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Abstract

Business environment of automobile industry has become more competitive due to changing customers' needs and demands, market competition, globalization, technological development and innovation. Automakers should have perfect strategies and policies to overcome uncertainty and future development of Electric vehicles (EVs) and its sectors. In this context, Porter's competitive strategic is niche in the businesses strategies those can allow to adapt. This study focus on Porter's competitive strategies model analysis between Japan and China, are made up mass production and sales in Asia as well as in the World. Therefore, it would be analyze the development of EV in Japan and China have expending it demand in international market more competitive. The EV has striving to prevent global warming and to build a

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new technology and spreading a zero-emission concept focused on EV and EV sectors. The EV has been contributing to resolving domestic and international energy issues through an initiative of 'next generation vehicles'. The EV production has been started by Japanese multi corporations such as Toyota, Honda, Nissan, Mitsubishi motors and Chinese automakers BYD, Geely, Chery BAIC BJEV and others. However, the EV and its sectors has the potential to grow and maybe in the 21$_{st}$ century it has a huge possibility to lead the world automobile market.

Keyword: EVs, Comparative Strategy, innovation, markets.

I Introduction

Last autumn in 2017, Fukuoka city (Japan) arranged a motor show at three different places. I visited all three places and all booths of motor companies. I found there are several categories of vehicles (conventional gasoline and next generation vehicles [(1)]), those are different size, segment types, design, model and quality are sophisticate technology and luxurious vehicles was display from the worldwide. These vehicles produced of high technology. It is no doubt all visitors want to make their choice of car. Every booth explained about technology, design, model and quality of their vehicles. But the questions of prices (average price of new EVs is $34,721) and customers. Despite the high price of vehicles persisting doubts about how many people would actually afford them. There are hundreds of thousands of Asian middle class [(2)] people who cannot buy these Electric vehicles (EVs). A rising middle class in China, India and others emergence economies are expanding demand for passenger cars, and with it, demand for oil. According to International Economic Development Council (IEDC), there may be as many as 1.5 billion cars on the road by 2050, compared to 750 million in 2010 (IECD, 2013, 4).

EVs and EV sector [3] tied to more affordable, alleviate the cost of batteries and chargers infrastructure installations, innovation of new products and low energy consume in the worldwide. The governments across the world have set aside billions of dollars in the form of subsidies for early adopters of these alternative energy cars and to boost production of batteries for such vehicles. The market continues to expand, EVs sales are increasing across America, Europe, Oceania, and some Asian countries.

This is study based on secondary and archival materials and documents that will provides a comprehensive overview of EVs research and describes EVs, especially the Porter's model of the competitive strategies' concepts, EVs markets share and future markets, prospects and development. It will investigate based on historic, present, and future trends, and the market of EVs. EVs is expanding market and expected to remain prolong segment over the years to come. Japanese automobile manufacturing producing high technology, fancy design and model, where as China producing comparable low cost than Europe, America and Japan. Competitive strategies of EVs in Japan and China, which enable their sustained competitiveness despite the recent years.

This study will also attempt to verify the competitive strategies and business opportunities of the automobile industry in both countries Japan and China. The discussion of this paper is organized as follows: Section 2, Perceptions of Competitiveness and Strategies Model; Section 3, The Present Trends and prospect of the Electric Vehicles; Section 4, Competitive Strategies for EVs; and Section 5, Concluding Remarks.

Ⅱ. Perceptions of Competitiveness and Strategies Model

The term 'competitiveness' and 'international competitiveness' are uses frequently in both disciplines economics, management, including trade, supply and demand, consumption, industry structures, levels of competition within

industries and strategies utilized by competitors. However, competitiveness not always well defined. These are necessary and useful, but need to be augmented with empirical research studies. Yet, no universally accepted definition of global competitiveness exists in the literature. The disagreement on the definition is likely due to the multifaceted nature of the construct. Competitive strategy is about being different it means deliberately choosing to perform activities differently. Overall, there is no clear, single definition of competitive strategies. There are various definitions and perceptions of competitive strategies, which have gradually extended.

1．Competitive Strategies

One could argue that the topic of global competitiveness occurs at the cross roads between international economics and strategic management. According to Wassily Leontief (1953) was one of the first scholars to add an empirical element to the theoretical realm of international trade with his popular paradox of the Heckscher-Ohlin (1919) theory. In the context of competitive strategies some management scholars adopted the concept of competing globally in their research (Buckley and Casson, 1998; Tsang, 1999). From the historical perspective the competitive strategic has greatly influenced by Eighteenth-century economist David Ricardo applied the theory of comparative advantage, that a country boosts its economic growth the most by focusing on the industry. Still research on these area are going on. Corden (1994) refer there are three major areas of national competitiveness: sectoral or industry, cost and productivity competitiveness.

According to Dechezlepretre & Sato, (2014), competitiveness refers to the ability to compete in international markets. At the sector level, competitiveness refers to the attractiveness of different countries for a particular industry (Dechezlepretre & Sato, 2014). This concept can be applied at the firm, sector, or country level. Competition strategy is a business challenge based on the

simultaneous competition. It allows all participating firms to be better off, in terms of market shares, higher profits, technical improvements and innovation, depending on their particular interests and goals. Gnyawali, and Park stated, a higher standard of technology leads to a stronger competitive advantage, it is not always a wise choice to develop those innovative reforms alone since such research projects may take an unpredictable length of time and even fail to lead to a profitable commercial model, especially, when similar technologies have been implemented by other competitors (Gnyawali, and Park, 2011, 650-663). With reference to Hamel and Prahalad (1994) states that reinforced the concepts of core competencies, industry level analysis and competing for the future. Other research has focused on improving the competitiveness of firms from developing nations (Fitzgerald, 2002); the focus is on firms that are the leaders in world markets, regardless of their origin.

In 1980s, Michael Porter wrote three books, *Competitive Strategy: Techniques for Analyzing Industries and Competitors, Competitive Advantage Creating and Sustaining Superior Performance, and Competitive Advantage of Nations.* Among these research Porter analyzed ‘Generic Competitive Strategies’ model in *Competitive Advantage Creating and Sustaining Superior Performance in1985*, and become very popular and still being utilized by many companies in the world wide. In this research shown, that companies pursue one of four generic strategies based on their strategic target and their strategic advantage, cost leadership, differentiation and focus that will explain as follows (Porter, 2004a, 4-6).

2． Generic Competitive Strategies’ model

The Generic strategy model of Porter which espouses cost leadership, product differentiation and focus (Figure 1). The generic strategies provide direction for firms in designing incentive systems, control procedures, and organizational arrangements. In the context of the overall generic strategy which a firm may be

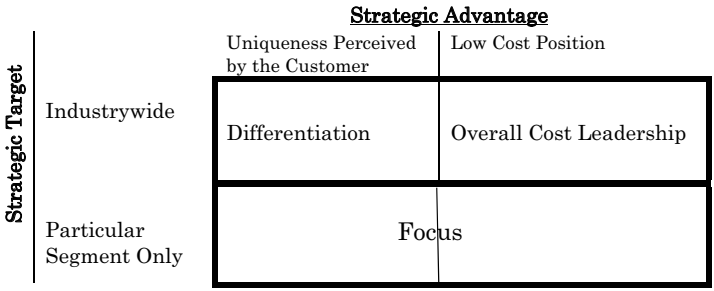
pursuing that strategic options may be usefully considered. Porter suggested that businesses can secure a sustainable competitive advantage by adopting one of three generic strategies. The generic competitive strategies that firm's may use to gain competitive advantage through the cost leadership, differentiation and focus are as follows (Porter, 2004b, 35).

i) Cost leadership strategy that overall cost could be provide the low cost. A firm utilizing a cost leadership strategy seeks to be the low cost producer relative to its competitors. A firm which finds and exploits all sources of cost advantage and aims at becoming a lot cost producer in the industry to pursue a sustainable cost leadership strategy.

ii) Differentiation strategy, that offer a better product or service. A firm seeking to be unique in its industry along some dimensions of its product or service that are widely valued by customers is said to have adopted differentiation strategy.

iii) Focus (Niche) strategy that focus on a particular market niche which focus on one type of customer When a firm seeks a narrow competitive scope, selects a segment or a group of segments in the industry and tailors its strategy to serving them to the exclusion of others, the strategy is termed focus strategy.

Figure 1: Illustration of Porter's Generic Strategies



Source: Porter, 2004, 39.

More recently, Porter's theory is generally accepted, the studies have tested on national competitiveness based on the model. Competitive strategy is the basis on which a business unit might achieve a competitive advantage in its market. At the same time a firm can clearly improve or erode its position within an industry through its choice of strategy. Generic strategy then not only responds to environment but also attempts to shape that environment in a firm's favor.

EVs has analyzed with generic strategy on the low cost leadership, companies that use the differentiation strategy offer unique products or services to the customer, the EVs to develop and maintain its competitiveness in the target market. EV's generic competitive strategy is based on making its products different from those of competitors. The company's intensive strategies for growth are focused on developing new products that suit global market trends. The company grows through innovation and creativity, which enable the business to compete against global markets. However, before analysis on competitive generic strategies of EVs, it will brief discuss of trends and prospect of EVs of both countries Japan and China.

Ⅲ. Present Trends and Prospect of Electric Vehicles

The development history of the automobile [(4)] are different opinion on invented as well as electric automobile can be divided into a number of periods, based on the prevalent means of propulsion during that time. The early period, development of electric car has been over a hundred years but failure to gain the public acceptance in various stages due to various reasons. The first EVs were introduced as early as in 1838, more than half century before internal combustion engine vehicles (ICEVs) entered the market (IEA, 2015, website).

Second period, the electric powered cars continued development all the way into the 19th century, enjoyed popularity between the late 19th century and early

20th century, when electricity was among the preferred methods for automobile propulsion, providing a level of comfort and ease of operation. It was the time of golden age for EVs, because gasoline engine powered vehicles were not developed enough at all (Michael, 2007, 16).

Third period, the EVs could not be achieved its goal, due to cost disadvantage versus the gasoline vehicle, Ford model T was sold US$550 and the Century Electric Roadster was sold US$1,750 in 1912, the improved gasoline engine and produced mass production as the basis for mass consumption. EVs used increased to a peak of 30,000 units whereas gasoline vehicles were 900,000 in 1912 in America (Mihael, 2007,16-19). While demand for gasoline engine vehicles grew rapidly in America, Europe, then Japan and later other Asian countries. As a result, the EV entered into "dark age" in 1920s (Mihael, 2007,19) remarked by Robert McAllister Lloyd who was pioneer of EV (David, 2000, 88).

Fourth period, in 1970s had twice the oil crisis that followed the imposition of the OPEC (Organization of Petroleum Exporting Countries) embargo, world's attention on the development of EVs but the dissemination of gasoline engines as the motive power of choice in the late 19th century marked the end of EVs except as curiosities (David, 2000, 17-18).

Fifth period, golden age of EVs sector coming again. The beginning of the new century EV ever be reborn in latest and high technological using IT (information technology) and AI (artificial intelligence) technology. GM came up with the Chevrolet Volt in 2007, a vehicle that would drive on battery power; Tesla Motors came up with the luxury model Tesla Roadster and, in 2010, Nissan Leaf introduced the first Asian mass produced EV. The Mitsubishi iMieV is the first EV that sold in more than 10,000 unit in 2011. The Prius Model from Toyota success full innovative, which totaled 3 million items sold in 2013. In Asia region has started to expansion the market for EVs (Table 1). In terms of the development of its EV industry, Asia has now pulled ahead of

Table 1: Trend of Electric Vehicles (BEV and PHEV) in Some Asian Countries and USA (Units: 1,000)

Country	Type	2010	2011	2012	2013	2014	2015	2016
China	Stock	1.91	6.98	16.88	32.22	105.39	312.77	648.77
	Registrations	1.43	5.07	9.90	15.34	73.17	207.38	336.00
	Market Share(%)	0.01	0.04	0.06	0.09	0.38	0.99	1.37
America	Stock	3.77	21.50	74.74	171.44	290.22	404.09	563.71
	Registrations	1.19	17.73	53.24	96.70	118.78	113.87	159.62
	Market Share(%)	0.01	0.17	0.44	0.75	0.74	0.67	0.91
Japan	Stock	3.52	16.14	40.58	69.46	101.74	126.40	151.25
	Registrations	2.44	12.62	24.44	28.88	32.29	24.65	24.85
	Market Share(%)	0.06	0.35	0.53	0.63	0.68	0.58	0.59
South Korea	Stock	0.06	0.34	0.85	1.45	2.76	5.95	11.21
	Registrations	0.06	0.27	0.51	0.60	1.31	3.19	5.26
	Market Share(%)	-	0.02	0.04	0.05	0.09	0.21	0.34
World	Stock	16.81	64.58	182.64	388.07	715.39	1262.61	2014.22
	Registrations	6.78	47.58	118.06	203.66	323.42	547.12	753.17
	Market Share(%)	0.01	0.10	0.23	0.38	0.54	0.85	1.10

Source: IEA, 2017, website

other countries, a leadership position, growing industrialization in China, India, Indonesia, Malaysia and several other countries in Asia Pacific is likely to contribute to the growth of EVs. The performance of automobile manufacturers in China, India and ASEAN [(5)] is takeoff periods from the development stage. In 2016 automobile including EVs sold in Asian 18 countries total was 42.64 million which was the first time to exceed 40 million units. China was the high numbers of vehicles 28.03 million units, Japan 4.97 million units, India 3.71 million units (Fourin, 2017a, 270-275).

The ASEAN and China market is an important market that Japanese automobile manufacturers have cultivated over several years, but competition has been intensifying due to the entry of American, European manufacturers since 1990s. Recently the Chinese and Indian automobile market have been creating a competitive situation of the European, American and Japanese

company joint venture. Asia Pacific already become the world's largest automobile market whereas, EVs sales of the total numbers of vehicles are not so many, compare with conventional vehicles, but sales and production are increase steadily.

EVs have remained a relatively small market. The market is still concentrated in a limited number of countries. Among the total sales 95 percent are taking place in just 10 countries in Asia, America and Europe. China, America, Japan, Canada and the six European countries [(6)]. China became largest EVs in 2016, with 336 thousand new electric cars registered. EVs sales in China were more than double in America, where EVs registrations rebounded to 160 thousand units in same year. However, this section, it will be analyzed the EV development in Japan and China. In cases of Japan, Toyota produce hybrid and PHV, Honda, Nissan, and Mitsubishi are also manufacturer of EV, but there are small and medium size companies, which have the capability to build small EV cars for specific niche markets such as the vehicle markets for handicapped or elderly persons. In cases of China, the EV market and production is completely different between Japan which will be discuss later.

1． Electric Vehicles in Japan

Japan played an important role in the Global Automobile Industry, since they began building their first automobiles in 1910s. The history of first car in Japan has controversy and mystery with it. According to Sasaki, the first Japanese car was the Yamaba omnibus built in 1904 and powered by steam. Others say the first car built in Japan was the Yoshida omnibus built in 1905 powered by a gasoline engine (Sasaki, 2009, 14-18).

The automobile industry of Japan is known worldwide for its beautiful designs, innovative models, high quality, and use of advance and sophisticate technology. The Nissan Automobile industry in Japan was established in 1933, which was Datson by DAT Motors, produced small vehicles. Then Toyota

Automobile in 1937 those were produced at full scale the first time in Japan. During the wartime Japan was restrictions on gasoline, EVs were used between 1937 to 1954. In 1949 there were 3,299 EVs were use about 3 percent of all Japanese vehicles on the road at that time (Mihael, 2007, 20). After Second World War, the automobile industry technology has made remarkable progress, started to mass production of gasoline vehicles. In 1970s EVs reappeared through assisted by government funding US$ 20 million to the Toyota, Daihatsu, Mazda, Mitsubishi all worked on prototype EVs(Mihael, 2007, 25) but this time also EV has not achieved their goal . With the hard work and determination, Japanese makers have earned a prestigious position in the world automobile industry which contributed to be one of the international leader in1980s. The automobile industry in Japan rapidly growth from the 1970s to the 1990s, and overtook America as the production leader with up to 13 million cars per year produced and exported. Japan has been in the top during the 1980s through 1990s, then America in second and Germany third ranking (JAMA, website). At present, Japan has 11 companies 78 factories within 22 prefectures producing finished motor vehicles, including two that make only trucks, and several thousands of companies that supply parts and perform subcontracted work. In 1993 total automobile industry production reached peak to 42 trillion yen, 13.4 percent of the total for all manufacturers. According to the Japan Automobile Manufacturers Association, the total workforce in Japan 64.40 million among these 5.34 million workers employed in the automobile related industry, including vehicle and parts manufacturers, as well as employees of contracted companies, making 8.3 percent of total labor force nationwide in 2016 (JAMA, 2017, 2). However, automobile industry production, especially in Asia has been increasing significantly. The production performance of China exceeds Japan since 2010 and produced more 29 million in 2017, and Japan produced more than 9 million, South Korea and India produce more that 4 million (JAMA, website). According to Shimokawa, Japanese auto makers began to deteriorate

rapidly after the bubble economy. He mentioned, during the 1980s and 1991 Japanese all eleven automakers profit 1.1 trillion yen had fallen to less than half that, 400 billion yen by 1993. Three out of eleven companies went into deficit, that make confused the competitive power of auto makers in Japan (Shimokawa, 2012, 92). Begging of twenty first century Japanese automobile had several crises are recall, world recession, earthquake and tsunami, parts supplier in Thailand has flood affected. Under these circumstances Japanese auto maker has decided to produced and innovate to new model and new technology through for lean leadership (Jeffrey and Gary, 2012, xiv), and overcome the all crises.

(1) Production of EVs in Japan

The automobile industry utilizing new materials, high-tech electronics, new power sources, information technology (IT) and artificial intelligence (AI), the type of car which capable of producing new vehicles. EVs were developed faster there was a time when EVs were mainstream in the beginning of the 20th century. The automobile industry in Japan has been making efforts to innovate and mass produce, particularly PHEVs and EVs. The production data is not available up to 2012, the total production of NGVs was 746,102 units in 2010, which was exited one million units the first time in next year. EVs production was 16,169 units in 2010 and next year 2011 was 42,036 units and decreased to 29,757 units in 2012 (*Jisedai jidosha shinko senta,* website). Nissan, Toyota, Honda, Mitsubishi, and some others companies produced EVs. In December 2017, Toyota announced its partnership with Panasonic for the production of batteries to be used in EVs.

(2) Sales of EVs in Japan

PHEVs and EVs sales have been growing over the several years. EVs are also promoted Nissan and Mitsubishi have released EV and Toyota has released a plug-in version of its Prius. The Prius as the world's first mass-produced HV

Table 2: Production of All Types Vehicles and EVs by Some Automakers in Japan (Unit)

Year	Items	Toyota		Nissan		Honda		Mitsubishi	
		All	PHEV	All	Leaf	All	Fit	All	i-MiEV
2012	Production	3,492,913	480,640	1,148,265	14,000	1,029,313	300,644	517,088	12,585
	Sales	1,597,608	317,676	662,963	11,115	745,204	209,275	140,493	4,782
2013	Production	3,356,899	601,913	964,546	29,230	840,650	250,000	591,893	2,264
	Sales	1,597,608	253,711	682,659	13,021	763,388	181,414	139,016	2,952
2015	Production	3,188,444	267,800	872,796	9,300	730,207	191,000	635,441	5,597
	Sales	1,435,934	127,403*	594,181	9,057	726,927	154,838	102,009	1296
2016	Production	3,166,338	471,000	950,054	22,400	820,240	215,600	555,018	5,248
	Sales	1,586,822	248,258*	539,719	14,795	707,044	148,176	85,720	408

Note * the data only Prius model.
Source: JAMA and *Jisedai jidosha shinko senta,* Fourin, and *Nikkan Jidosha Shinbunsha*, Toyota, Honda, Nissan and Mitsubishi website.

since 1997, it is driving global environmental vehicles, and its cumulative sales volume in 2016 reached 9.11 million units (Nikkei Sangyo Shimbun, 2016 May 23rd). Nissans' LEAF was launched following Mitsubishi iMiEV, a full-scale mass production compatible EVs (Table 2), and the number of EVs for customer has been increasing.

(3) Domestic Market in Japan

Although the domestic market in Japan has experienced economic stagnation, the global financial recession and the natural disasters of March 11, 2011, the vehicles market has seen a firm upward trend as a result of specific market policies and government incentives. HEVs have been on the market for several years, but it was not get market popularity in the first time, and now fairly sophisticated and reliable, are consequently in high demand. Since then, rising gasoline prices and growing concern of pollution have helped make the Prius the best-selling hybrid worldwide during the past decade. Due to the late introduction of the latest model and associated technology, the sale of NGVs dropped in 2015 to 1,116,409 NGVs units and 10,467 EVs units. Comparatively, in 2014, NGVs sold 1,127,874 units and EV sold 16,110 units on the Japanese

Table 3: Trend of Japanese Automobile Industry (Unit)

Items			2010	2011	2012	2013	2014	2015	2016
Production of All Vehicles			7,741,063	7,911,073	9,943,077	9,630,181	9,774,665	9,278,321	9,204,590
New Registration	EV		2,442	12,607	13,469	14,756	16,110	10,467	15,299
	PHV		0	15	10,968	14,122	16,178	14,188	9,390
	NGVs		492,590	472,727	952,501	1,025,353	1,127,874	1,116,409	1,444,772
Sales	E	Total	2,442	12,607	13,469	14,756	16,110	10,467	15,299
		Stan.	4,459	8,674	11,705	14,494	14,649	12,794	13,056
	V	Small	—	4,585	4,719	2,283	1,786	1,042	407
	PHV		0	15	10,968	14,122	16,178	14,188	9,390
	NGVs		492,590	472,727	952,501	1,025,353	1,127,874	1,116,409	1,444,772
	Share		11.7	13.4	20.8	22.5	24.0	26.5	34.8
Sales of All Vehicles			3,880,266	4,009,988	4,439,092	5,375,513	5,562,888	5,046,510	4,970,260
Exports of All Vehicles			4,803,068	4,622,005	4,658,649	4,632,178	4,490,724	4,582,525	4,636,454
Imports of All Vehicles			243,493	289,088	349,435	361,333	354,704	336,988	—

Note: Stan. (Standard), (—) data not available.
Source: JAMA and *Jisedai jidosha shinko senta*, Fourin, 2014, 282-285. 2017, 280-283, and *Nikkan Jidosha Shinbunsha*, 2017,334-355.

local market (Table 3). Viewing this as an opportunity Tesla introduced its latest model e-vehicle into the Japanese market, and has had a gradually expanding market.

2． Electric Vehicles in China

The development of automobile industry along mass production in Europe, America then Japan, but in China behind for near half century and nobody would have predicted that China would become highest product and giant market in the world. The high economy growth in recent decades has expanded demand of vehicles markets. However, it has also caused a negative environmental impact that is currently raising concerns from both the Chinese government authorities and the international community (Vennemo *et al.,* 2009). From this perspective, Chinese government development of New Energy Vehicles (NEV) (Liu & Kokko, 2013). These vehicles, powered by renewable energy, can counter the ills caused by the rise in consumption and pollution from fossil fuel cars purchased. Research of NEV and EVs since the 1990s by

the government, companies and research institutes have been contributed great achievements. Some of the independent companies have been building plants and successful in expanding their EVs market, for example, Geely, Chery and BYD are mainly.

However, the historical background of the Chinese automobile started as early as the 1930s. At first the government set up a program for the vehicles production between 1938 and 1958. Soviet and Japanese support helped to set up production works for HGVs (hypersonic glide vehicle) industry in Shanghai, Tianjin, Changchun and Nanjing (Taylor, R.1996). China's main alliance was with the USSR (the Union of Soviet Socialist Republics) that was one reason, Russian technology and designs engaging in technological development in vehicles manufacturing. The first modern automobile factory First Automobile Works (FAW) began produced of commercial vehicles in 1958. NJ130 the first time 2.5 tones light duty truck which was based on the Russian GAZ (*Gorkovsky Avtomobilny Zavod*), was produced in Nanjing which named 'Guerin' brand by Ministry of Industrial Machinery. In the same year FAW has produced nationally in Changchun with the "Red Flag" and in Shanghai with the model "Phoenix". The following decades others companies has established and started to produced varied segments of the vehicle.

After the economic reform in 1978, China has transformed to socialist market-based economy. China around 40 years, restrictions and controls on the automobile sector have been gradually relaxed. As result, vehicle manufacturers growing and China has established more than 130 companies. The automobile sector that between 1950s and 1980s manufacturing produced for military and commercial vehicles. Among 130 companies only 16 produce passenger vehicles, and only four of these businesses achieve annual output of more than 100,000. These are FAW (First Automotive Works), SAIC (Shanghai Automotive Industry Corporation), DMC (Donfeng Motor Cooperation) and the Tianjin Automotive Industry Corporation (TAIC). In the 1980s and early 1990s,

the government began to approve joint venture partnerships with major global automobile manufacturers in order to develop China's domestic production capabilities. The government of China has an important step in the development of the automobile industry policy in 1994, as known 'Policy for the Automobile Industry'[(7)]. The aims of the policy's were to attract large internationally established manufacturers to operate in China under joint venture, with foreign ownership of such ventures limited up to 50 percent. As well as getting involved with foreign companies, the Chinese are making efforts themselves to prevail in the automobile market.

Under the new automobile policy and joins the WTO in 2001, has encouraging joint ventures participation. As a result, top 10 automobile producers has joint with foreign companies as a joint venture. The FAW, SAIC and DMC so-called 'big three' has participated in the joint ventures. Some company have change to joint name: SAIC Volkswagen Automotive Co. Ltd., FAW-VW Automobile Co. Ltd., Dongfeng Nissan Passenger Vehicle Co. Ltd., Beijing Hyundai Motor Company, Changan Ford Automobile Co. Ltd. (CAF), Dongfeng Peugeot Citroen Automobile Company Ltd., FAW Toyota Motor Sales Co. Ltd., Chery Automobile Co. Ltd., Geely Holding Group, SAIC which shows that joint ventures with foreign automakers maintain a strong position on the Chinese market. These automobile industry has advanced technology and solutions are fundamental and necessary elements for its' sustained growth and international competitiveness. China become the world's biggest vehicle market as well as EVs, has considering a ban on the production and sale of fossil fuel cars by 2040, in a major boost to the production of EV. The government wants to put 7 million EVs on its roads by 2025 (CAAM website).

(1) Production of EVs in China

The performance of vehicles production in China reached one million vehicles in the first time in 1992 (Chowdhury 2013, 88) and further increased

Table 4: Trend of Chinese Automobile Industry (Unit)

Items		2012	2013	2014	2015	2016
Production		19,271,808	22,116,825	23,491,900	24,597,600	28,028,000
NEV Production	EV	13,300	14,243	48,605	254,633	340,000
	PHV	1,000	3,290	29,894	85,838	87,000
	Total	14,300	17,533	74,763	340,471	517,000
NEV Sales	EV	—	14,604	45,048	247,482	316,000
	PHV	—	3,038	49,715	83,610	86,000
	Total	—	17,642	74,763	331,092	402,000
Exports		1,013,235	943,166	950,000	755,500	708,000
Imports		1,132,031	1,195,040	1,430,000	1,101,900	1,041,000
Market Size		19,,306,435	21,984,079	22,833,590	24,944,000	28,361,000

Note: market size = (total local production + imports) – exports), (—) not available.
New Energy vehicles (EVs, PHVs, and FCVs.
Sources: Fourin, 2014, 2017, Global Trade Atlas, MIIT, CAAM, website.

more than 5 million in 2005 which country stood forth raking in the world. The auto industry became the first raking in production and sale since 2010. Two manufacturers, the SAIC and the FAW, where Volkswagen is involved in joint ventures, achieve output of even more than 200,000 vehicles per year (CAAM, website). This includes both the big joint ventures with foreign participation and also completely Chinese producers, who often produce fewer than 1,000 vehicles per year. The total production 29 million vehicles produced in 2017 is expected to grow to 40 million by 2025 (CAAM, website). It is important to note the imports of passenger cars that drastically exceed the exports (Table 4) which is due to the fact that Chinese consumer prefer imported cars over the ones produced domestically. The exports of Chinese passenger car manufacturers are considerably small showing slight growth only in 2012 (Table 4). China mostly exports light trucks and passenger cars to developing countries and Middle East (Amighini, 2012, 325-341).

(2) Sales of EVs in China

The EVs companies including SAIC, FAW, Dongfeng, Changan, BAIC,

Table 5: Sales of Chinese EV enterprises in 2016

Passenger EVs		Electric Buses	
Company	Unit	Company	Unit
BYD	100,178	BYD	13,278
Geely	49,218	Yutong	26,856
BAIC BJEV	47,048	Zhongtong	14,105
Zotye	36,999	Higer	7,042
Chery	20,963	BAIC Foton	6,754
SAIC	20,017	Golden Dragon	5,327
JAC	18,369	Yinlong	5,285
JMC	15,608	Wuzhoulong	5,103
Chang'an	4,931	Ankai	4,950
DFM	4,347	Skywell	4,893

Source: Ming Cheng and Minghao Tong 2017, 2

Chery, BYD Geely and others in the country produced a total of 48,000 pure electric cars and 30,000 plug-in hybrids (Table 5). Of all EVs sold in 2013, 71 percent are sedans, 27 percent buses and 1 percent trucks. The data of CAAM, EV sales increased 324 percent in 2014 as compared to 2013. Production reached 78,499 units, 4.5 times higher than the figure in that year (CAAM, website). According to IEA, Chinese government has a target of putting 500,000 EVs and PHEVs on the road by the end of 2016, and 5 million by 2020. Table 4 shown the target was not to the goal. However, Table 5 shown the sales of EVs in different companies in 2016.

(3) Domestic Markets in China

With China's economic development has been so great that it has been called "the factory of the world" in 1990s, and the resulting increase in its population's purchasing power by growing middle class., the country has become one of the world's largest consumer markets so called "market of the world" recently. Thus, several automobile manufacturers operating in the Chinese market, started developing electric vehicle models (Mark and

Markus, 2011, 24-25). Still in China, there is less than one car for every six individuals. In the United States, there is nearly one car on the road for every person and Japan has one car for every two person. While the number of cars per person in China take time to reach U.S. levels. According to the CAAM, the market should double its size to approximately 200 thousand units in 2015 (CAAM website). Automobile production and sales of China overtook all over the European countries, Japan and finally the United States as since 2009. Automobile production began to pick up significantly at the start of the 2000s, and currently has the highest growth potential more than 29 million vehicles sold in 2017 (JAMA, website).

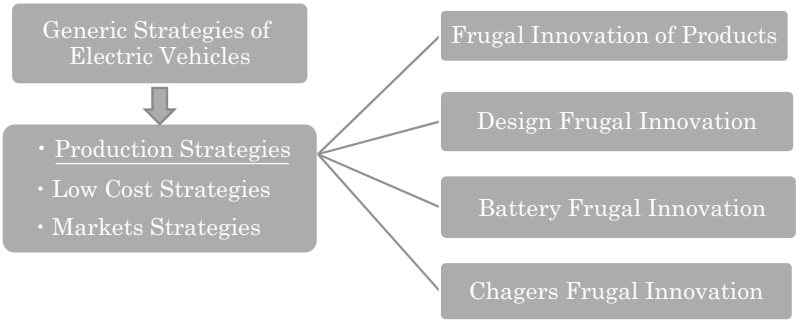
Expansion of market demand of EVs due to fall in costs for lithium ion batteries. The government introduced a number of policies aimed at increasing purchases of passenger vehicles. A ‘car-scrappage scheme’[(8)], ‘China’s emission standards’[(9)] ‘The Thousands of Vehicles, Tens of Cities (TVTC) Program’. This pilot program, which also started in 2009, has been selecting and subsidizing Chinese cities to implement EVs as a way to disseminate the culture of this mode of transportation in the country. The number of cities scaled to 25 and in all of them, public utility sectors such as buses, taxis, sanitation vehicles, postal fleets and official vehicles were prioritized (Gong et al. 2013, 207-228). Government also provided a grant of between 3,000 yuan (US$ 470) and 6,000 yuan (US$ 940). In January 2010 these grants were increased to between 5,000 yuan (US$ 785) and 18,000 yuan (US$ 2825) and the scheme was extended by six months to the end of 2010 (CAAM, website).

Ⅳ. Competitive Strategies of Electric Vehicles

Competitive strategy of EVs advocates three main factors (Figure 2) of products, cost, and markets. These three factors are possible to compete to competitiveness of the company through technology innovation as well

as ‘frugal innovation’[10]. In these regard, company has main concern is for customers and prices. The company took several steps to overcome of competitiveness through to make the customer understanding about the products (design, technology and model). An EV buyer decisions has always priority on prices and products. Satisfaction of customer with the product, cost and services of EVs, they make decision to buy an EV. Regardless, technology development and frugal innovation is very important factors to reduce cost, produce high quality that contribute to good product and services. However, it will analyze and find out possibility efforts of frugal innovation in EVs and its sectors are as follows.

Figure 2: Competitive Strategies of Electric Vehicles



Source: Compiled by Author from Porter’s Generic Strategy.

1．Production Strategies

The Asian EVs players based in Japan, South Korea, and China created significant competitive pressures in the international market. Recently, the production of EVs rising competition among the Asia, America and European giant companies like, Tesla, Chevrolet, Ford, Mercedes-Benz, BMW, Toyota, Honda, Nissan, Mitsubishi, Hyundai, Kia, BYD and others to shift their

production bases in innovation in different model which help them operate efficiently in a globally competitiveness. Perspective on the competitive impacts of strategy vary between Japan and China.

The competitive pressures of Japanese EVs as well as auto manufacturer has been facing workforce problems, increasing an aging population, and changing Japanese style of management "*Genba*[11]" under these circumstances automobile industries are moving to new technologies, to develop new innovations on original inventions, and to bring them to market. Japan is the most significant technological advances country, automobile sectors as well as EVs sectors are one of the pioneers in this industry, which has been making effort to produce EVs at low prices, high technology and latest model. As a high technology's country, Japan which can adopt of frugal innovation for product to achieve their goals.

China has opportunities of low cost in nature, based on low wage huge workforce and it has a big market. The EVs maker the BYD (Build Your Dreams)[12] launched the e6 sedan since 2008 crossover those also similar initiatives for environmental burden and energy problems. But EV sectors in China has need to more advanced technology to the innovation that possible of frugal innovation new high technology. Japan achieved high technology and better performance like Toyota's Prius, Nissan's Leaf Mitsubishi i-MiEV, Honda's Insight and Fits and others makers.

The EVs producers must consider to innovate for emergence markets and middle class customers those are able to afford such an EV. Intensive strategies are implemented with strategic objectives for maximizing the growth benefits of such innovation. Japanese government has an intensive program has been subsidies[13] are granted for the purchase of such vehicles. EVs production strategies consider to frugal innovation of design, batteries and charger to use the low cost to increase their ability to compete global markets.

(1) Frugal Innovation of Design

The development of technology is now and where it will go in the future, and what was the old technology (Michael ,2007, x) or first technology of EV, that come through the innovation for long way. Innovation is the way of new design, long ranger batteries, charger and others parts are important for further innovation like frugal innovation of EV production. Frugal innovation has been applied Tata Motors [14] in India extensively in the electronic goods. EVs and its sectors uses many parts are electronic items. Frugal innovation is achieving more with fewer resources that companies can create high quality products with limited resources, capabilities to build new models, design and quality. Frugal innovation can contribute less complex and more sophisticated products that are easier to handle and considerably cheaper to produce EVs. For example, the manufacturing of gasoline vehicle to need 30,000 parts whereas EVs drive motor and buttery as main parts to need less than 20,000 parts to produce each unit. EVs are optimized to meet multiple objectives, size, weight, physical shape and interior space in the vehicle determine its appeal to the potential customer, as does the performance on the road range and the time to recharge (Michael, 2007, 120). Although design, safety, reliability, comforts, and ease of operation, long range, automatic driving, and price affordability is encouraging market demand. The most important to design and reduce as possible as the weight of EV. Honda Insight is an example to reduced body weight by 40 percent below that of a comparable steel body, which are seem to achievement of frugal innovation. At present development costs for new models are in the order of more than billion US dollar, and need to be offset against high volumes in order to ensure competitive prices that will led to cost declines (*Jiseidai Jidosha Shinko Senta*, website).

Porter (1985) believes that technology is one of the most significant forces affecting business competition. Technological developments in EVs sector have been accelerating and achieving in many related fields, like a driving

range, charging times, utility economy and others. Based on this generic strategy, strengthen competitive advantages through marketing strategies that reinforce the uniqueness of the company's brand. Brand uniqueness helps in achieving industry leadership. The differentiation generic strategy develops the competitive advantage of new business operations that use the company's brand.

(2) Frugal Innovation of Battery

The battery system is one of the most important technology of EVs and their range performance. EV need large amount of energy is stored in a charged battery as it is in tank of gasoline, and any short circuit which does occur in an accident could result in a major release of this energy and a consequent explosion and fire (Michael, 2007, 124). High technology and frugal innovation has potential to significant improve to the batteries that help to overcame short circuit, weight and size, and also achieve to the barrier of high prices to compete with gasoline vehicles. Development in advanced technology batteries such as lithium-ion, reduced vehicles weight, but still a trade-off between range and battery weight and size (Michael, 2007, 122, 189). Lithium-ion provide relatively high power and energy for a given weight or size, and can significantly reduce costs compared with other battery concepts[15]. Lithium-ion has relatively long life cycle and low self discharging losses sensitivity to overcharging, which is why they require a battery management system. Battery costs, which account to 25 percent of an EV's price, as for example, the price of battery, in the case of i-MiEV of Mitsubishi Motors is 2,400,000 yen. It more than half of price of electric passenger vehicles is 4,599,000 yen and reduction of this cost is indispensable to the spread of EVs.

The battery production among the world top ten, five from Japanese companies those are AESC, Mitsubishi/GS Yuasa, Hitachi, Panasonic and Toshiba. In South Korean companies are LG Chem and Samsung SDI, Chinese

BYD, these are all captured their domestic and international markets. According to Japan's Ministry of Economy, Trade, and Industry shows that China holds just 1 percent of total patent registrations for lithium ion batteries far behind Japan at 52 percent and the United States at 22 percent in 2012. Panasonic is still the world's largest supplier of EV batteries globally; it is currently building the so-called Giga factory in Nevada, US, with US-based EV producer Tesla. Chinese battery producers, including CATL, BYD, and Lishen, continue growing, and battery production shifts from Japan and South Korea to China. As a result, China producing 55 percent of global lithium batteries, which will increase to 65 percent by 2021. It is quite clear that China recognizes the opportunities in the rapidly growing battery industry and does not plan to miss out on these opportunities (CAAM website).

(3) Frugal Innovation of Charger

Charging a battery is fundamentally different from filling up gasoline in a vehicle, which refuel at gasoline stations within three minutes for filling time. While EVs may charge parked at home, at work, or in public spaces. AC chargers are capable of first charging an EV about 30 minutes in Japan (Table 6). These chargers are able to transform high-voltage AC to DC, for storage in EVs. There are slow and fast charger developing in Asian countries (Table 7). The travel cost about 500 km, about 5000 yen or US$40 in Japan. In a small EV

Table 6: Charging Time and Range of Japanese EVs

Types	Makers	Model	Range (km)	Charging Time (hour)		First charging (minute)
				AC100V	AC200V	
EV	Nissan	Leaf	228	—	8	30
	Mitsubishi	i-MiEV	180	21	7	30
PHV	Toyota	Prius	26.4	3	1.5	—
	Honda	Accord	37.6	4	1.5	—
	Mitsubishi	Outlander	60.2	—	4	30

Source: Nikkan Kogyo Shinbunsha, 2014, 29.

to put the 25 kWh of energy needed to travel each 160 km into the battery in the same time and costing about 300 yen (US$2.50) per charge.

The charger connectors namely CHAdeMO “CHArge de Move” or “charge for moving”, The CHAdeMO association a partnership between Toyota, Nissan, Mitsubishi, Fuji Heavy Industries and the Tokyo Electric Power Company−was established in March 2010. Combined Charging System (CCS), and others (Tesla Supercharger and China GB/T). CHAdeMO connectors are capable of delivering 62.5 kW of DC and are specified by Japan Electric Vehicle Standard (JEVS) (*Jiseidai Jidosha Shinko Senta*, website).

Japan has surpassed the number of gasoline stations with EV charging service station. In 2016, there are over 40,000 charging service stations in Japan, compared to 34,000 gasoline stations where as in America there are 14,349 stations (*Jiseidai Jidosha Shinko Senta*, website). This growth is supported by government policies and automakers’ effort to boost EV infrastructure. For instance, in 2014, Toyota, Honda, Nissan, and Mitsubishi formed a new company called Nippon Charge Service, LLC to encourage the installation of EV chargers.

Table 7: Electric Vehicles Charger in Some Asian Countries and USA (Number of Units)

Countries	Type	2014	2015	2016
China	Slow charger	21,000	46,657	52,778
	Fast charger	9,000	12,101	88,476
USA	Slow charger	9,142	15,483	24,658
	Fast charger	2,518	3,524	5,384
Japan	Slow charger	8,640	16,120	17,260
	Fast charger	2,877	5,990	5,990
Korea	Slow charger	151	449	1,075
	Fast charger	237	489	750
World Total	Slow charger	91,494	159,072	212,394
	Fast charger	17,127	28,021	109,871

Source: IEA, 2017, website

China has growth in both EVs and their charging infrastructure. In 2015, 160,000 charging piles has been built, and that only accounts for 40 percent of the original plan. China intends to build 12,000 charging stations by 2020, which can accommodate five million EVs by 2020. According to Ministry of Science and Technology of People's Republic of China, charging service companies still face bottlenecks, Chinese government has provided subsidies to provinces and cities to support installing charging stations. The subsidy could reach 30 percent of the total investment. (Ministry of Science and Technology of People's Republic of China, website)

However, the development of chargers has not the solution of EVs sector at all. It need to the design, billing systems, public safety and planning issues, the negotiation of international standards and beefing up the electricity grid to carry the increased load. The national and international standards organizations attempt to find definitive solutions to these issues, but there are so many competing national standards. Commercial enterprises attempt to leapfrog the competition by coming up with new and unique frugal innovative solutions.

2． Low Cost Strategies

Cost leadership of generic strategy requires main strategy elements such as scale efficient plants, outsourcing abroad and design process that is heavily focus on the manufacturing of the products. Price is one of the factors that influences sales variability of products and services significantly. Mass production and mass consumption is basic strategies of cost leadership. The automobile industry has developed mass production, mass consumption since 1960s. But the end of the twentieth century it was clear that mass production, mass consumption and mass waste which come to way of a lean [16] production system. This led to the emergence of perform flexibly with change in demand and which operated through all the processes of development production, procurement, sales and cost (Shimokawa 2012, XIV). Technology innovation

and development has been contributing low costs EVs and its related battery costs have been declining since 2010. Further frugal innovations, as well as substantial new battery capacity will declines price that will be contribute to expansion of EVs markets. Still the cost of EV are quite high (Table 8). EV technologies are substantially more expensive than conventional vehicles; batteries represent the high cost. The dealer price is 3.15 million to 3.99 million yen, which means, after subtracting the government subsidy of 400,000 yen and waiving the taxes, which purchasers have to pay 2.5 million yen an EV (*Jiseidai Jidosha Shinko Senta*, website).

In China, where consumers can access the central government subsidy of 60,000 yuan (about $9,600) as well as an additional city-level 60,000 yuan subsidy, the price of a BYD E6 is still 170,000-180,000 yuan ($27,200-$28,800) which is twice the price of similar, domestically branded conventional vehicles. According to Hao et.al (2014, 722-732), the support and subsidies of Chinese government are not enough for the EVs market to take off further technological improvements regarding the limited electric range and reductions of the battery costs are essential for the further development of this EVs sector. Another barrier is the limited driving range of EVs between charges. Lastly, the lack of infrastructure for charging creates obstacles for deployment of EVs. On average, Chinese produced cars are cheaper than those produced in Europe, Japan and USA. The average price of EVs sold around US$25,000 (Table 8). In addition to relatively low labor costs, domestic producers have been able to keep prices low by using established technologies and models obtained through various joint venture partnerships (Table 8). Currently, most of the automobiles companies consider price reduction as major strategic for growth. For price reduction, companies need to take series of decisions at every stage of production and selling; starting from managing factors of production and supply chain to negotiation with dealers.

Table 8: Comparative Analysis of Different Companies EVs

Maker	Model	Range in Km/h	Price (US$)
Nissan (Japan)	Nissan Leaf	170	31,545
Mitsubishi (Japan)	Mitsubishi i-MiEV	100	23,845
Honda(Japan)	Clarity	145	37,510
Hyundai (South Korea)	Hyundai Ioniq Electric	200	29,500
Kia (South Korea)	Kia Soul EV	150	32,800
Renault (France)	Zoe	300	31,000
Chevrolet (America)	Chevrolet Bolt EV	380	37,495
Ford (America)	Ford Focus Electric	190	29,995
Mercedes-Benz (Germany)	Mercedes-Benz B250e	140	40,825
BMW (Germany)	BMW i3	180	43,395
Volkswagen (Germany)	e-Golf	200	30,494
Fiat (Italy)	Fiat 500e	150	32,780
Tesla Motors* (America)	Tesla Model S	500	69,200-135,700
	Tesla Model X	480	90,000-140,000
BAIC (Beijing Auto) (China)	ES 210	175	The average price of Chinese EV 25,000 to 35,000
	EV 200	200	
	E150 EV	140	
	C30 EV	200	
Dongfeng Nissan(China)	Venucia E30	160	
FAW Volkswagen	Carely	140	
BYD-Daimler(China)	DENZA EV	253	
BYD (China)	e5	220	
	e6	330	
	T3	220	
Changan (China)	Benni EV	150	
	E30a	160	
	Eado EV	160	
Chery (China)	eQ EV	200	
	Riich M1	120	
Dongfeng (China)	E30L	160	
FAW (China)	Besturn B50 EV	140	
Geely (China)	EK-2	180	
Shanghai GM(China)	Springo	150	
SAIC (Shanghai Auto) (China)	Maxus EV80	170	
	Roewe E50	180	

Note:* Tesla has nine EVs model, lowest price is US$ 35,000 to highest US$140,000.
Source: CAAM, Web (2015),Environmental Protection Agency, website

3． Market Strategies

The EVs market mainly is driven by decreasing cost of battery and increasing in popularity among customers. EVs became much cheaper to maintenance than conventional vehicles. In addition to government support also providing incentives on purchase of EVs, and growing fuel prices are the factors of expanded EVs demand. The growth of EVs is attributed to the ever increasing production and sales of automobiles. Vehicles are becoming an increasingly affordable commodity owing to the growing disposable incomes.

As mentioned above, China had sold over 29 million vehicles in 2017, and high percentage of electric vehicles and is the world's largest EV market. Keep in mind that this number includes both plug-in hybrid electric vehicles (PHEV, BMW i3) and battery electric vehicles (BEV, Tesla Model S). BYD does make pure electric cars, a top speed of 80 to 100 km/h and ranges of average 100 to 150 kilometers one full charge takes four to eight hours which are very small two-seater car. In comparison, the compact-size Nissan Leaf has seating for five, a range of 170 km and a top speed of 150 km/h. Under these it can realized that use of EVs is highly prevalent in America, Europe, and Japan. Well developed and extensive charging infrastructure along with the incentives provided by the governments of these regions are expediting the growth of the electric vehicles. In contrast, China private owner show a slower adoption of EVs owing to the availability of gasoline vehicles.

Unless Chinas' EV technology overcomes charging, range barriers, battery technology innovation. Product of EVs are differentiation as its generic strategy for competitive advantage. Porter's model states that this strategy involves unique products offered many market segments. In this generic competitive strategy, quality and uniqueness through innovation differentiate the company's products from competitors. A strong brand based on the differentiation generic strategy creates competitive advantage to attract customers to the company's products, and to manage customers' expectations.

Ⅴ. Conclusions

From above provides the salient features of the EV in Japan and China. The paper analyzed of frugal innovation that specialization in EV sector and competitiveness as each of these two countries. EVs are uses by public sectors, private sectors, personal, and companies in Japan. Due to high price of batteries and lack of charger infrastructure in China EVs are uses mainly in public sectors. Private sectors, personal level still not much popular. Unless EV technology overcomes existing charging and range barriers given the current battery technology, most EVs in China only have ranges less than 200 kilometers, and one full charge takes four to ten hours−private consumers are unlikely to buy an EV. China should follows innovating an EV is a way through a change in strategy, long range and easy access to charging locations. The cost leadership of such a EVs are quite high when it can no longer focus on low prices to penetrate foreign markets. Precisely that high price of such an EV, the government of both countries provides grants of several hundred thousand yen per person that is acquiring to elevate of the high cost.

Japanese government and automobile authorities has been working on such a plan for emerging Asia, the implementation will certainly take time. It can bring out the idea that, Japanese ODA funding for developing infrastructure in Asia, Africa and others regions. There are some possible to make programs and plans and funding from ODA to develop charger infrastructure which is the important factor for EVs driving in Asian emerging countries and others countries. The strategy of the Japanese EVs producers must consider the needs to finding its market niche.

There are no doubts about how large the market for EVs and demand of high quality of Japanese EVs in the future. A rising world population, especially in Asian countries, will push up demand for EVs. Since the price of fuel is a key

advantage of EVs, vis-a-vis declining batteries cost, that will be reduce price of EVs and make them less competitive with gasoline vehicles. It could expect that there are great opportunities to expand demand of EVs in the future.

EV is a nascent market in this perspective, yet to go a long way and mature. It should keep an eye on these changing novel trends and try to catch up with them. Everywhere these trends are springing up without resistance. The automobile manufacturer should always be open to innovation and resilient to these contemporary changes. A fruitful result would be a healthy and vibrant EVs market leading both countries Japan and China to economic prosperity. It may be that some questions about the comparative analysis of company level, and that will be the focus of future research.

Endnotes

(1) Next-generation vehicles include Hybrid Vehicles, Plug-In Hybrid Vehicles, Fuel Cell Vehicles, Electric Vehicles, Hydrogen Vehicles, Clean Diesel Vehicles, Natural Gas Vehicles, and Diesel-Alternative LPG Vehicles.

(2) More than 60 percent of the world population has live in middle class in 2015. According to OECD report in 2011, the size of the "global middle class" increase from 1.8 billion in 2009 to 3.2 billion by 2020 and 4.9 billion by 2030. According to ADB (2010) estimated the size of the Asian middle class will expand to 2.7 billion by 2030. China and India will see the largest number middle class status. Middle class belongs US$ 2 to $13, in East Asia alone, 806 million people already count themselves as middle class – more than the total population of the European Union (Chowdhury, 2017).

(3) In this paper EV sectors included, batteries, charge system known as vehicle to grid, charging infrastructure and others.

(4) It is very evident to the average observer that the so called horseless carriage is looming up as an important factors in the transportation problem (David, 2000, 29). Automobile is not an invention of modern times. The historiography of the automobile industry was largely the fabled story of individual entrepreneurism, managerial capitalism, consumer satisfaction, and increasing prosperity (David, 2000, 15). The evolution of automobiles started as early as 1769, by invention of steam-powered cars capable for human transport (*Nikkan Kogyo Shinbunsha*, 2014, 19).

(5) Among ASEAN-10, seven countries has exceeded per capita income UD$ 2000-3000,

which has contributed to motorization in ASEAN countries (Fourin, 2017b, 2-9). In this perspective, Asia cars have the potential to grow and a huge possibility to become the world market leader of this EV industry.

(6) Norway, the United Kingdom, France, Germany, the Netherlands and Sweden.

(7) The main object of the policy was, *to group and intensify the automotive industry (reduce the 120 makers to eight to ten groups by 2000); to promote the personal purchasing of cars in order to make passenger cars the pillar of the automotive industry; to limit production of passenger cars to 0.15 million units and institute minimum production of small commercial vehicles at 0.1 million units annually; to allow foreign capital investment up to 50 percent; and to institute an incentive measure for localization which reduces the import tariff of parts depending on the localization index* (Shimokawa, 2012, 266).

(8) The car-scrappage scheme, the Government also halved the sales tax on smaller vehicles in January 2009. Initially set at 10 percent, the sales tax on cars with an engine size less than 1.6 litres was cut to 5 per cent and a further subsidy, implemented in early 2009, was paid on rural purchases of light trucks and mini-vans (up to 5,000 yuan US$ 785, in value, subsidies for purchases of motorcycles and three-wheelers were also introduced),(Mark and Markus, 2011, 26-27).

(9) China has adopted the same vehicle emission standards as the European standard, known as "Europe IV," and factory emission standards are even tighter than the USA and Europe. The emission standards for passenger vehicles for nitrogen dioxide (NOx), particulate matter (PM2.5), and carbon monoxide CO are 0.25, 0.025, and 1 gram per kilometer, respectively. These standards vary by vehicle size, truck versus car, the age of the vehicle, and the region in which the vehicle is operated. The Chinese standard for particulate material (PM2.5) is 30 mg/m3. In Europe it is 50 and in the USA is it 23. PM2.5 are fine-grained particles of size 2.5 microns or less-this size can pass into the lungs and causes of respiratory problems, aggravate bronchitis and asthma, or in extreme dosages, can cause death. China check the levels of ozone and particulate material (PM2.5) in Beijing, Chengdu, Guangzhou, Shanghai, and Sheyang (CAAM, website).

(10) Frugal innovations in automobiles will mainly be focused in the areas of friction reduction for improving fuel efficiency of engines, emission reduction, light weighting and recyclability. Tiwari and Herstatt (2012) define frugal innovations as new or significantly improved products (both goods and services), processes, or marketing and organizational methods that seek to minimize the use of material and financial resources in the complete value chain (development, manufacturing, distribution, consumption, and disposal) with the objective of reducing the cost of ownership while fulfilling or even exceeding certain pre-defined criteria of acceptable quality standards (Tiwari, *et al*., 2017). The author has further

research on frugal innovation.

⑾ *Genba* means on-the-spot, at the scene, being present on the shop floor. It is what managers are expected to do in manufacturing plants. This concept is embodied in manufacturing excellence (Jeffrey and Gary, 2012, xxiii).

⑿ In 1995, BYD Company Limited started operations with 20 employees and US$ 300,000 in initial investment. Since then, the company has grown at an average of 70% per year. Today, the Chinese company has a staff of 190,000 employees worldwide and around US$ 9.1 billion in sales (CAAM, website).

⒀ Japan brought in the Clean Energy Vehicle Subsidy in 1998 which consisted of a subsidy along with tax cuts for low-emission vehicles. This was superseded by the Eco-Car subsidy available between April 2009 to September 2010 and December 2012 to September 2013,varying between 100,000 yen to 250,000 yen depending on whether the new vehicle replaces an existing vehicle or not. (Alhulail I, Takeuchi K. (2014) "Effects of tax incentives on sales of eco-friendly vehicles: evidence from Japan" . Graduate School of Economics Kobe University).

⒁ The frugal innovative vehicle 'Nano car' produced by Tata Motors in India, 100,000 rupees a car, which is the cheapest car in the world. (100,000 rupees is equal to US$1498.21 or 250,000 yen).

⒂ Commonly used of battery types of all EVs are Lead acid, Nickel metal hydride, Lithium ion (Lithium manganese, Lithium iron phosphate,), Zebra, LiFePO4 LiFePO4 and others Automotive battery concepts include nickel-metal hydride (Ni-MH), sodium-nickel chloride (Na/NiCl2), and non-electrochemical alternatives such as super capacitors, which allow fast charging but provide low energy density. As a result, batteries with higher energy and power densities are being developed, such as lithium air (Li-air), lithium-metal or lithium Sulphur (Li-S), but these are far from commercialization (Cookson, 2015; Hacker, Harthan, Matthes & Zimmer, 2009). Li-air batteries may reach energy densities of up to 11,680 Wh per kg (Imanishi & Yamamoto, 2014), which approximates the energetic content of gasoline.

⒃ Lean manufacturing is very closely related to Total Quality Management and derives from the Toyota production model, that focuses on delivering the highest-quality product at the lowest cost and on time (Jeffrey and Gary, 2012, 7).

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