Organization of Work in E-supply Chains: Case Study of India

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The global automotive industry is undergoing a transformation in the production and distribution of vehicles with the onset of digital revolution and radical changes in mobility preferences. Additionally, climate change, energy security issues and rapid urbanization are accelerating this transformation (NITI Aayog, 2018). The changes in the transportation paradigm will gradually and eventually shift preferences away from traditional combustion-engine based automobiles to electric vehicles and shared mobility solutions. They would fundamentally alter the structure of the industry, typically designed in a hierarchical model of input suppliers, component manufacturers, assemblers, dealers, financers and customers towards a more interdependent network of key players in the industry.

This essay, drawn from a study based on extensive literature review and interviews with industry stakeholders, explores the impact of these anticipated changes on the organization of work in the Indian automotive industry. Specifically, it dwells on the potential demand for new skills and creation of new employment opportunities. It has three broad components.. One, it compares the supply chain design of traditional versus the upcoming newer supply chains and their impact on inter-firm relations; two, it analyses the impact of e-vehicles on demand for labour and skill sets; and third, it draws the role that state policy has to play in facilitating these changes as they have implications for the employment of the vast pool of unorganized workers in the automotive sector.

The essay has four parts. Section 1 describes the global evolution of the e-vehicle industry and the major challenges it faces. Section 2 analyses the supply chain differences between the combustion and electric vehicles. Section 3 contrasts the skill sets required for such a transformation in the Indian context. Section 4 discusses the impact of COVID-19 on these changes and section 5 presents the critical role of the public policy in facilitating the re-organization of work in the automobile industry.

Background

The automobile industry is well known for its structured supply chain that allows transfer of best practices and coordination of demand across global markets. The traditional producer-driven supply chain is heavily dependent on a network of tier 1 to tier 3 suppliers who are involved in not only high-end work but also jobbing and repair units; wherein, a system supplier assigns tasks across various levels of the supply chain. The advent of electric vehicles (e-vehicles) is bound to disrupt the traditional supply chain model by breaking this hierarchy and introducing new models of contractual relationships and governance between various stakeholders in the supply chain. Parts such as pistons and fuel injectors will be obsolete and demand for new components and skills is likely to emerge. The transition from combustion engines to electric vehicles would happen in phases as countries transition from hybrids to plug-in hybrids (PHEVs) to Battery Electric Vehicles (BEVs) to Fuel Cell Electric Vehicles (FCEVs).

There are several challenges for mass production of electric vehicles that include battery cost, charging time, driving range, infrastructure and standardization of recharging stations and high initial investment outlays. Additionally, electric vehicles are more expensive because of the technology involved. There are several infrastructural challenges with respect to grid connectivity, charging stations and logistics of transporting/carrying battery from consumer's standpoint. Finally, the emissions depend upon the method of electricity generation in the electric vehicles industry (Akhavan-Rezai et al., 2015; Su et al., 2011 in Peter Cooper et al, 2019). Given these challenges government regulation will play a crucial role in the diffusion of this technology. Industry forecasts with respect to adoption of this technology in India predict that the major transformation will occur during 2040-2050 (Bloomberg Electric Vehicle Outlook, 2020).

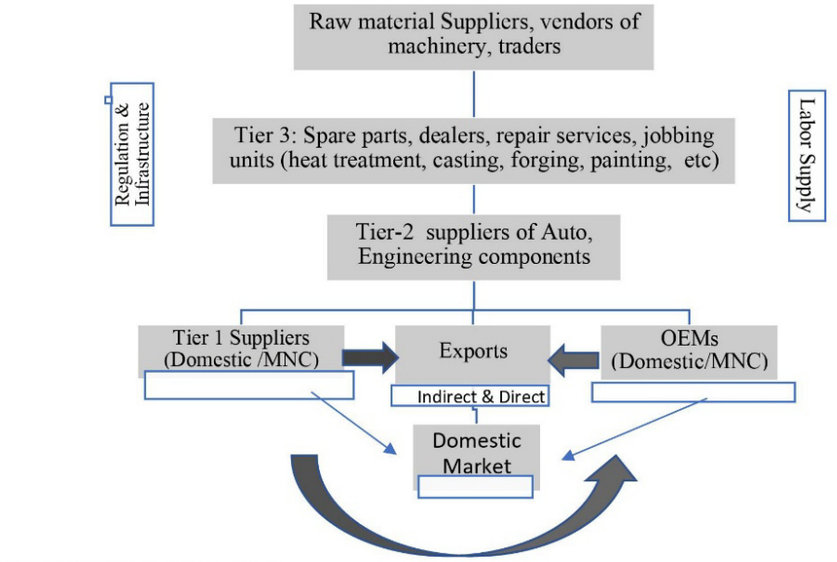
Currently, the top countries in terms of consumption of e-vehicles are the U.S, China, Japan, Netherlands and Norway. In terms of technological advancement, Japan, South Korea and Germany are in the forefront. There are hardly any e-vehicle producers in Asia. At present, according to Tury (2019), there are only three countries - Slovakia, Turkey and Mexico where electric vehicles are assembled.. However, as labor costs in these countries increase, some of the production may get outsourced to lower-labor cost and higher skill economies such as India, if favorable conditions and technological capabilities are available.

Dismantling the supply chain: combustion versus electric-vehicle industry

Key actors in the supply chain

The production in traditional automotive industry is driven primarily by six component segments: the engine, suspension, transmission, sheet metal, electrical equipment and tyres. These create a vast array of backward linkages with many producer-driven industries such as steel, aluminum, rubber, electrical and others. Value creation and control over the value chain rests with the engine and powertrain component segment, which is controlled by the vehicle manufacturer. In terms of proportion of cost of the vehicle, however, the component sector comprises two-thirds of the cost of the automobile. As per labour, figure 1 shows that the supply chain relies mostly on contract labor for the assembly work. Direct employment comprises both regular and contract workers, constituting an approximate 30 percent of employment in the automotive industry. Indirect employment comprises the remaining 70% which includes the entire gamut of customer services such as vehicle finance and insurance, vehicle repair, vehicle

service stations, vehicle maintenance, vehicle and component dealers, drivers and cleaners (PWC, 2013).



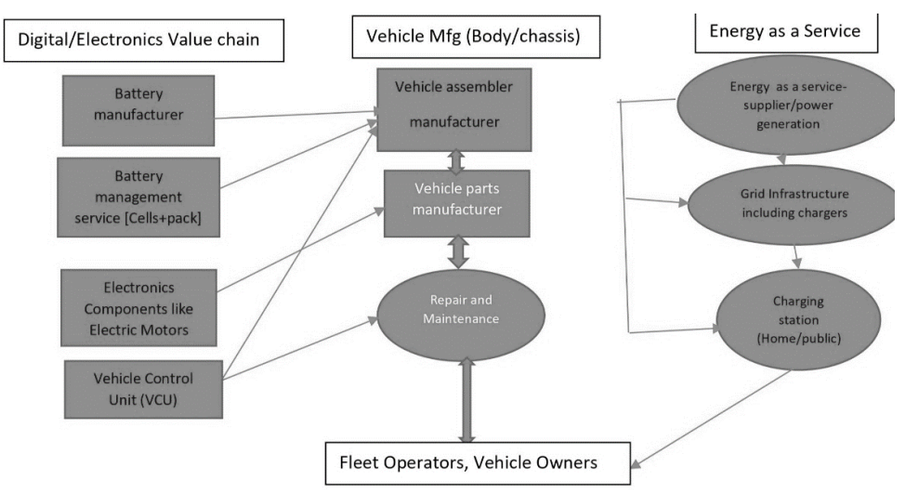
Source: Field survey interviews

Figure 1: Traditional Automotive Supply chain

The electric vehicle supply chain is highly complex and consists of various inter-connected players (Figure 2). Unlike the traditional combustion based automobiles, EVs are less complex to build. They take 30 percent less time to assemble. Hence workforce requirements might be lesser and might result in a reconfiguration of labor demand in the global production network. However their value chain is far more complex. Value creation in the e-vehicle industry rests with the production of the battery segment which constitutes almost 35-40 % of total cost and is currently dominated by a few countries such as China that have access to the raw materials like Lithium. Important components include motors, controllers, chassis and body and other electronic components. Electric vehicles have fewer moving parts and replace the need for some existing components. For example, fuel tanks are replaced by regenerative braking systems. Replacement of mechanical systems with electronic systems will demand core competencies in hardware, software systems and functions such as remote diagnostics (Masiero et al, 2017). The supply chain of electric vehicles can be broadly categorized into:

1. Digital/Electronics: This consists of the battery management system comprising of fuel cells and the battery pack; other electronic components, dashboard, vehicle control unit, digital, Internet of Things (IoT) and cloud services
2. Vehicle motor manufacturing, vehicle assembly comprising the body and chassis.
3. Energy as a service, comprising of grid infrastructure, charging infrastructure and energy providers

Each of these has its own supply chain and interlinkages to the electrical and electronics industries and the energy sector. The following section analyzes the key skills required in each segment of the supply chain and the current status of each segment in India.



Source: Based on secondary literature and interviews by Authors

Figure2: E-Vehicle Supply Chain

Impact on Employment and shift in labour requirements: Electric Two and Three wheelers

The growth in the electric vehicles industry, several studies predict, would lead to an increase in the additional number of jobs – 8,50,000 in 2030 to 2 million and a shift in work skills by 2050. India's growth trajectory with respect to electric vehicles will be very different from its Western counterparts. In India, employment generation in the e-vehicle industry will largely depend on the 2-wheeler industry, which comprises 79 percent of the total automobile industry. India's tryst with electric vehicles started with the automotive mission plan in 2005 with incentives for manufacture of electric 2-wheelers. This was subsequently withdrawn in 2011 until FAME (Faster Adoption and Manufacturing of Hybrid and Electric Vehicles) policy was launched in 2015.

In India, as the electric two-wheeler market is highly price sensitive, manufacturers are working on business models such as leasing of batteries on a per kilometer basis and designs for easy portability of batteries such as built in trolley with charger. However, given the current business models and no clear government vision, existing 2-wheeler players have no incentive to invest in large scale EV production, and will cannibalize their own market shares. In the three-wheeler segment, there are currently one million battery operated vehicles which need to be converted from lead acid to lithium-ion driven battery. This project can generate a huge demand for electric vehicles and encourage more players in the industry.

Skill Mapping across the supply chain

a) Battery Manufacturing and Battery Management System (BMS): The power in the value chain rests with the battery manufacturer responsible for fuel cells. On top of the battery, lies the BMS, which controls the performance of battery, the electronics that go into the battery and the vehicle control unit that dictates the flow of power into the power train or the electric motor. Since the main source for battery is China, India does not have any potential for localization. Indian companies are focusing on the battery pack, which currently differs from manufacturer to manufacturer and there is potential for standardization. Battery pack consists of the entire battery module and its control systems

including the BMS. The design of the battery pack can be customized to improve the life and performance of the battery. For example, the Tesla's automobile's battery pack is unique and uses the flat battery technology, whose suppliers are locked-in with the manufacturer. As battery pack design becomes standardized, there will be more cost efficiencies in the sector, which may eventually generate more employment. In India, there is a potential for creating skills in the electric induction motor segment, given the existing capabilities in allied sectors of electronics, mobile, etcetera, which need to be mapped onto the automotive industry. There will also be demand for skills related to managing the vehicle control unit, which may come from the IT and the computing sector. As of now, new suppliers such as KPIT are emerging at the top of the value chain with engineering design capabilities.

b) Vehicle Manufacturing: EV manufacturing requires fewer moving parts, hence fewer components, but it requires more skilled manpower for repair and maintenance of electronic and electrical components. This segment has witnessed mergers and acquisitions in recent times to acquire capabilities and achieve scale to cater to global demand for electronic components. In India, new suppliers such as Comstar Automotive Technologies and Sona BLW have acquired significant capabilities in the domain of electric motor manufacture and e-axles. Both entities merged as Sona BLW acquired Comstar automotive technologies in 2019. New suppliers such as Varroc may emerge as tier-I suppliers to e-vehicles in India. Varroc Group, set up in 1990 is now a global supplier of lighting systems, power train components, electric and electronic assemblies and polymer-based vehicle products (Economic Times, 2018).

c) Energy as a Service: The value chain in this sector comprises energy providers, energy infrastructure and charging stations. In India, there are currently 80000 petrol stations as compared to only 500 charging stations. This shows the potential for employment generation in this sector. The key players in India will include private players in the automotive manufacturing segment, NTPC (Charging infrastructure), BHEL (battery technology), Power ministry in the public sector and Tata Power and OLA in the private sector.

The generational shift required in employment

With the creation of new supply chains in the automotive industry for manufacture of EV's, a major task will be the upscaling of the small and medium scale traditional auto-ancillary companies to enable transition to EV vehicles production. Unlike the conventional internal combustion engine (ICE) based automobile industry, EV industry might have lesser scope for semi-skilled or low skilled jobs. Further, many of the SMEs are located in the maintenance and repair segment, which might see a fall in demand. The new skill requirements in the industry would mostly be in the skilled and semi-skilled segment as Table 1 shows. However, the transition to the supply and demand for new skills is bound to happen gradually across the globe and there will be a generational shift in employment opportunities in the automotive sector.

Impact of COVID-19

The global automobile industry is facing one of the worst disruptions in production and supply chain due to low demand which is aggravated by the onset of COVID-19. While car sales and registrations have declined drastically across the world, the market share of electric vehicles has continued to grow, at least in Europe. Sales of Battery-Operated Vehicles (BEV) have increased across the U.K, Italy and France by 30-50 percent (International Transport Forum, OECD, 2020). While short term prospects of EVs may be impacted because of disruption in supply chain and low fuel prices, in the long term, with breakthrough in technology, access to new mineral resources such as nickel and cobalt, and the policy imperative to meet emission targets will result in growth of the EV industry. In India, in the fiscal year 2019-20, the automobile industry witnessed a degrowth of 15 percent (SIAM, 2020) with the commercial vehicle segment being the worst hit (-29%), followed by two wheelers and passenger cars (-18%) and three wheelers (-9%). The worst period was March 2020 which bore the brunt of the pandemic resulting in a degrowth of 39 % over March 2019. Recovering from the impact will take a substantial time as the industry has to deal with both demand as well as supply shock. However there has been an increase in the sales of electric vehicles by 20 percent as per the data released by the society of electric vehicle manufacturers (SMEV) in India; which includes 152,000 two-wheelers (majority of which are low speed electric scooters which do not require registration), 3400 cars and 600 buses. This growth does not include e-rickshaws which come under unorganized sector and which reported sales of 90000 units in FY 2019-20. The impact of pandemic may well have accelerated change in lifestyle and acceptance of alternative mobility choices which are cleaner and cost-effective for short distances.

Policy role and Implications

Though the Indian government has been pushing researchers, innovators and industry to support EV manufacturing through slogans such as "Make in India" and "Vocal for Local", there is a need for clear policies and incentives to overcome the current challenges (Financial Express, Inc42, Autotechreview, 2020). Possible alternate technologies such as sodium-ion or aluminum-ion cells are being researched in India and around the world, but

Field of activity	Skilled	Semi-skilled	Un-skilled	Representative job profiles
Scientific research of batteries	■			Chemists, material scientists
Design & development of automobile technology	■	■		Engineers, software developers, industrial designer
Manufacturing	■	■		Assemblers, machinists, production managers
Vehicle maintenance		■	■	Automotive service technicians, mechanics
Infrastructure development	■	■		Urban and regional planners, power-line installers/repairers, electricians
Sales and support		■	■	Retail salespersons, customer service representatives

Source: Analysis of the Electric Vehicle Industry, International Economic Development Council, 2013, page 23.

Table 1: Job Profile in the ECV Industry

none of these have been tested widely in the real world. Firms such as Reliance Industries, Suzuki (with Toshiba and Denso), Indian oil corporation and Exide industries have announced plans to invest in battery technology in India.

Diffusion of electric vehicle technology is often characterized as a chicken and egg situation, where the policy dilemma is whether to manufacture vehicles first or create the charging infrastructure for the same. Looking closer at the type of vehicles being bought, a clear policy push is required for creating demand for fleet vehicles and commercial vehicles which require public charging stations. However, for two wheelers and small cars, a two- pronged approach to incentivize both the demand and supply side of the industry are required. Specifically, fiscal subsidies to consumers would shift the demand in favor of electric vehicles on the one hand, and producer incentives for R&D would create incentives to manufacture innovative models and thus, go a long way in kick-starting the EV journey in India. Fiscal support in most countries to the EV industry has been in the form of direct subsidies. However, a NITI Aayog report in India advocates for subsidies in the form of carbon credits or coupons, staggered import duties based on the good's contribution to the value-add chain and GST based on vehicle utilization (NITI Aayog, 2018). Given that the success of EV manufacturing depends on several stakeholders from Research labs, OEMs, start-ups, battery manufacturers to infrastructure developers, specific policy measures targeting crucial players in the supply chain is imperative.

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