pillar of protecting competitive advantage, but it is also vital to sustain logistics advantages as an assembly hub in Global Value Chains of automotive industry. There are two main strategies to realize this objective, at national level, logistics infrastructure should be modernized and perfected, and at international level country's connectivity to international trade hubs should be expanded and diversified. For Turkey's case, at national level, underdeveloped railroad infrastructure should be completed on the country's East-West axis, new logistics hubs should be built to strategic areas, intermodality solutions should be supported and made available at ports, logistics hubs and production facilities. Meanwhile, new technology solutions should be incentivized to modernize sector-specific logistics and logistics industry. On the other hand, at international level, Turkish infrastructure should be integrated to international infrastructure networks such as TEN-T and BRI, connectivity of Turkish ports to Turkey's target markets should be increased and customs procedures should be modernized with new technology solutions and facilitating procedures should be activated for key sectoral players integrated Global Value Chains. Otherwise, Turkey might soon be face losing competitive advantage in one of its most successful industries. New sector-specific master plans should be designed and published to guide Turkey's transformation with short, medium and long term policies.

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