

# **THE IMPACT OF SUPPLY CHAIN IN THE WAREHOUSE MANAGEMENT SYSTEMS OF TURKISH AUTOMOTIVE INDUSTRY**

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## **Abstract**

*In today's competitive automotive industry where finished products appear similar, companies are under pressure by market forces to improve their supply chain capabilities if they are to compete in the market place. The rising modifications in vehicles models, types and designs across different segments with increase in the differentiation of spare parts has also made the Supply Chain Management more complex than ever before in a lean environment of the auto industry. In this article, which explain the framework, functionality and impact of Supply Chain Management (SCM) in productiveness of the industry in times of economic melt-down and expansion in product line? The researcher, measures the impacts of improved Warehouse Management Systems (WMS) in the automotive industry supply chain against the 14 automotive manufacturers operating as Original Equipment Manufacturers and Automotive Components Manufacturers in Turkey with emphasis on production capacity, annual sales and market share of each company as reported in the annual company report 2013/2014.*

*Keyword: Automotive Industry, Supply Chain Management, Warehouse Management Systems, Original Equipment Manufacturer, Automotive Equipment Manufacturer*

## INTRODUCTION

This study shows how automotive warehousing and operations management has improved from what it used to be, with high storage area and small assembly floor reserved for shipment to the opposite. The research reveals the processes of inbound, outbound and how it can be improved using lean concepts, techniques and technologies. The fast through-put and shorter lead time has been a major target of supply chain operators with a rapid response minded leadership. This has made the Turkish auto industry's supply chain a success amid struggling and fragile economy/region.

The general operation in a conventional warehouse can be defined in two basic flows, the inbound (receiving and storing of materials) and outbound (retrieval and dispatching). The former is about all the activities needed to do when parts arrive at the warehouse and the latter cover all the process performed when parts are ready to be shipped to both internal and external customers on specific order fulfillments. Most strategic approaches in used today in Supply Chain Management (SCM) and warehouses across all sectors of the economy originates from auto industry, in today's Turkish auto industry supply chain, which has embraced the same systems and the techniques with Japan, United States and European neighbor Germany .

### Warehouse and SCM in Automotive Industry

The automotive industry is the world's largest single manufacturing activity with thousands different spare parts inventory at the complex warehousing facilities with hi-technological infrastructures and full or partial automation in place. The automotive industry warehousing is strategically positioned to act according to the Supply chain approach employed in different seasons for different reasons. The strategic change in the industry is rapidly changing so, is its warehousing approach changing very rapidly. The complex warehousing operation in automotive industry is integrated with Warehouse Management System (WMS) facilities to coordinate production planning schedules and timelines.

Maintaining inventory stock levels using OEM applications provided by individual automotive vendors through an automated computer system within the WMSs. The warehousing operation is the main point of spare parts order and distribution amongst other network in the integrated production systems. The central and support warehousing approaches is adopted by many automotive manufacturers in which warehouses are actually divided according to location and production capacities in other to maximize the utilization of floor space.

## **The Role of Warehousing in SCM**

A warehouse is simply defined as a facility in the supply chain of an organization used for material planning, receiving and storing of inventories that are needed for further production of goods and services, the same definition applies to stores with significant different in design, operational capacity and capability. The Warehouse function is a package of services that enables the smooth running of the other operating functions in any organization as raw materials and spares needed in other section are holding in stock (Rita Makumbi, 2013).

Each plays a significant role of serving the purpose of its institution by holding stocks and releasing when needed to increase value. It also provide valued added processes and shorten response time in delivery of materials as when due. Automotive industry warehousing is the place that coordinates with research and development department for product improvement and value engineering operations for customize services to gain competitive advantage. These warehousing is classified by the role it plays at a particular location or supports center, as different warehouses exist in the industry to fulfill different manufacturing needs or other production approach like: built-to-order, built to stock etc.

## **Impact of SCM in the Aftermarket Approach**

Aftermarket approach of automotive warehousing management is strictly on just-in-time procedure as spares are supplied at the right place, in the right quantity and quality, at the right time to solve the aftermarket operational needs. Support warehousing coordinate speedy deliveries based on JIT to meet market demand for overall profitability of the supply chain. Global aftermarket champions operate with optimized networks of warehouses in the different regions and location as the case maybe and use benchmarks to transfer best experiences among warehouses to meet critical demand in most efficient way (capgemini, n.d.).

## **SCM Impact in Inbound and Outsourcing Strategies**

Supply chain Inbound is the process of taking inventory into the warehouse floor/shelf. The inbound warehousing is an integral element and the process of receipt, inspection and storing of material inventory. It's the basic activity of a warehousing operation for a manufacturing firm, involving the processes and documentation of raw materials for use in production. For organizations to really focus on their core competency in the management of complex warehousing, there is need to outsourcing parts of the supply chain to highly technical supply chain expert company. There is a mutual corporation between the outsourcing company and chartered company's internal operational activities and the occurrence of disruptions in the firm's inbound logistics flow from subcontractor's activities (GöranSvensson, 2001).

## **SCM IN THE AUTOMOTIVE INDUSTRY**

The automotive industry is traditionally the forerunner in the development of modern warehousing, SCM, production and logistics strategies due to the complex nature of the industry's production and assembly line. Warehousing in the automotive sector has been gaining tremendous importance in recent times due to the growing need to reduce storage and lead times for material inventory. Furthermore, the concentration of the auto manufacturing activity in a few location has led automotive manufacturers to construct warehouses in strategic places as central or support warehouses to ease fluctuations in there supply chain and increase rapid response to requirements.

This is an industry where suppliers are playing important role in the control and coordination of materials and logistical services in the making of the industry. Such logistical services like:

- Grouping of different tier 1 suppliers and modules
- Pre-assembly
- Assembly of components, modules and systems
- Line feeding
- Just-in-sequence delivery
- Processing of delivery schedule
- Just-in-time
- Quality control

### **Just in Time Approach (JIT)**

The most fundamental approach in automotive SCM and warehousing strategy in lean manufacturing is the JIT approach. JIT is basically, a strategy to cut operational costs by reducing the amount of inventory held in the stock to avoid material and financial waste. In JIT's approach, there is a significant positive correlation between use of non-financial performance indicators and organizational performance in productivity measurements (David Upton, 1998).

Almost all the players competing in automotive industry use 2PL or 3PLs as the case maybe, for a part or full of their logistics operations due to the JIT success approach in the industry. The importance and efficiency of SCM and JIT services has the automotive logistics and supply chain evolve much faster as compared to other industry application of JIT.

### **Sequencing and Scheduling**

Sequencing and scheduling are one of the logistical services performed in automotive warehousing and SCM, the process of organizing work cells in the assembly line, to carry out all

the activities necessary to produce the desired outputs at the expected time for expected results. Sequencing and scheduling program indicates the timing of each work station as when it starts and when it will be completed, even on each work cell or machine and as well as any additional materials needed for each task. Sequencing and scheduling ensures clarity and precision are managed in accordance with maximum speed. Sequencing technological application works accurately in determining the best and most efficient production process in combination with lean tools like; JIT and JIT in sequence methods in production schedules. There is a relationship constraint between sequencing and scheduling in the work load activities and jobs in the production line. The optimization of such a system involves determining the customer service order (sequencing) and the inter-arrival times (scheduling) (P. Patrick Wang, 1999).

### **Quality Control and Inspection**

Quality control and inspection are better applied together as one needs the other to function accurately, because quality control simply means organization-wide approach to maintain set standard in all aspects of the firm that starts from top management to the least rank and file in an organization. This least work force needs to be monitored and controlled to follow the laid down rules and regulations as set standard to meet quality specification. So, quality control and inspection consists of the steps the entire organization applies in the program to create permanent environment that will maintain that which the organization forestall. The management's willed to continuously improve its ability to deliver high quality products and services to customers and maintain their competitive edge. A key aspect of quality control and inspection is adequate supervision in all arrears of a product life from material source to production line (Ignet, n.d.).

### **Classification of Spare parts Inventory**

Classifying spare parts in the WMS to simplify the SCM of automotive warehousing is by analyzing individual spare parts and components in groups according to similar attributes, performing functions and levels of criticality. It is not a good solution to implement the same inventory management policy on all items in stock. The inventory classification management policy is determined by the necessity inventory level, ordering quantity and the time of purchase. Each item inventory in the stock is analyzed according to certain criteria and it joins the corresponding storage policy. The three basic criteria of classification are:

- Based on spare parts usage (ABC approach)
- Based on levels of criticality (VED approach)

- Based on frequency of demand (FSN approach)

The classification, labeling for easy identification of these inventories spare parts in the WMS using afore-mentioned approaches is popular in the industry as it's in line with lean philosophy. By classifying and codifying all the spare parts in the warehouse, it becomes easy for the operation to minimize the duplication of spare parts thereby affecting reduction in the inventory (Maryam Abbasi, 2011).

### **Value Chain Analysis (VCA)**

Value chain in automotive supply chain is critical to their competitive advantage and customer satisfaction. VCA are those operational activities that an organization operating in a particular industry performs for customers in strengthening their operational capacity and capability in order to deliver a valuable products or services for the market. The impact of VCA cannot be undermined in the manufacturing industry as it's seen as a multiple assessment tools in describing the operational performance of value adding process mechanisms including the analysis of product flows, information flow and the general coordinations and managements of these flows. It draws on all the stakeholders to the opportunities for improvement at different stages in the value chain in strengthening them for effective change.

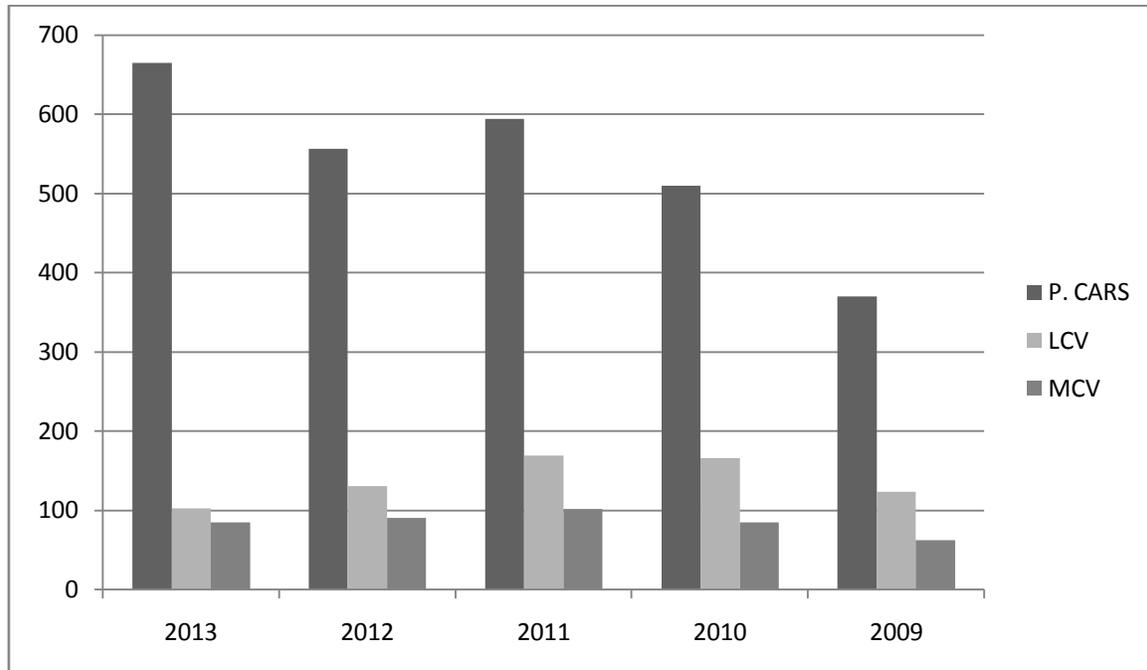
## **RESEARCH METHODOLOGY**

### **The Study**

The methodology in this research consists of two independent studies where each study has its own research question, its own research design, and its own intended academic contribution. Despite the independent relationship of each element, they are all part of a greater whole of operational activities with one purpose. Since 2007, the foreign direct investments in Turkish automotive industry has increased tremendously, and has resulted in increase in the production capacity of 1.4 million vehicles, which has pushed them to sixteenth position in the global ranking of largest automotive manufacturer and one of the leading production bases in the Europe.

The increase in production capacity among 13 automotive players operating in the sector, this has reflected on the WMS impact in the productivity of the industry despite economic slowdown. Looking at the general growth level in all the production segments in the Turkish automotive industry in 2013, Sales volume grew by 19% and reached a record high of 664,655 units.

Figure 1: Turkish Automotive industry 5 year Sales Report (1000 units)



Source: Ford Otosan Annual Report 2013

The industry is targeting an increase in production capacity of up to 2 million units by 2015. The research will gather and analyze the annual reports of the quoted automotive companies in TSE. Data gathered will be classified into these concentrations for clarity of objective:

- Production output,
- Sales turnover,
- Performance and demand managements

To identify the production systems input, output and returns on investment (ROI) during the period under review. Capacity utilization has a strong effect on sales turnover and increase in capital. This research will concentrate on sales turnover reported on the latest annual reports of 2013 for these companies compared to previous reports. This study is by nature exploratory and contains quantitative and qualitative aspects. Interviews were intended to be carried out in order to gain better understanding of the SCM and WMS situation in these companies' operation and to identify issues and challenges facing these facilities and strategic solutions to improve them.

### Sampling

The research work intended to explore the entire automotive industry operating in Turkey, which comprises of OEMs, ACMs and all SCM networks as mentioned in figure 1 above. In order to maintain the validity and reliability of data sources, we are concentrating on OEM operators who

are members of accredited automotive institutions like; Automotive Manufacturers Association (OSD), Automotive Supply Industry (TAYSAD), Motor Vehicle Technical Committee (MARTEK), Automotive Technology and R&D Center (OTAM), Turkish Standard Institute (TSE), Automotive Industry Promotion Committee (OETK), Union of Uludag Automotive Parts and Components Exporters Association (UTAYSIB) etc.

Table 1: Automotive manufacturers in Turkey

No	Companies	Ownership Structure	Global Partner	Products
1	TOFAS/FIAT	Joint Venture	FIAT	Passenger Car
2	OYAK/RENAULT	JV	RENAULT	P. Car
3	TOYOTA	Foreign Direct Investment	TOYOTA	P. Car
4	HYUNDAI ASSAN	JV	HYUNDAI	P. Car
5	HONDA	FDI	HONDA	P. Car
6	FORD/OTOSAN	JV	FORD	Commercial Vehicle
7	KARSAN	LOCAL	PSA/RENAULT TRUCK/HYUNDAI TRUCK	CV
8	BMC	LOCAL	LOCAL	CV
9	M.BENZ TURK	JV	M.BENZ	CV
10	ANADOLU ISUZU	JV	ISUZU	CV
11	TEMSA	LOCAL	MITSUBISHI	CV
12	OTOKAR	LOCAL	LAND ROVER	CV
13	M.A.N	FDI	M.A.N	CV

Sources: OSD 2010 Report

The sample selection will be limited to the OEMs listed in table 1 above; their annual reports will be analyzed to extract the impacts of WMSs to automotive SCM.

### Measuring Production Output and Sales Turnover

This research is focused on production output and sales turnover analysis based on the two companies with the highest annual production capacity based on 2013 annual report presented on AGM. Productivity is evidence of work performance expressed in output and is a measure of the efficiency of production; this can be expressed as the ratio of outputs to inputs used in the production process. Productivity is the relationship between the quantity of output and the quantity of input used to generate the output. It is basically a measure of the effectiveness and efficiency of your organization in generating output with the resources available ("A guide to productivity measurement, Spring Singapore," 2011).

Productivity is defined as a ratio of output to input:  $PRODUCTIVITY = OUTPUT / INPUT$

Sales turnover on the other hand is a measurement of how a company's produce ends in the market place with a return in cash to support the operation, within a specified period of time in an accounting year. Sales turnover has a direct effect to productivity which is efficiency expressed in monetary value or as ROI.

### WMS Evaluation and Capability Analysis

WMS's technological advancement in the industry has shown the industry's level of SCM adaptability to emerging trends; it has shown an increase in the productivity and performance levels as shown in Figure. The industry has demonstrated improvement in the WMS adoption in different capacities from medium to high number of functionalities which represents medium-high technology contents, medium-high adaptability to fit into warehouse operations and to integrate functions and support for warehouse automation.

## EMPIRICAL RESULTS

### General Production Output

Among the 13 automotive manufacturers listed above, I have selected 2 companies with the highest market share in the industry, with 11.5% in PC, 25.1% in LCV, 8.8% in PC, 20.7% in LCV, TOFAŞ/FIAT and FORD OTOSAN respectively.

Table 2. General Production Output

TOFAŞ/FIAT			FORD OTOSAN Report:		
Vehicle Segments	Production Output (Units)		Vehicle Segments	Production Output (Units)	
	2012	2013		2012	2013
Passenger Car (PC)	77,538	82,817	Passenger Car	556,405	664,655
Light Commercial Vehicle (LCV)	178,890	161,797	Light Commercial Vehicle	131,776	103,446
TOTAL	256,428	244,614	TOTAL	688,181	768,101

There is a production volume decline in 2013 by 4.6% compared to 2012 operation results in TOFAŞ/FIAT and an increase with almost the same margin in FORD OTOSAN due to shift in demand from LCV to PC. Other factors which contributed in the changes include contraction in the economy, rising trend in foreign exchange rates against the local currency Turkish Lira. This attributed to cost increases in the sector and the resultant negative effect on the general profitability in the industry. The growth experienced in domestic market was due to higher level of PC sales as happened in the previous year, whereas LCV market showed a contraction. The domestic and export sales result further clarify the production capacity and efficiency.

### General Sales Turnover

The industry in general experienced increase in sales volume of 885,180 units in all segments about 9.7% growth in 2013 compared to the results of the previous year. The growth rate experience occurred in domestic market which showed a shift from LCV to PC, with total of 664,655 sales volume of which grew by 19%. The reduction in the LCV sales continued as a result of the slowdown in the economy, coupled with the introduction of Special Consumption Tax (SCT) and hike in the operating licenses in commercial vehicles.

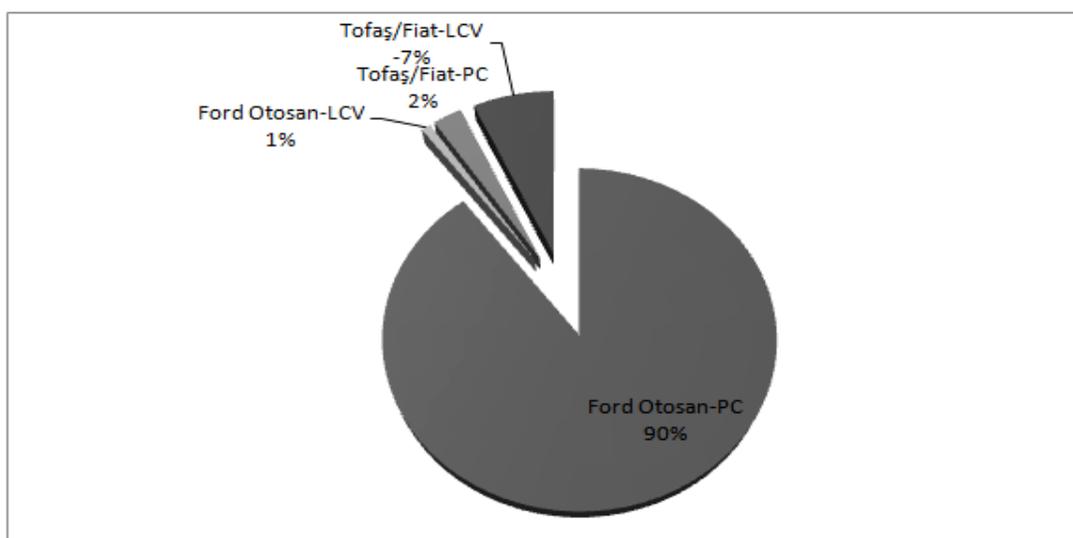
Table 3. General Sales Turnover

SALES ANALYSIS	DOMESTIC SALES		EXPORT SALES		CHANGE (%)
	2012	2013	2012	2013	
FORD OTOSAN-(PC)	387,895	437,984	168,442	226,671	90%
FORD OTOSAN-(LCV)	58,442	27,546	45,004	75,901	1%
TOFAŞ/FIAT-(PC)	47,095	53,538	46,869	43,477	2%
TOFAŞ/FIAT-(LVC)	71,316	53,354	107,200	116,842	-7%
TOTAL	564,748	572,422	367,515	462,890	4%

### Sales Volume Analysis

FORD OTOSAN continues to lead with a market share of 12.9% in all segments and maintains leadership in domestic market in PC segment with a total of 664,655 sales volumes about 9% growth in 2013. Despite the contraction in the European market, Ford Otosan experienced its highest record ever with total export sales of 302,575 units. Ford Otosan's export grew by 11% and LCV indicated sales increase by 1% in Europe due diversity of her export markets.

Figure 2. Sales Volume Analysis



### Market Share Analysis

TOFAŞ/FIAT total sale continues to show a negative result which indicated that overall market share in 2013 was dropped by 1.9% in general and -7% in LCV market. The only positive figure experienced was in PC which grew by 2% in 2013 with total export of 272,480 units in all segments. Despite this poor result the company is among the local brand that sustained their market share with increasing price competition in all segments of the industry.

Figure 3. Domestic and Export Sales Analysis

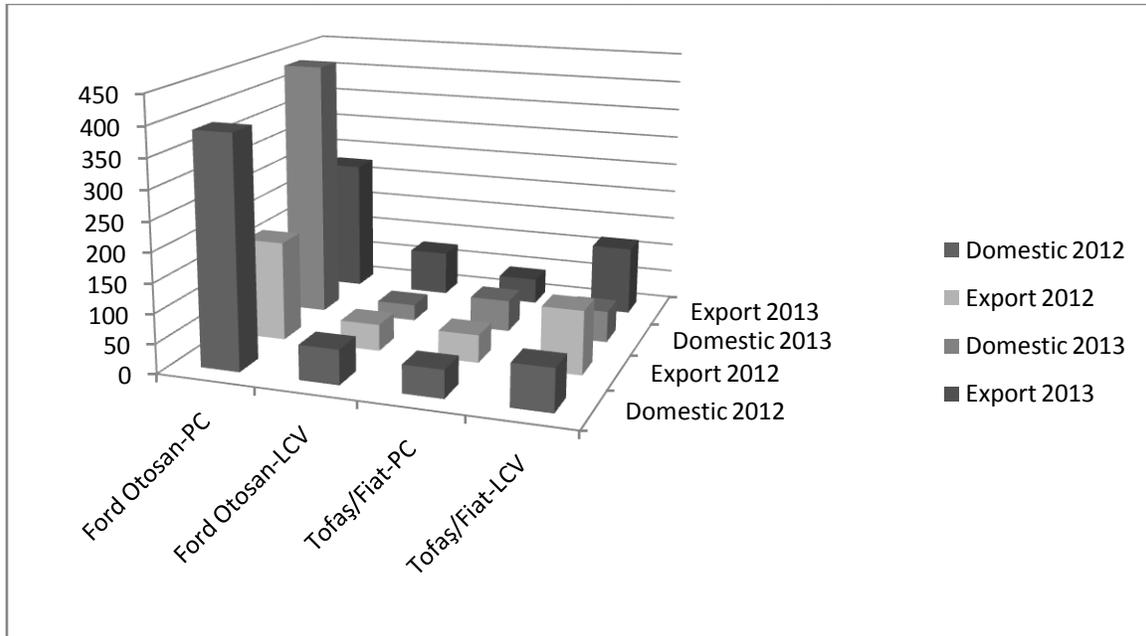
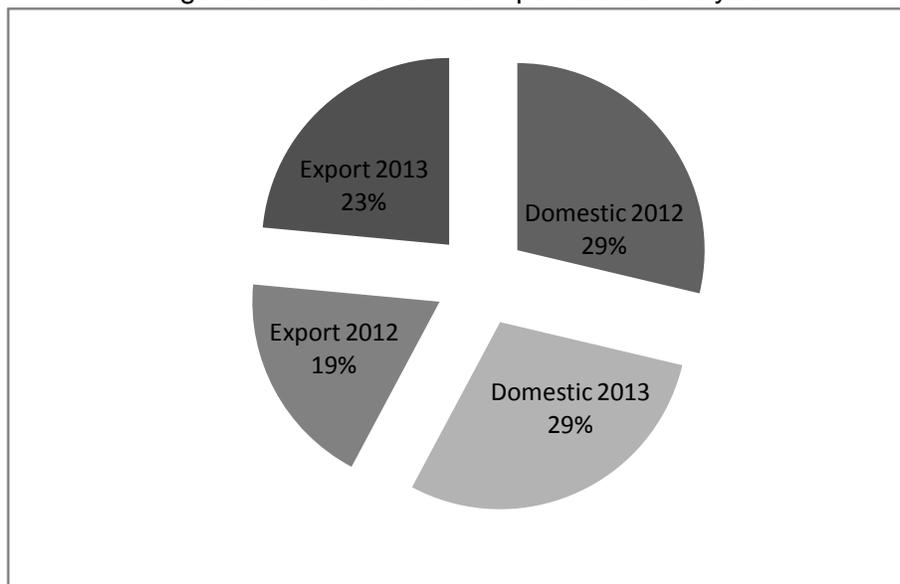


Figure 3b. Domestic and Export Sales Analysis



## CONCLUSION

This research reveals that SCM in the WMS helps the general effectiveness and efficiency of the entire organization by reducing operating costs, inventory levels and increase responsiveness to demand in strengthening the overall competitive advantage of the organization. When installing WMS to facilitate SCM in automotive manufacturing facilities, the clear goals and objectives of the project should be discussed prior and analyzed by all the sections and departments that will apply the systems in their individual functions. After implementation with automation, this will advance the productivity and output of the plant and ensure that the production site is producing at full capacity.

In Turkish automotive industry about 65% of companies operating in this sector are planning to update or replace their WMS to improve SCM in the next few months to reposition operational competitiveness, because companies are looking for more agile and visible capabilities in their new WMSs. Looking at the WMS in the largest automotive warehouse and parts distribution center at Ford Otosan's Kartal facility, with a warehouse operating floor area of 25,000m<sup>2</sup> among the largest facility of Ford group in Europe with about 96.5% fill rate featuring all the WMSs to manage processes and procedures in real time, the efficiency and effectiveness have always increased operational capacity, hence, the company maintains leadership in the industry.

## RECOMMENDATIONS

I am making reasonable suggestion for academic references and industrial application. Turkish automotive industry in general has an installed production capacity of about 1.6 million in MCV, LCV and PC segments, but, the industry is performing below installed capacity compared with her European counterparts. This section will focus on the reasons behind under-performance and under-utilization, as we offer our constructive criticisms and recommendations for further research. Let's consider the existing installed production capacity among the major players in the industry; HYUNDAI ASSAN

- Hyundai, Ford and Renault 100% installed capacity are operating on > 80%
- Hyundai Assan and Toyota recently announced capacity increase in the Turkey plants
- Fiat plant in Bursa produces > 90% installed capacity and bears the 'silver' production quality which remains highest in the industry.
- In BMC, Otokar, Karsan, Temsa, Isuzu, M.A.N. Diesel, Daimler and HVC have production facilities in Turkey with installed capacity of 100,000 in total.

The inability to meet expected production capacity in the industry, in general, it can be caused by the challenges facing the industry globally like; Demographic changes and shift in global economic power and, Increasing consumer expectation.

New technologies are dramatically changing the features in a vehicle from conventional support to enhanced driver support to better fuel efficiency and new or improved carbon emissions. In my recommendation to the afore-mentioned challenges facing the industry can be classified within the internal and external environments, which the former can be controlled while the latter can only be managed with the frame-work of the institution. Training and retraining the workforce outside the immediate and limited environment to a more high tech research centers will empower and improve their technical know-how and further impact the host company. The human resources in automotive industries and her numerous suppliers globally are confronted daily with increasing operational complexity and supply chain dynamics as a result of increasing numbers of products and options, increasing pressure to innovate, shorter technological cycles, and global supply networks. Those trained among the global leader will import unusual skills with new techniques to tackle emerging trends as a solution to the challenges facing them through;

- Understanding their market and its dynamics
- Through building brands among existing products
- Adapting production strategies to existing cultures
- Balancing and taking a long-term view in perspective

Those trained leaders should be allowed by management to take the responsibility for driving automotive companies forward through creating a coherent strategy, defining goals and find ways and the right people to meet them without strong family intervention and influence. This article doesn't have all the answers, but I hope it will provide some useful starting points for further thought and future discussion.

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