TOYOTA

IST755 Strategic Management of Information Systems

TECH ADOPTION

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Table of Contents

1. About Toyota

Toyota Motor Corporation is a Japanese automotive manufacturer headquartered in Toyota, Aichi, Japan. Toyota was the largest automobile manufacturer in 2012 (by production) ahead of the Volkswagen Group and General Motors. Toyota is the world's first automobile manufacturer to produce more than 10 million vehicles per year. Toyota is the world's market leader in sales of hybrid electric vehicles, and one of the largest companies to encourage the mass-market adoption of hybrid vehicles across the globe. Cumulative global sales of Toyota and Lexus hybrid passenger car models passed the 9 million milestones in April 2016. Its Prius family is the world's top selling hybrid nameplate with almost 5.7 million units sold worldwide as of 30 April 2016 (Toyota, Wikipedia).

Toyota Motor Corporation produces vehicles under five brands, including the Toyota brand, Hino, Lexus, Ranz, and Daihatsu. For US Market, total **market share** of Toyota as of Jan, 2017 is 12.5% and **global market share** is 12.19% (Statistica).

2. Industry – Level Framework

In the article by Teece, Pisano and Shuen, they identify two major streams in strategy: Industry-level and Firm-level. The first stream identifies the keys to firm success in terms of competitive positioning within an industry. The most famous proponent of this view is Michael Porter, whose theories of competitiveness have shaped a generation of managers. Porter's Five Forces framework is familiar to just about everyone who has taken a course in strategy. In this view, the potential profitability of a firm depends on the nature of its industry, and its position within the industry.

2.1. Porters Five Forces Model

Michael Porter provided a framework that models an industry as being influenced by five forces. It is a framework that attempts to analyze the level of competition within an industry and business strategy development.

2.1.1. Supplier Power - Bargaining Power of Suppliers: LOW

One of the porter's five forces is the force of supplier power. This is because Toyota being in the manufacturing industry requires raw materials, labor, components and other supplies. Under this force, the relationship of Toyota with its suppliers as well as relationship of Toyota with its customers will be analyzed. This is because just as there are suppliers to Toyota, Toyota is a supplier of its products to the end customers. Suppliers can have an influence over the firm or industry if they are powerful which may eventually affect Toyota's position in the market.

The bargaining power of suppliers in case of Toyota is insignificant. Various factors as discussed below play role in the significantly weak force of bargaining power of suppliers for Toyota.

- ➔ Toyota has a diverse supply-chain to support its operations. It has wide range of suppliers around the world. Moreover, there are enough suppliers available to Toyota which makes the supplier power low.
- ➔ One of the most important factor which promotes weak supplier bargaining power in case is Toyota's health relationships with its suppliers.
    - Toyota typically gets much of its components and parts through local suppliers and thus maintaining a long-term contract which also ensures steady supply for Toyota.
    - Toyota awards and recognizes its suppliers annually based on performance targets.
    - Toyota has a specialized portal for its suppliers in North America region. www.toyotasupplier.com helps existing suppliers to conduct business easily with Toyota including its purchasing policies and other documentation.
- ➔ Toyota's cost of switching suppliers could be no more than moderate as suppliers around the world want to work for Toyota. This is because of the volume of supplies Toyota takes in. Suppliers aim to collaborate with Toyota. Toyota keeps interchangeable suppliers allowing them to minimize this force. Though Toyota relies heavily on its suppliers for most of the parts and materials, the cost of switching suppliers doesn't affect the force of bargaining power of suppliers. This is also because, Toyota is capable to manufacture its own supplies too.
- ➔ The materials required to manufacture components and parts are widely available and accessible. Hence, it also weakens the supplier power.
- ➔ There is low threat of forward integration by suppliers. This weakens the force of supplier power. Moreover, there is reasonable chance of backward integration as Toyota has the capability to buy firms manufacturing its components or parts.

2.1.2. Threat of new entrants (Entry Barriers): LOW

Threat of new entrants in the industry is another of the five forces. This is because a new entrant may have the capability to become a rival and eat market share. The automobile industry in general has very less threat of new entrants. The threat of new entrants is relatively low and hence the force weak for Toyota. There are various factors contributing to this weak force as discussed below.

- ➔ Setting up a new firm in the industry require high costs of setting up and maintaining including significant entry barriers like high costs of brand development, high cost supply-chain, etc. This makes the threat of new entrant to compete Toyota low.
- ➔ High capital requirements and extensive economies of scale enjoyed by Toyota create substantial barriers for new entrants.
- ➔ The size and global scale at which Toyota operates today is another barrier for new entrants. Access to distribution channels is difficult and would require very high capital.

- ➔ The extension of threat of global setup of Toyota is another policy. Governments usually protect the home markets by introducing high import taxes. This would further weaken the force of threat of new entrants.
- ➔ Toyota was founded in year 1937 in Japan. It is very difficult to replicate the experience and knowledge that Toyota possesses by a new entrant. Also, the reputation of so many years cannot be attained by a new entrant.

2.1.3. Buyers Power - Bargaining Power of Buyers: HIGH

The power of buyers is the impact that customers have on a producing industry. This component of the Five Forces analysis shows the influence of buyers on business. Here the buyer's power is strong as there are many suppliers for particular buyer. Toyota's customers directly affect the business through revenues. In Toyota's case, the following factors are the main contributors to the high bargaining power of buyers in the automotive industry environment:

- ➔ Buyer's Concentration
  - There are many buyers. Most of the buyers are individuals that buy one car, but corporates or governments usually buy large fleets and can bargain for lower prices.
- ➔ Buyer purchases compromise large portion of seller sales
- ➔ Low switching costs (High)
  - The low switching costs mean that customers can easily change from Toyota to competing firms at no extra cost.
  - Products are standardized and buyer can easily switch to another product. Most of the buyers are individuals that buy one car, but corporates or governments usually buy large fleets and can bargain for lower prices
- ➔ High quality of information (High)
  - Toyota's customers can easily choose their best option because they have access to accurate information, such as product information from companies' websites.
- ➔ Moderate substitute availability (Moderate)
  - Substitutes are available, although cars from firms like Toyota are still better in terms of convenience.
- ➔ Buyers do not threaten backward integration.

2.1.4. Threat of Substitutes: MODERATE

In Porter's model, substitute products refer to products in other industries. A threat of substitutes exists when a product's demand is affected by the price change of a substitute product. Substitutes to Toyota products include public transportation, bicycles and other modes of transportation. In Toyota's case, the following factors in the automotive industry environment are the main contributors to the moderate threat of substitution:

- ➔ Low switching costs (High)
  - In most cases, it is relatively easy for customers to shift from Toyota to substitutes.
- ➔ Moderate availability of substitutes (Moderate)

- These substitutes are only moderately available. In some areas, substitutes to Toyota's products are absent, such as in some suburban areas where public transportation is not readily available.

➔ Low convenience in using substitutes (Low)

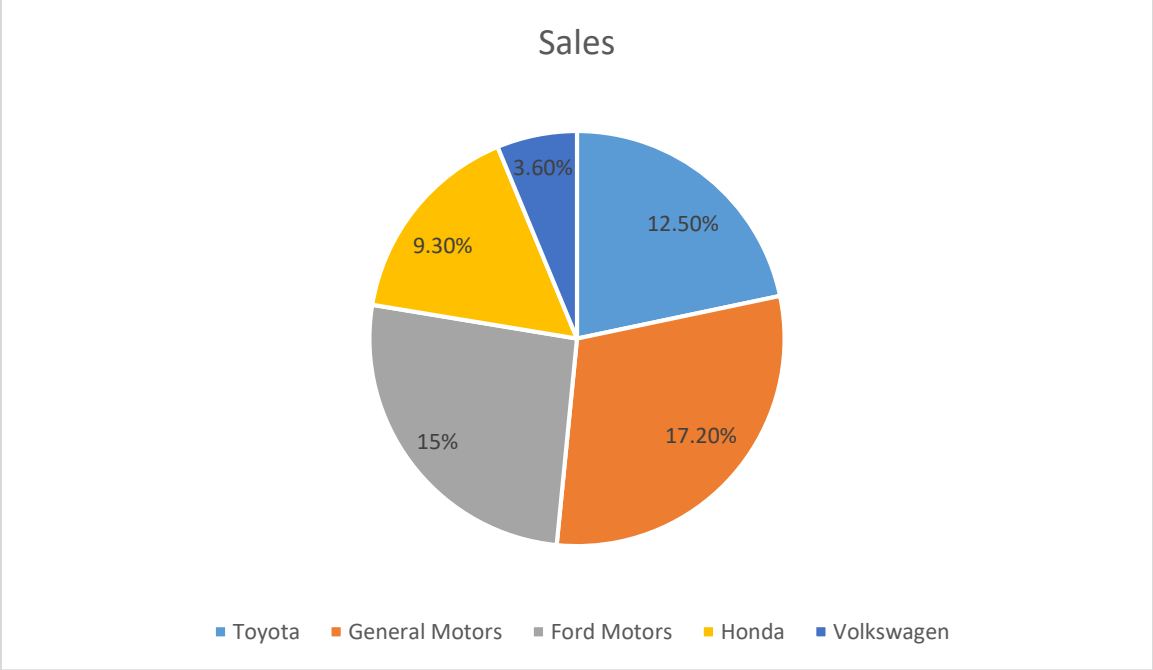
- Substitutes can rarely offer the same convenience

➔ Alternative types of transportation almost always cost less and sometimes are more environment friendly

2.1.5. Industry Rivals: HIGH

Industry rivalry or rivalry among existing firms is one of Porter's five forces used to determine the intensity of competition in an industry. Industry rivalry usually takes the form of jockeying for position using various tactics (for example, price competition, advertising battles, product introductions). This rivalry tends to increase in intensity when companies either feel competitive pressure or see an opportunity to improve their position. Toyota must deal with the strong force of competition. Toyota's competitors are Ford Motors, General Motors, Honda Motors and Volkswagen. Major sections in which all this companies compete are SUV's (Toyota's 4Runner VS Ford Explorer), Luxurious car (Toyota Camry VS Honda Accord; Toyota Prius VS Ford Mustang) and Sedan (Toyota Corolla VS Volkswagen Jetta).

Market Share (US Market 2016):



➔ Large Number of firms (High)

- Toyota and its competitors compete for the same customer and resources. Toyota and its competitors have almost similar market share.

- ➔ Toyota has continued with its efforts to strengthen its management platform and raise its corporate worth. It has also focused on developing and manufacturing environmental conscious products that also gratifies consumers' needs easily (E.g.: Toyota Prius)
- ➔ High aggressiveness of firms (High)
  - Automotive firms are aggressive against each other in terms of being innovative.
- ➔ High variety and differentiation of firms (High)
  - Toyota competes with a high variety of firms, which differentiate through cost, electronics, fuel efficiency, style, brand image, and other variables.

2.2. Business Strategies

Business strategy means many things, but one key view is that firms need to identify where they can stand out from competitors and gain a sustained advantage.

2.2.1. Operational Efficiency

Operational Efficiency has not only been a business strategy but strategic weapon for Toyota. Operational Efficiency has been mastered in terms of Toyota. Toyota invented various operational paradigms like Kaizan and Kata were benchmarks of Toyota Production System. These processes are explained in detailed under the Dynamic Capabilities framework in this paper. These processes enabled Toyota to make higher profits but the focus here is what customers achieve from this operational efficiency.

From the perspective of customers, Toyota's operational efficiency lies in its products. This cannot be termed as operational excellence as customers are not directly linked with the production system of Toyota. These processes developed by Toyota pertain to its manufacturing and supply-chain. The customer base of Toyota is attached to Toyota through its product range and dealerships. But from the customer's perspective, the hybrid cars have been a huge success from Toyota especially the Toyota Prius. These Toyota hybrid cars have proven be to as hassle free as just gasoline cars. The automatic hybrid system in the cars work independently without the interference of the user. This increases the faith of customers in Toyota's operational excellence. The hybrid cars give best in class mileage generating savings for customers. Hence, operational efficiency is business strategy for Toyota.

2.2.2. Operational Excellence

Operational Excellence is pacing up as a business strategy for firms in this era. There are various initiatives taken by Toyota that are directly related to the customer and hence promotes Operational Excellence.

One way Toyota has strong customer connect is through its strong dealer and service center network. Another aspect is that; customer satisfaction ranks top among Toyota's policies. Toyota has various customer feedback methods and initiatives that directly involve the customer and enhance the operational excellence for them.

Firstly, there is a helpline number for promoting customer relations and customer feedback. The customer service telephone line is toll-free. The customers can call this help line to seek any assistance related to their vehicle. Moreover, also to notify Toyota of their grievances. This makes it easy in terms of customer to contact Toyota directly and hence promoting operational excellence.

Secondly, Toyota's website has a dedicated section for its customers where customers can create their own account using the Toyota vehicle they own. This is important as they have tailored experience setup according to vehicles owned by the customers. This account provides various services to Toyota customers. Customers can schedule and track service of their vehicles. Moreover, service offers are provided through the portal, customers can access manuals anytime. Furthermore, there is lot of media content available to the customers about their vehicles. Another feature of the website is that the customers can interact with other customers on the forum creating transparency and unity among Toyota customers. This again promotes operational excellence as if customer of any other automobile maker wants to connect to other customers of same maker, it might be a hassle. The customer might have to use other networking sites. Whereas, this feature allows Toyota's customers to easily connect with other customers.

2.2.3. Customer Segmentation

Toyota has not focused much of individualistic customer intimacy as its business strategy. But there are factors which could fall in the category of customer segmentation. Loyalty bonus, discounts and exchange offers are other ways Toyota keep emotionally connected to its customers. Loyalty bonus is an off on the MSRP of the vehicle for existing Toyota owners. Periodic seasonal offers and discounts are rolled out to existing Toyota owners in terms of exchange or upgrade vehicle offers.

2.2.4. Product Innovation

Product Innovation has been a major strategy for Toyota. Not only product innovation, be it alternative energy sources, interconnected traffic and safety systems, human assisting robots or new modes of personal transport, Toyota is constantly focused on innovation. These are explained below.

One of the best examples of Product Innovation in case of Toyota is its use of alternative energy sources through its hybrid vehicles. Toyota is a leader in hybrid technology. Since, Toyota introduced hybrid system, it has recorded 5 million sales of its hybrid vehicles. Not only that product innovation has led to high volume of sales for Toyota but it has led to approximately 30 million few tons of CO_2 emissions saving approximately 11 billion liters of gasoline.

Toyota also started introduced plug-in hybrid vehicles in the market. Toyota also has recycling scheme where after end of life vehicles will be recycled including the hybrid batteries. Product Innovation is its major strategy is clearly visible by the number of patents approved for Toyota. Toyota received 1636 patents only in the year 2015. Toyota also is among the top spenders in

R&D. Toyota has been using human assisting robots in its manufacturing plants for a long time now.

Interconnected traffic and safety systems are supposed to be the future of automobile transport. Toyota has been ahead by announcing its next-generation connected vehicle framework. Toyota is working on Data Communication Module which would be installed in its vehicles. It is integrated with emergency notification system on deployment of airbags. The new framework will allow the vehicles to communicate with each other promoting safety on roads. Toyota will also create Toyota Big Data Center to handle data collected from it vehicles.

All the details above clearly indicate that product innovation has been Toyota's important business strategy.

3. Firm-Level Framework

The firm-based views focus on the capabilities and resources of the firm, rather than its positioning relative to rivals, buyers, suppliers etc.

The Resource Based View argues that success depends on having a mix of resources that enable the firm to outperform its competitors. Sustained competitive advantage means being able to protect those resources, preventing imitation (e.g. by patents, trade secrets), and avoiding substitution.

Dynamic capabilities view expects resources to become obsolete and creative destruction will continue. Thus, the ability to constantly adapt to change is key to long-term success.

3.1. Dynamic Capabilities View

According to David J Teece, dynamic capability of a firm "the firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments" (Teece, 1997). Moreover, David explained that dynamic capabilities is not like operational capabilities individually but is creating, extending or modifying resource base to build a longer-term competitive advantage. This approach of dynamic capabilities framework enables to see how a firm or an organization maintains its competitive advantage during rapidly changing environments. This framework aids both in terms of future potential but also promotes guidance to gain competitive advantage in demanding environments.

"Dynamic Capabilities thus reflect an organization's ability to achieve new and innovative forms of competitive advantage given path dependencies and market positions (Leonard, 1992). According to dynamic capabilities view, long-term survival of a company depends on its ability to create dynamic capabilities which are divided into 3 categories namely Sensing, Seizing and Transforming. Certain innovative responses are required when time-to-market and timing are critical, rate of technological change is rapid and the nature of future competition and markets difficult to determine. It has been observed that stocking valuable technology assets has not created useful capabilities.

Hence, from the above discussion it can be inferred that Dynamic Capabilities ensure that organizations operate at highest levels of excellence in their existing businesses, whilst at the same time allowing for the exploration of new ideas and implementation of innovative business models. Toyota reinvented manufacturing and supply chain management in automobile industry by creating a lean production system.

Serval factors need to be identified to determine dynamic capabilities of a firm i.e. processes, positions and paths. Also, how readily can a competence be replicated an imitated determines the distinctive of the competence. Below are discussed dynamic capabilities that could allow a firm to promote competitive advantage for itself. According to Teece, three dynamic capabilities are necessary in order to meet new challenges as discussed below

3.1.1. Learning

According to the concept described by Teece, the organizational knowledge resides in new patterns of activity, in routines, or a new logic of organization.

How could routines be a dynamic capability for a firm is determined by how readily these routine activities can be replicated or imitated as it determines the distinctive of the competence. Toyota reinvented manufacturing and supply chain management in automobile industry by creating a lean production system. Toyota has defined specialized processes for its production which bring competitive advantage to Toyota. Kaizen is the heart of the Toyota production system. Under this system, Toyota members have a responsibility not only to follow closely the standardized guidelines but also seek their continual improvement. This is indirectly learning. Continual improvement through members of the community is learning. Kaizen for Toyota means continuous improvement in every sphere of company's activities.

Another approach followed by Toyota in production is 'Just in Time' approach. This approach clearly shows how ahead of time it has been. It adopted its approach in 1960s and 1970s but now has been universally imitated by automobile manufacturers around the world. Under this approach, the production of vehicles is regulated by the laws of supply and demand. The result of this approach is that the right parts and materials are manufactured and provided in the exact amount needed – and when and where they are needed.

While the world is moving towards more and more automation, Toyota has adopted automation with a human touch. The production system at Toyota can anytime be intervened by an employee if required.

Finally, the production system by Toyota has lots of benefits which comes as results to the firm. The product quality is improved along with employee-management relations by bringing employees and management in the joint pursuit of improvements in productivity, quality and working conditions.

According to Teece, collaborations and partnerships could be the source of new learning. Toyota has various collaborations in different spheres of its industry to promote learning. Firstly, Toyota

and Suzuki have collaborated to develop environment friendly technologies, safety systems, information technology and mutual supply of products and components. This is an important agreement as it sees developing technologies ahead of time and which would promote new learning among both firms.

One of the very important partnerships from Toyota has been its partnership with Toyota. This collaboration has the capability to change the automobile industry. It has created a new data analytics company to bring new internet-connected services in a car. This new entity has been termed as Toyota Connect and will use Microsoft's cloud computing platform Azure. For instance, developing a steering wheel that monitors heartbeat, vehicles communicating with another vehicle and such other futuristic tech-enabled automobiles.

Hence, from the above-mentioned partnerships and collaborations will enable Toyota to bring strategic assets into the firm from external entities.

3.1.2. Transformation of existing assets

Transformation of existing assets would be required by a firm from time to time to adapt to changing environments. This is crucial as change is costly and firms stand at competitive advantage when processes are developed to implement high pay-off changes at low costs. There is another important aspect to transformation of existing assets. Sensing the change in the market or internal needs is crucial before transformation and then seizing the opportunity to transform existing assets to meet the changing needs of the firm.

For instance, Toyota used information systems that fulfilled the usual 'order-taker' role i.e. supporting the traditional demand management. Traditional demand management refers to receiving handoffs from the business side or requests from individual units. But, Toyota has moved to a new model referred to as 'next-generation demand management'. This effort by Toyota is to meet corporate goals rather than individual project needs. Basically, Toyota leveraged the potential of existing IT along with transforming it into an enterprise level initiative which helped Toyota enormously including expansion in various countries. The new IT operating model promotes readiness and renewal.

For instance, Toyota's production system explained above is another example of how Toyota transformed universally used traditional production system in automobile industry.

3.1.3. Co-specialization

According to Teece, combination of assets such as physical assets, human resources and any other intellectual property may become valuable for a firm over time. Such assets are more valuable in combination than individually.

Toyota promotes a leading example in co-specialization through its product range. But what makes co-specialization a competitive advantage for Toyota is the whole process and ideology of manufacturing combined with its product range. The production system, human resource practices, corporate culture and continuous improvement enables Toyota to generate innovative

ideas which in turn pulls Toyota ahead of its competitors by delivering world-class products to its consumers at competitive costs.

3.2. Resource Based View

The firm-based views focus on the capabilities and resources of the firm, rather than its positioning relative to rivals, buyers, suppliers etc. The Resource Based View(RBV) argues that success depends on having a mix of resources that enable the firm to outperform its competitors. RBV emphasizes the internal capabilities of the organization in formulating strategy to achieve a sustainable competitive advantage in its markets and industries (Henry, 2011). Sustained competitive advantage means being able to protect those resources, preventing imitation (e.g. by patents, trade secrets), and avoiding substitution (Marullo, 2017). RBV focuses on the internal factors that contribute to a firm's growth and performance. It highlights the importance of firm's resources and capabilities. Both will together form a competency that can create a competitive advantage. Resources can also be divided into tangible resources and intangible resources. Capabilities of the firm in utilizing the resources have a big impact on how a firm will be able to stand out among other competitors. Competitive advantage arises when a firm has a lower cost structure, products differentiation and niche markets. RBV also concerns in value creation to compete with others (UKEssays, 2015).

If organization made of resources and capabilities which can be configured to provide it with competitive advantage, then its perspective does indeed become inside-out. In other words, sometimes organization's internal capabilities determine the strategic choices it makes in competing in its external environment. In some cases, organization's capabilities may actually allow it to create new markets and add value for the consumer, such as Toyota's Hybrid cars.

Toyota's much admired manufacturing system manages inbound logistics in the form of excellent material and inventory control systems. This ensures that inventory levels are sufficient to meet customer demand by having parts delivered prior to their assembly. Looking at other primary activities in the value chain, such as operations, we find automated and efficient plant with embedded quality control systems. This is backed by marketing and sales through advertising and dealership networks, and service using guarantees and warranties. Toyota's value chain activities, its linkage across them, and its linkage with the value chain of its suppliers are configured in such a way that they provide the Japanese competitor with a core competence or distinctive capability. It is this capability which provides it with competitive advantage and which its competitors have found difficult to match. Toyota is also able to appropriate the added value that is derived from these activities. For instance, Toyota makes more profit than the three largest automobile companies on the USA combined (Henry, 2011).

3.2.1. Resources

Resources can be thought of as inputs that enables an organization to carry out its activities. Firms' performance also depends on how resources are being utilized. Resources can be categorized as tangible and intangible.

3.2.1.1. Tangible Resources

Tangible resources refer to the physical assets that an organization possesses and can be categorized as physical resources, financial resources, and human resources.

Physical Resources:

It includes things like current state of buildings, machinery, materials, and productive capacity. Toyota owns physical asset in form of manufacturing plants, offices, equipment's, vehicles and many others. In March 2016, Toyota's equipment and property plants stood at 9,740,417 (yen in million) (Toyota, Annual Report Sustainable Management Report, 2016).

Financial Resources:

The extent to which an organization can achieve an acceptable return on its capital employed will determine the extent to which it can attract outside capital or financial resources. Financial resources will include its cash balances, debtors and creditors, and gearing. Toyota has enjoyed a healthy financial growth of a number of years marked by growth in revenues and profitability. In 2016, Toyota's revenues amounted to 28,403,118 (yen in million). The company recorded a net income of 2,312,694 (yen in million) in 2016 (Toyota, Annual Report Sustainable Management Report, 2016).

Human Resources:

The total workforce employed and their productivity, as measured by criteria such as profit or sales per employee, form a tangible human resource. Toyota is an employer to over 348,877 employees (Toyota, Annual Report Sustainable Management Report, 2016). The employees are an essential resource to Toyota as they are responsible for implementing the company's strategies and carrying out the production works.

3.2.1.2. Intangible Resources

Intangible resources comprise intellectual resources, technological/technical resources and reputation/goodwill.

Intellectual Resources

It includes patents and copyrights which themselves may derive from organization's technological resources. Toyota has several intellectual resources. Brands are among these intellectual resources. The Toyota brand is an essential resource for the company. This brand has gained recognition in most part of the world. Toyota has other small brands representing different products. These brands include; SUV, Lexus, Celsior, Corolla, Hilux, Probox, and RAV 4 among others. Copyrights and patents are other form of intellectual properties. These are found in the company's logos and most of the publications made by the firm.

Technological/Technical Resources

Technological resources include an organization's ability to innovate and the speed with which innovation occurs. Toyota has several technical resources. Toyota is a market leader when it comes to manufacturing technology. The company has invested in technological resources that have enhanced the manufacturing operations. The Toyota Production System is known around

the world as a flexible, customer-focused process that delivers a quality product in a timely manner. The company has also invested information technology. Toyota uses this technology to facilitate management and operation activities. These information technologies may include; supply chain management programs, inventory management programs, customer relationship management programs and many others (Custom Writing Tips, 2013).

Reputation/Goodwill

The reputation or goodwill of an organization is increasingly recognized as a valuable intangible asset which can easily be damaged by ill-thought-out strategies and marketing campaigns. Toyota has a sustainable brand name and a market leader position.

3.2.2. Competency

Competencies can be defined as the attributes that firms require to be able to compete in the marketplace.

3.2.2.1. Core Competency

A core competency can be thought of as a cluster of attributes that an organization possesses which in turn allows it to achieve competitive advantage. The Prius, an electric-and-petrol hybrid car represents a core competence for Toyota. With the success of Prius, Competitors, ranging from America's General Motors to Germany's BMW and DaimlerChrysler, scrambled to roll out hybrids of their own. Toyota certainly created a market share for themselves with Hybrid cars. It gave them competitive advantage (Henry, 2011). The Prius first went on sale in Japan in 1997, and was available at all four Toyota Japan dealerships, making it the first mass-produced hybrid vehicle. It was subsequently introduced worldwide in 2000. The Prius was sold in over 90 markets, with Japan and the United States being its largest markets. Global cumulative Prius liftback sales reached the milestone 1 million vehicle mark in May 2008,2 million in September 2010, and passed the 3 million mark in June 2013. Cumulative sales of one million were achieved in the US by early April 2011, and Japan reached the 1 million mark in August 2011. As of April 2016, the Prius liftback is the world's top selling hybrid car with 3.73 million units sold (Toyota Global Newsroom, 2016).

3.2.2.2. Distinctive Competency

Distinctive competency is important in providing an organization with competitive advantage. They derive from three areas: an organization’s architecture, innovation and reputation. Toyota’s distinctive competence is its production system known as the “Toyota Production System” or TPS. TPS is based on the Lean Manufacturing concept. This concept also includes innovative practices like Just in Time, Kaizen, and Six Sigma and so on. Toyota has worked tirelessly over the years to establish this distinctive competence. No other automobile manufacturer can do it as well as Toyota does. This distinct competence has led to a competitive advantage that has given Toyota a sustainable brand name and a market leader position.

4. Information Strategy Introduction

To manage the nexus between business strategy and information technology can be quite challenging, especially as IT is often considered as a mere implementation tool that is not essentially involved in building or shaping strategy. Very often, it is bolted onto the business as an afterthought, which hampers productivity. To be successful and productive, it is important that organizations move from a conservative IT strategy and approach to a more business centric approach. The key is to agree on a sturdy, flexible technology that can facilitate an agile business strategy. Business and IT alignment is a dynamic state in which a business organization can use IT affectively to achieve business objectives. Alignment can only be successful if it comes from both sides. Toyota's strategy supports the company's global growth which has now made it a global force in the automobile industry. This success is based on the effective alignment of Toyota's generic business strategy and their information systems strategies.

5. Applications

5.1. e-CRB (evolutionary Customer Relationship Building)

In March 2004, Toyota launched its state-of-the-art CRM (Customer Relationship Management) system called e-CRB (evolutionary Customer Relationship Building) in Thailand. e-CRB (customer relationship building) is based on TMC's Japanese-market G-BOOK system, which employs a built-in onboard terminal that seamlessly connects car users to navigation, news, weather, entertainment and e-commerce services among others, as well as on TMC's free membership-based website GAZOO, which offers online new and used-vehicle information, Internet shopping, member communication boards and more. Mainly, e-CRB provide information regarding the basic experiences of buying and owning a vehicle: shopping for one, purchasing one, enjoying it and taking care of it. e-CRB builds on a technology cultivated through the development of Gazoo and G-BOOK and offers its customers a variety of services such as providing information of new vehicles, accepting requests for brochures and estimates and notifying customers when it is time for maintenance by keeping track of the vehicle's maintenance history and mileage. (Wikinvest.com, 2009)

This application closely aligns with Toyota's customer segmentation business strategy. Through the application Toyota, is trying to get close to their clients and understand their needs. In addition, e-CRB offers an advanced operation system that can be utilized comprehensively at dealers including with respect to new and used vehicles and services. The objective of e-CRB was defined as improving the customer service relationships between dealers and consumers. While improving service relationship between dealer and consumer, Toyota achieves operational excellence by meeting customer's expectations. e-CRB focused on improving customer service between the two parties, no matter their location in the world. (UKessays.com, 2015)

5.2. Entune

Learning from the competitor, Toyota achieved operational excellence by introducing Entune to its customers. Entune is Toyota's entrant in the in-car infotainment wars, which also makes it align it to product innovation strategy. Hot on the heels of Ford's controversial MyFord Touch system, Entune takes a somewhat different approach-the idea is to give the centrally mounted touchscreen the functionality of a smartphone. Unlike some rivals, it doesn't provide control over basic vehicle functions, focusing instead on integrating handy apps into the driving experience. Assuming one have got a suitable smartphone with a data plan, the first step is to register phone with Entune. (Toyota, Entune, 2017)

Next, you use phone to download the Entune app, which includes everything one need to make the system work. Once Entune is activated, one can use the car's touchscreen (or the voice-recognition software, on models so equipped) to operate it; note, however, that phone serves as the data connection, so one will need to have phone in the car at all times-and an unlimited data plan is preferred. Entune premium version also provides integrated navigation comprising of real-time traffic monitoring and streamlined address inputs. (Sadlier, 2012)

5.3. Assembly Line Control System (ALCS) software (Just-in-time)

For Toyota, efficient production is a major element of operational efficiency. This includes optimizing equipment, product processes and employee output so that company produce the greatest number of quality products possible with the time and money invested. Toyota employs one of the most sophisticated supply chain systems in manufacturing, working closely with suppliers to ensure that parts arrive just when needed. For example, when a car comes out of the paint shop in Georgetown, the system sends seat supplier Johnson Controls an electronic message detailing the exact configuration of the seats required (leather upholstery, bucket seats, etc.); Johnson Controls has four hours to ship those seats to the plant in the exact sequence required. The instructions are provided by Toyota's proprietary Assembly Line Control System (ALCS) software. (Duvall, Toyota: Creating the Lean Machine, 2006)

5.4. Activplant's Performance Management System (Jidoka)

At every stage of the assembly line, Toyota employs devices allowing workers to stop production to correct defects. Such devices may be as simple as a rope strung above the assembly line, or a button that can be pushed. In other cases, it is sophisticated monitoring software such as Activplant's Performance Management System, which can alert operators to problems with equipment or robots in real time. Its clear objective is to create better products at a lower cost. (Process Improvement Japan, 2010) And it is done in two ways to achieve operational efficiency:

- Quality is built into the production process. Machines stop when abnormalities occur. As an added benefit, the cause of a problem can be easily located or identified. We can therefore prevent the reoccurrence of the problem.
- Manpower savings Releases the worker from having to monitor the machine so he can

5.5. Dealer Daily (Kaizen)

Getting the most value from resources and eliminating waste in production and operations are operational efficiency considerations. Kaizen is a system for continuous improvement. Toyota constantly looks to improve its business processes by finding ways to take Muda (waste) out of the system. It can be as simple as moving a tool to an assembly station so a worker does not need to waste time walking to get the tool. Or it may involve technology, such as allowing dealerships to swap car inventories using the Dealer Daily, an Internet portal, so customers are not left waiting longer for the vehicle they want. (Rosencrance, 2002)

Toyota's Dealer Daily is a large, Windows-based virtual private network (VPN) that links the dealers' management systems to Toyota headquarters or to other business units around the clock. Dealer Daily lets dealers order parts, download sales and other company information, file warranty claims and manage financing and insurance for customers online, saving millions in printing and distribution costs. Dealers that are connected to Dealer Daily over the managed network pay a monthly subscription fee based on the bandwidth they select. Users inside the dealership access the VPN via PCs on an Ethernet LAN. They access Dealer Daily, which is password-protected, through Internet Explorer. Using Dealer Daily, Toyota can deliver critical news and other information instantly to any user at any dealership across the country. The company can also post critical messages that need immediate attention on Dealer Daily's home page and send targeted messages to users via the system's e-mail application.

5.6. Business Intelligence

Business intelligence, or BI, is an umbrella term that refers to a variety of software applications used to analyze an organization's raw data. BI as a discipline is made up of several related activities, including data mining, online analytical processing, querying and reporting. (Mulcahy, 2007)

In 2011, Toyota implemented a business intelligence project in response to the crisis stemming from a massive product recall in 2010. The focus was to get a common view of the previous 6 years of data from various sources. It allows Toyota's quality engineers to search through, drill down, mash up and analyze data from sources as disparate as its vehicle configuration system, customer call centers, warranty claims system, customer mediation group and service centers. Toyota delivered the BI System much faster with the help of software called Enduca. In addition,

they also implemented software including Microsoft BI guru, QlikView, SAS Business Intelligence, Cognos (IBM web based application). (Vijayan, 2011)

They implemented business intelligence to work on failed products and services. With the help of Business intelligence tools, Toyota got insights about the customer segmentation and cohort analysis to concentrate on specific range of customer. Business Intelligence aligns to operational excellence as they want to deliver high quality products and Customer Segmentation for targeting different customers across the globe. BI comes under the research and development infrastructure of the Toyota family.

5.7. Smart Fueling System (SAP-HANA)

SAP HANA is on the latest technology by SAP that uses in-built memory management system. Toyota has partnered with SAP and created a system that uses a touch screen allowing the drivers to fuel their vehicles more efficiently. The fueling system is built on the SAP HANA cloud platform. Building on this platform allows it to analyze information about the vehicles location to find the nearest gas station. The system connects with the vehicle as well to alert drivers when their fuel level is low before directing them to the most convenient gas station in their location.

Integration into the SAP HANA cloud platform also allows drivers to authorize transactions from their vehicles or mobile devices to process payment for fuel. Expediting the transaction process is an aspect of the system that will drastically save consumers time at the pump. Smart Fueling system aligns to operational excellence and customer intimacy. (SAP, 2014)

5.8. CAELUM CAD (Computer Aided Design)

Toyota uses CAD (Computer Aided Design) to incorporate new design and technology for vehicles manufacturing. In 2010, Spatial Corp., a leading provider of 3D development components for design, manufacturing and engineering applications, provides CAD translation with product manufacturing information (PMI) to Toyota Caelum Incorporated for use in their latest software release, Caelum III version 4.4. The new version integrates the 3D models in to the computer aided design.

This align to the product innovation part of the business strategies to improve products design and performance thereby coming under research and development department of Toyota. (Takaba, 2017)

6. Infrastructure

Toyota is world leader in car sales and had just not pioneered the industry in automobiles but also in implementing state-of-art technologies by using world class applications in their environment. We as a team analyzed the applications that make Toyota as an organization different. The company is famous for implementing new technologies to make their production

and IT seamless. We have understood the importance of these application by understanding the business strategies. We will start with the application and the infrastructure that support those applications.

We will start with the e-CRB also knows as evolutionary customer relationship building. As previously mentioned in the application section that this technology was launched in the year 2004 and it is a Toyota's custom and proprietary Customer Relationship Management-CRM tool. The infrastructure required for this application is quite obviously heavy as it was giving user the online shopping, maps, news, weather experience by redirecting to Gazzo infrastructure later called as Toyota media service corporation.

As this system allowed user to connect with the car, it was using the Bluetooth technology for pairing in its basic infrastructure. The data was then communicated to the Gazzo which was also Toyota owned and hence Toyota managed proper servers for information communication with the car and Gazzo. As most of the activities performed were online, it is assumed that it was possibly taking satellite help for weather and map or it may have used API's that took data from other reliable sources and provided the services back to the user. If the user performed an online transaction of online shopping, the data was transmitted to the warehouse team which then dispatch the order. It implies that the company was using an infrastructure that allowed to communicate multiple teams as per the instruction provided by the user on the interface. Also, the servers and databases store the information about the user which can later be used by the technology team to analyze and improve the services. The communication certainly requires the networking technology which signifies the obvious use of VPNs, wirings etc. As the data transmitted may be critical for an individual it compels organization to use Firewalls in its infrastructure. Also, we believe that the organization may have had implemented technologies that can help user to use external websites by transmitting data from its local network to the public network. (Anicas, 2014)

As a tech-savvy company, the other applications that help in functioning of seamless work at Toyota is Entune. This is an infotainment concept by Toyota. The user can access the popular applications like Bing, iHeartRadio, MovieTickets.com, Pandora, Fuel Guide, Sports, stocks on the touch screen of their car and can access them by voice as well. As simple it sounds, its oppositely complex as it involves multiple devices like car media device, phone application. The underlying technology will surely have a system having Bluetooth that connects the mobile device to the car and has antennas that regularly communicate back to each other.

The system of Entune directly engages mobile phone and the car media hardware in its infrastructure. The application engine sends data to the server and then server communicates

back to the car ecosystem which is indication of the wide use of the server in this application. The Entune application directly mirrors the user phone and allows users to interact either handsfree or by touch. The application does not only limit to accessing the servers of Toyota but also request and talks to the server of application. For example: The application will communicate with the Pandora app and thus access its servers to listen to the songs while connected.

One of the most important and interesting application that Toyota widely uses is Assembly Line Control System(ALCS). As previously mentioned in the application section this application is more about maintaining Just in time concept and keeping supply chain healthy. This application directly engages suppliers and Toyota itself. The application mainly runs on the system that automatically places the order to the concerned team once the supply chain is out of its equilibrium. The system infrastructure includes production status monitoring system which understand the number of units produced in a time interval.

The infrastructure of Assembly Line Control System also includes use of inventory management which keeps the check of items present in the warehouse. This system is not complete with the use of RFID as at every process it scans the products used and produced which and RFID helps in updating the inventory system by scanning the items. Another important but unnoticeable part of the Assembly line control system infrastructure is printer. The printer usually prints a lot for company and client reference and the supply chain process involves a lot of signatures which are usually done on the dispatch and delivery documents that are printed by the company. While tracking the update in the Assembly Line control system the user/admin usually scans the tracking table of database which is essentially stored at database servers. Air Location keeps the track of the storage of completed automobiles in the yards and hence an important part of the ALCS. Additionally, the mainframe client/server architecture powers up the ALCS and it also uses the HP and Windows 2000 server to host the application.

Activeplant Performance Management System

The system is complex and helps save Toyotas time in examining major manufacturing defects. As mentioned, it checks the system production defects. The infrastructure related to this a system which stores the information of actual desired product. And that information is stored in database. The system scans the parts by its laser and optical scan which measures the dimensions and compare it with the standards. The information is collected using the Programmable Logic Controllers(PLC) devices. The whole infrastructure also includes use of databases which allows the engineer to load the dimension as per the part. When the measurements are taken, and mapped by the machine it sends report and save the information in the database for future reference. In whole, it is combination of complex machines, databases, user interface and

network connection that connects the system to the network. (Duvall, Toyota: A Car Every 20 Hours, 2006)

Dealer Daily

Dealer daily as understood in the application section is very critical for the organization and for the dealers associated to it. The system allows dealers and organizational staff to be always in sync and keeps the work moving. As mentioned in application section it is obvious now that the VPN is used which allows the two business ends to communicated privately over network. The infrastructure includes routers and machines from which data is transmitted. The system share and stores data for which the data management software are implemented in the network apart from database management servers, cables and physical & software firewalls (for security reasons). As from Dealer daily a lot of packets are transmitted it requires high bandwidth which can be supported through the coaxial cables and fiber network, LAN. Being a key application for Toyota it receives heavy traffic which is then balanced using the load balancers in the network. (Keenan, 2001)

7. IS Organization Strategy

Whenever you talk about Cars in any part of the world, the first name that comes to our mind is Toyota. What is the reason for such a great reputation? Toyota believes in Customer First, Quality First. This is what drives Toyota. One would wonder how Toyota can make both customer and quality the priority? The answer to this is their organizational structure. A company's organizational structure describes how an organization accomplishes its goals, decides the tasks that need to be performed, and who makes the decisions. (Bernal, 2015)

Toyota's production systems and its organizational structure have been long lauded as one of the most efficient and effective, in terms of customer satisfaction and performance. This helped them to create a culture of excellence. The have worked to use Just-In-Time methodology for their production i.e. raw materials are only delivered when they are needed. And this level of efficiency is possible only because of the organizational structure of the company which has undergone some serious changes since 2013.

Before 2013, and for most of its existence, Toyota's organizational structure were based on centralized decision making by the Japanese. It is typified by the little delegation of authority and information flows only one way from top to bottom. For example, executives in the US received from high official based out of Japan and were closely monitored for their performance. The main advantage of centralized decision making is that only one group knows about the complete organization and can make better decisions with the help of complete information.

2013 onwards there has been a significant change in the organizational structure of Toyota. Why was this change implemented in the first place? The centralized decision-making structure was highly criticized for slow response time to address safety issues.

Below are the main characteristics of the new organizational structure which is called as divisional organizational structure. (Gregory, 2017)

7.1. Global Hierarchy

Toyota still has the global hierarchy despite its reorganization in 2013. However, Toyota has now increased the decision-making power of the regional heads and business unit heads to lower down the response rate in any emergency. In the simple words, in the new organizational structure, the decision making has become less centralized. All the unit heads now report to headquarters in Japan.

7.2. Geographic Divisions

Toyota's new organization structure has eight regional divisions

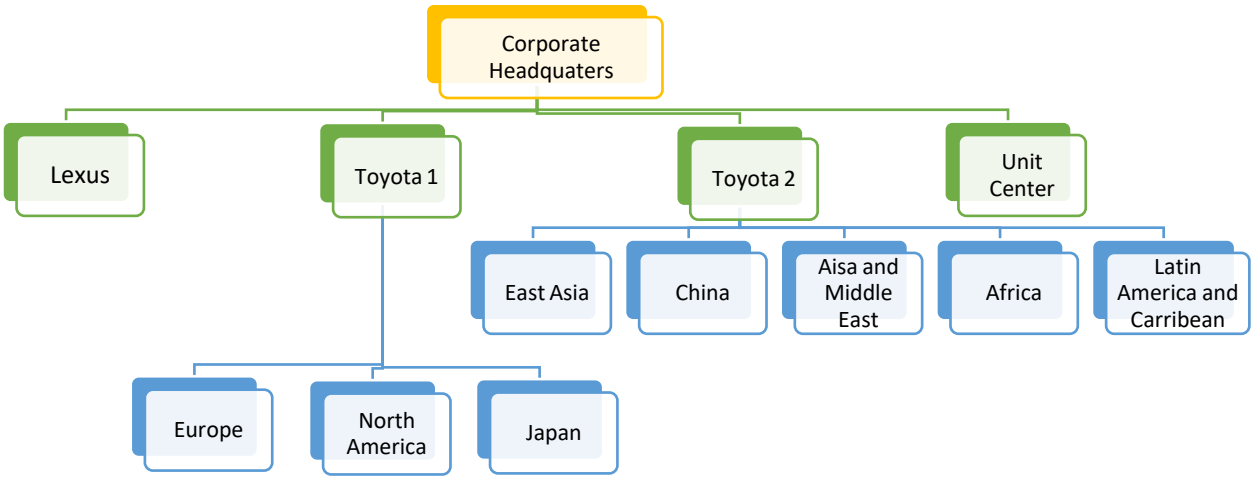
1. Japan
2. North America
3. Europe
4. East Asia and Oceania
5. China
6. Asia and Middle East
7. Africa
8. Latin America and Caribbean

With the help of these regional divisions, the organizational structure enables Toyota to improve products and services per the regional market conditions and requirements.

7.3. Product Based Divisions

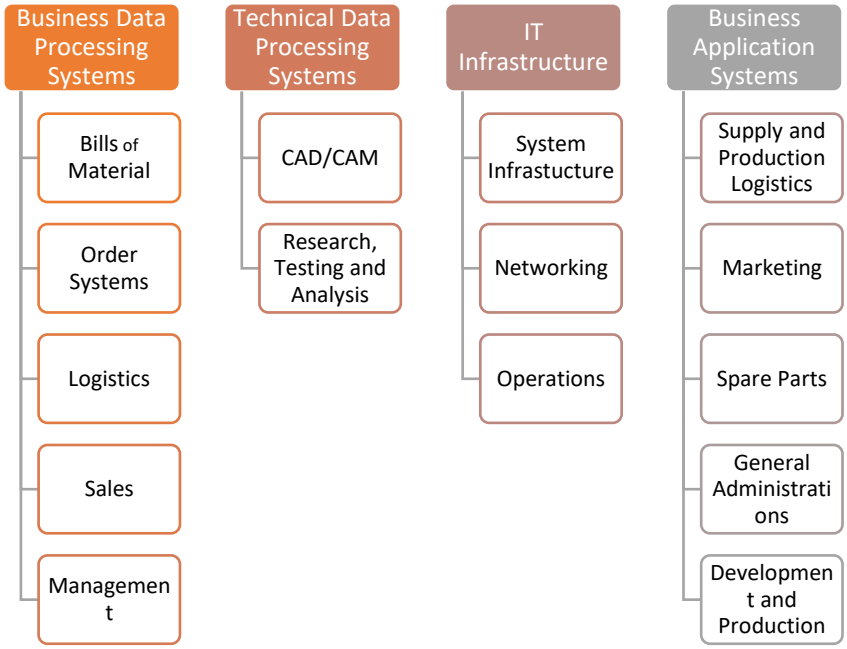
One of the important feature of new organization structure of the Toyota is product based divisions. They have following four product divisions.

1. Lexus International
2. Toyota No. 1 for operations in North America, Europe and Japan
3. Toyota No. 2 for operations in all other regions
4. Unit Center, which is responsible for engine, transmission and other related operations



7.4. Toyota's Information System Structure

Information technology systems are one of the driving forces in the success of Toyota. Below charts depicts the overview of the information systems structure of Toyota.



The organizations IS structure is basically divided into four broad categories including Business Data processing systems, technical data processing systems, IT infrastructure and Business Applications Systems. (Corporation T. , 2012)

1. Under Business Data Processing Systems, electronic processing and centralized management of BOM (Bill of Materials) was established which included parts logistics calculations and price management of purchased orders. Order system included ordering system, domestic data communication systems, order forecast systems, NUMMI computer system and Dealer's Online systems. Logistics is a very important aspect of any manufacturing firm. Information systems in logistics includes online dispatch systems, spare parts inventory systems and integrated export vehicle systems. Sales has got monthly payment bill processing and catalog publishing systems.
2. Technical Data Processing Systems included CAD/CAM systems which are one of the company's most guarded secrets. They have Driveline CAD, Engine CAD, Casting mold CAD/CAM, Suspension CAD and engineering drawing CAD. Apart from this, they have systems and infrastructure for research, testing and analysis which includes Thermal testing system, Strength and stiffness analysis, Engine testing system, Drive testing system and Comprehensive vehicle testing system.
3. Third one is IT infrastructure. Toyota has all the latest infrastructure consisting of both Software and Hardware. For operations, they have all the latest applications installed in the infrastructure. These are Electronic forms system, Data entry system, Emergency information system.
4. Business Applications System has two parts: Commercial Systems and Engineering Systems

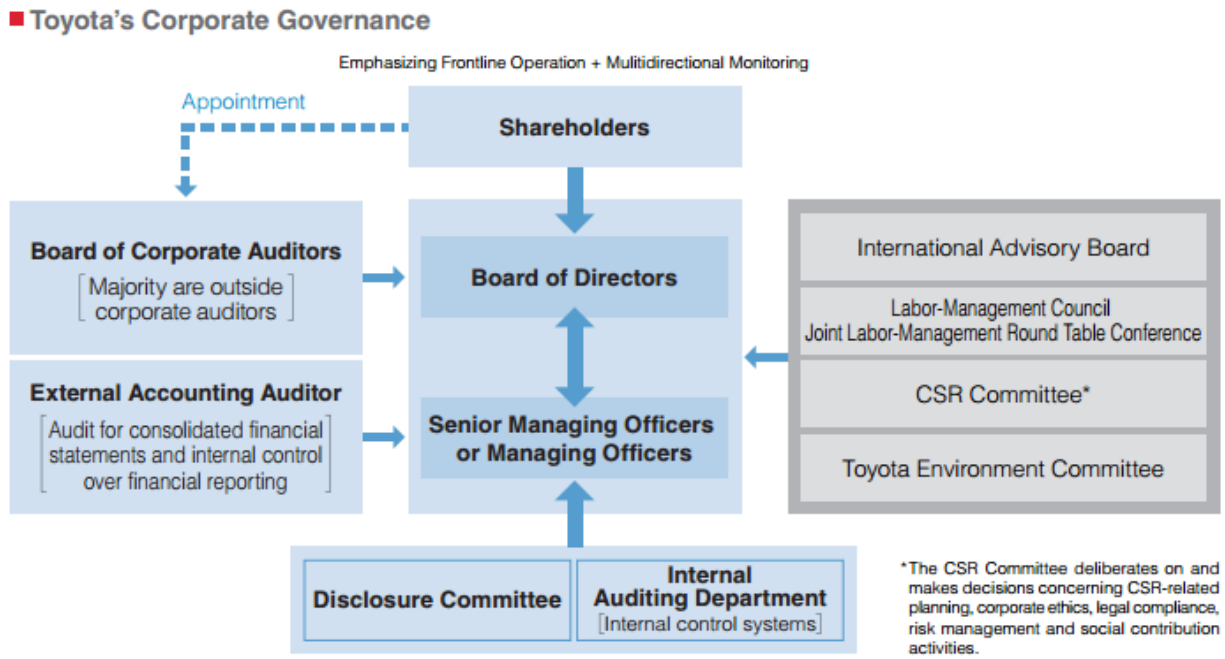
    a. Commercial Systems
        i. Parts Release Preparation Systems
        ii. Global Units part processing systems
        iii. Vehicle production system introduced
        iv. Health Management Systems
        v. Daily Work Report Systems
        vi. Plant Total Cost Systems
    b. Engineering Systems
        i. Production Information Systems
        ii. Vehicle specification search systems
        iii. 3D Drawing systems
        iv. Global Engineering Support Systems

7.5. Governance Structure of Toyota

Toyota announced its global vision by formulating it by March 2011. They decided to go for global vision by learning from the deterioration of their business environment and a series of bad quality products. They aim to exceed customer expectations by development of better cars and

enriching lives of the society. To fulfil this vision, Toyota has made some changes to its management structure by reducing the board of directors and decision making layers. They intent to continue delivering products with respect to customers demand in each region. Toyota headquarters will provide overall direction and furnish support for the initiative taken by the regional heads.

While they are aiming faster decision processing, they drastically reduced number of directors and abolished the position of Senior Managing Director. In addition to it, they will replace the current three-layer management – Executive Vice President, Chief Officer and Executive. Moving forward with this new structure will support a swifter flow of information from the divisional general managers, who are intimately familiar with their operations, to senior management. Toyota is to enhance clarity in organizational responsibilities: The Board of Directors decides what Toyota will do as global Toyota, and Chief Officers decide how to implement that decision as chief executives for day-to-day operations, etc. (Corporation T. M., 2016)



Any reasonable person would agree that Toyota's accomplishment over the past 25 years depends on strong management principles and an unmistakable harmony between "hard" and "soft" innovation. None of these management principles can sustain without continuous strategic alignment. The first step is to define the business process clearly, which Toyota has done. Next the strategic goal must be set, and converted into a long-term strategy. Additionally, Toyota sets the benchmark, with an unmistakable concentrate on harmonious growth and enhancement of profitability, the two primary components of Toyota's business purpose. Next the organization culture must be adjusted, and this is the place Toyota plainly sets the benchmark around the

world. There is hardly any other organization in the world with a more solid company culture, fully in line with its business purpose.

In 2006/2007 Toyota was confronted with something they had rarely experienced before: quality issues. Known as the manufacturer of the most solid autos on the planet Toyota in 2007 had a greater number of recalls in the US than they had over the past 10 years. After analyzing the causes Toyota found that the issues were an aftereffect of the enormous growth in sales in the earlier years. To stay aware and keep up with the production Toyota had expanded its manufacturing capacity in Europe and the US to the extent that their 'Toyota Way' training program couldn't keep up with the influx of new workers. The new workers weren't adequately adjusted to the Toyota business purpose and Toyota's religious focus on quality and manufacturing efficiency. Devoted to one of the key components of their business purpose ('pursuit of harmonious growth') Toyota reacted by briefly sizing down production and stall sales to ensure that the proper alignment did take place.

8. Sourcing

Outsourcing IS functions has been a long trend as a cost saving measure. It is evident from the fact that Toyota Motor North America Inc has outsourced 80% of its IT workforce. This has enabled company to cut information-systems support costs. Traditional outsourcing enable Toyota to create partnerships providing consistent and efficient infrastructure services and legacy systems support. These traditional partnerships did not enable Toyota to leverage emerging technologies and provide these services to dealers and customers.

Thus, Toyota looked for smaller and agile suppliers to address their need for providing new innovative services to dealers and consumers. For instance, the consumer portal delivery group at Toyota is responsible for consumer facing web portal. This group decided to overcome long-term engagements with major partners to find startups or small associations working on new ideas. This brought in new sourcing arrangements into Toyota but along with new partners, there was a demand for new governance approaches. One of the major factors or it could be termed as concerns for Toyota would be to provide these small suppliers access to enterprise data.

Under the new governance model, Toyota created an architecture team which helped defining key business capabilities along with technology and data standards. By adhering to these new architectural standards, small suppliers could now build new functions and applications. Drifting away from traditional outsourcing by creating partnerships with small and innovative players allowed Toyota to experiment with new technology trends and importantly, accommodate the diverse and local needs of its vast dealership network. (UkEssays, 2015)

The Toyota dealers network includes varied and numerous dealerships ranging from small, rural, to metropolitan and mega dealerships. One of the Toyota's goal is to enable its dealerships to

create its own applications and websites suited to their individual local needs and budget. To promote this flexibility throughout its dealership network, Toyota partnered with 19 web-development providers from which individual dealerships can choose. This enables Toyota to ensure efficiency while promoting local innovations.

This above explanation clearly indicates that Toyota's sourcing choices are related to its business strategies. Partnership with two kinds of suppliers bring different strengths to the table for Toyota. Core partners enable reliable and consistent services to Toyota while the small niche players allow Toyota to experiment with new technology trends and accommodate diverse local needs of its dealership network. Enabling the dealers to have websites and applications promotes Toyota's business strategy of operational efficiency. Outsourcing certainly enables Toyota to control expenditures. Enabling its dealer network with applications and websites ensures operational efficiency.

As per Barbra Cooper, the information systems group at Toyota (North America) has moved from an order-taker role to next generation demand management (Barbra, 2009). What this means is that the information systems group at Toyota is trying to meet overall corporate needs rather than narrower project by project demands. According to Toyota, this move aims at eliminating redundancy and produce only systems that match the strategic direction of Toyota. The outsourcing of IT has evolved over years especially after a performance audit at Toyota in 2002. Earlier, the IT existed at business-unit level and was developed per individual unit needs and IT was considered as a black box where all the funds were going by the business.

There is not much information available in terms of which specific IS functions are outsourced by Toyota, it is very clear by the fact that if 80% of the Information Systems is being outsourced, most and major functions in Information Systems are outsourced. Toyota has been active in outsourcing as it believes to experiment new trends in technology. Hence, more than what goes on to decide if the function needs to be outsourced, it takes more for Toyota to decide on whom to outsource the function to. Toyota has a diverse portfolio of partners and depending on the purpose of function, it chooses the partner as discussed in the above section. IT that aids daily regular functioning of Toyota has been outsourced by Toyota. (Toyota, Bringing Innovation to Toyota USA, 2013)

Toyota has established an Information Technology Center in North America. This is something that Toyota believes it should do itself. Toyota has not outsourced what it is building for the future. This center has 39 employees but its role for Toyota is major. The center works on finding new markets and applications. It is working on connected services i.e. the future of services on, for and with the car. They also work on intelligent computing, network, systems and software. This clearly indicates that Toyota has not outsourced IS functions that it foresees to be used in the future. One of the reasons for this might be that it wants to keep these confidential. This

clearly relates to the business strategy of product innovation as Toyota performs R&D for future cars at its Info Technology Center. (Newsroom, 2012)Another important aspect about this function of Toyota is that the center has come up with over 100 papers and patents. As per Toyota it's a function where they work on advanced IT looking for greater innovation and advanced IT implementation. This indicates that the advanced IT function of Toyota has not been outsourced. Similarly, Toyota has opened a Technical Center in Silicon Valley which works on enhancing the customer experience with in-vehicle infotainment systems. This confirms that Toyota is in sourcing research and innovation related IS functions.

9. Information

Toyota has effectively pushed advancement in its information systems by assimilating new information processing technologies while reacting to different changes in the external environment, including quick globalization of development, manufacturing, and sales operations, advancements in car electronics technologies, compliance with global environmental standards and changes in the Japanese and global economy.

Development and advancement of IS at Toyota in between the 1980s to half of the 1990s saw progresses in office automation and in the globalization of corporate strategies in the commercial systems of business application systems. In designing the systems of business application systems, Toyota implemented in-house-created CAD/CAM frameworks to more extensive ranges of activities and furthermore incorporated supplier operations.

In the early 2000s, progressions in managerial frameworks made IS more universally versatile and furthermore achieved change of Toyota's general administration structure. Advancements in designing IS frameworks made collecting and retrieving information more coordinated and more useable on a global basis. From the late 2000s, Toyota tried to all around institutionalize all business application and improve utilization of data. (Toyota, Information Systems, 2017)

It is not the IT that drives business at Toyota, it is their TPS (Toyota Production System). However, technology plays an important role in supporting and empowering the processes adhering to TPS. Behind TPS is IT, supporting and empowering the business that help Toyota take out waste, work with virtually no inventory and persistently enhance production. (Shmula, 2006)

Toyota has prospered in an exceptionally aggressive and competitive environment since it had developed a set of finely-tuned business processes and IS frameworks that promotes productivity, agility and quality. It could react to clients and changes in the commercial market center instantaneously as events would unfold, while working intimately with providers and retailers.

Toyota's administration saw there was a chance to utilize information systems to enhance business process performance. Innovation and technology alone would not have given any solution. Toyota needed to precisely reexamine its business procedures to bolster a build-to-order production model that construct vehicle production with respect to genuine client orders as opposed to "best conjectures" of client demand. Once that was established, e-business was used by the company in organizing the stream of data among internal production, ordering, and invoicing systems inside the organization. and with frameworks of retailers and providers.

By helping Toyota construct the vehicles clients have requested, its order management system minimizes inventory expenses, because the organization and its merchants don't need to pay for making and putting away vehicles clients did not need. This system helps builds consumer loyalty by making it easier for clients to purchase precisely the model, make and choice of vehicle they fancy. Data collected through this information system helps the company monitor trends and forecast demand and production requirements more precisely. This information system in turn creates value for Toyota by making its requesting and vehicle creation process proficient and viable electronically integrating key business processes in vehicle ordering and inventory management has made this company much more agile and adaptive to customer demands and changes in its supplier and dealer network. (GoogleUser, 2017)

Toyota believes in creating, a knowledge management system where, people and technology must integrate to exploit trends and minimizing the limitations of each component. It is very important that both components work very closely with each other to maximize the potential of the system. Being able to successfully utilize this knowledge management system, has given Toyota a key competitive edge in the automobile industry. At the end of each work week, groups of Toyota's production network gather around to identify actual or potential problems in quality, productivity and safety. However, it's not always possible to fly across the world to see what is happening. This is where collaborative tools come in play. With the help of these tools Toyota can maximize their collaboration not only within the manufacturing plants in Japan but also with plants and branches all over the world. They can spontaneously make decisions through email, web conferencing, screen sharing. Productivity, quality and innovation can be obtained when ideas at Toyota are shared globally. In conclusion, Toyota's integration of both technology and people has increased their productivity levels which has led to the boost of Toyota's revenue.

10. Alignment

Firms cannot be competitive or successful if their business and information technology (IT)/information systems (IS) strategies are not aligned. Strategic alignment positively influences IT effectiveness leading to greater business profitability. Conversely, it is argued that failure to leverage IT may seriously hamper a firm's performance and viability. Alignment is seen to assist a firm in three ways: by maximizing return on IT investment, by helping to achieve competitive

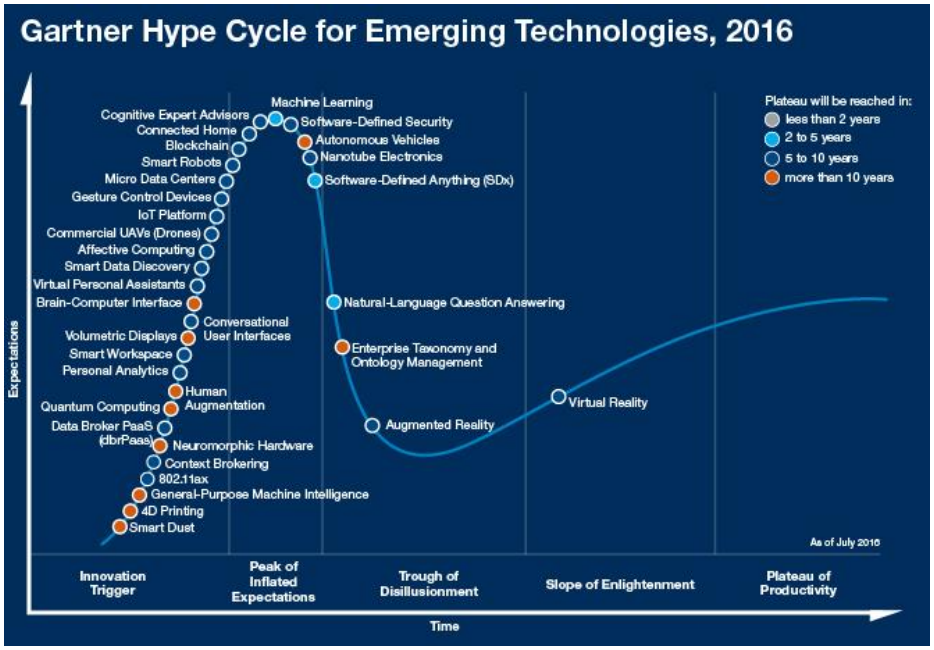
advantage through IS, and by providing direction and flexibility to react to new opportunities. (Avison, Jones, Powell, & Wilson, 2004) Henderson and Venkatraman's strategic alignment model, a classic work in IS that presents two types of alignment—business to IT and internal to external. Toyota has balanced well by aligning its business strategy to it IT strategies.

Business Strategy	Information Systems	Organizational Structure
Operational Efficiency	Performance Management Systems (Jidoka) Control Systems (Just in Time)	Geography Based Divisions: Europe, East Asia, Japan, North America, China, Middle East, Africa, Latin America and Caribbean
Operational Excellence	Entune SAP HANA	Global Hierarchy
Product Innovation	CAELUM CAD (Computer Aided Design)	Research and Development Department (R&D) with each business units
Customer Segmentation	Customer Relationship Management Business Intelligence	Product Based Divisions Toyota 1 - Europe, North America, Japan Toyota 2 - Asia, China, Africa

11. Tech Adoption

11.1. Introduction

Looking at 2016 Technology Hype Chart by Gartner, we believe Toyota should adopt the concept of Autonomous Vehicles. Autonomy technology is any kind of technology that can function without being told what to do by a person. Robots in science fiction movies are a good example of autonomy technology. An autonomous vehicle (driverless car, self-driving car, robotic car) is a vehicle that can sense its environment and navigating without human input.

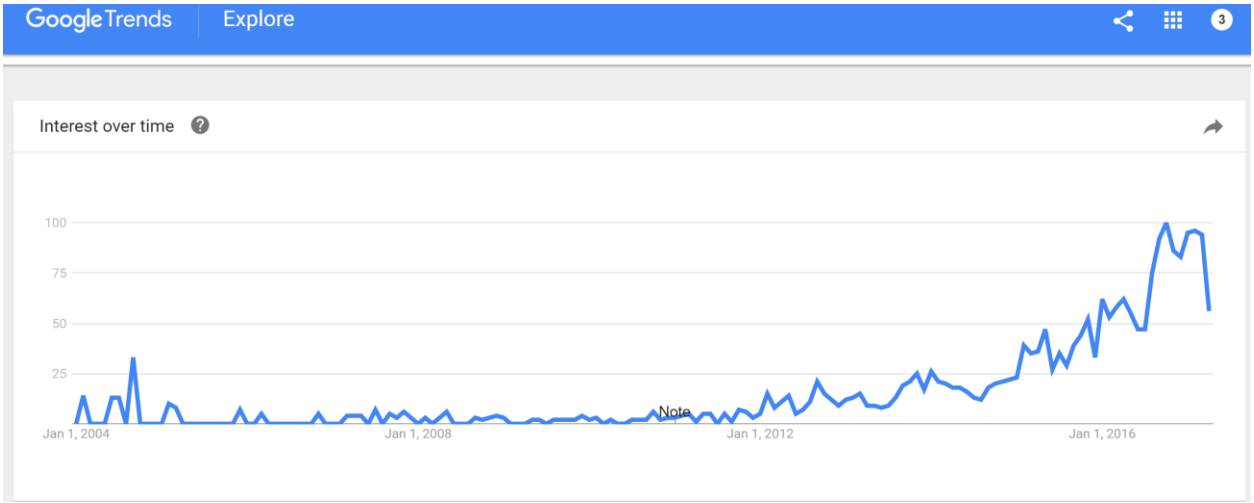


Autonomous Vehicle is almost at the end of peak of inflated expectations, and is now inescapably poised to fall to the Trough of Disillusionment. Peak of Inflated Expectations is when people start thinking the new technology will change the world as we know it, Trough of Disillusionment is when we realize that the new technology has flaws and many give up on it. For autonomous Vehicle, the impending slide through Negative Hype and into the Trough of Disillusionment has started. It turns out that the presumed, slow feature creep through 20 or 30 lucrative years of advanced driver assistance systems to eventually reach widespread uptake of SAE's (Society of Automotive Engineers) Full automation creates several intermediate barriers. One of the barriers is that humans generally come to rely on assistive technologies quickly and incautiously. The reliability with which drivers will remain attentive while using intermediate levels of semiautonomous features, or can rapidly re-refocus their attention in the event the vehicle requests oversight, is very challenging. A further barrier to consumer ownership of fully robotic vehicles will be financial. Because the technology for robotic mobility will evolve so rapidly, household vehicle lifespans will plummet and their ability to retain resale value after purchase will be abysmal. (Grush & Niles, 2016)

11.2. How much attention is the innovation being given on the Web? Is that attention growing or declining, and at what rate?

The topic of autonomous cars is a buzz word in contemporary automobile market and on the web. The way technology is changing; it has affected car industry widely. The web is addressing this technology respectfully and considering it as a promising advancement with the capability of being disruptive in coming years. After the rise of Tesla and announcement of Uber's and Google's autonomous cars it aroused hopes of positive technological development in this field.

Attention to this technology is growing and a lot of publishing networks, news broadcasters, web blogs, magazines and forums are addressing this technology. The autonomous cars are considered as new era of personal transportation and being continuously compared to disruption that mobile phones created in the wired-phone market. Below, we can notice the huge increase in the search of autonomous cars in the year 2016 as compared to almost flat years between 2004-2012.



11.3. What conferences are devoted to the innovation? Is attendance growing or declining, and at what rate?

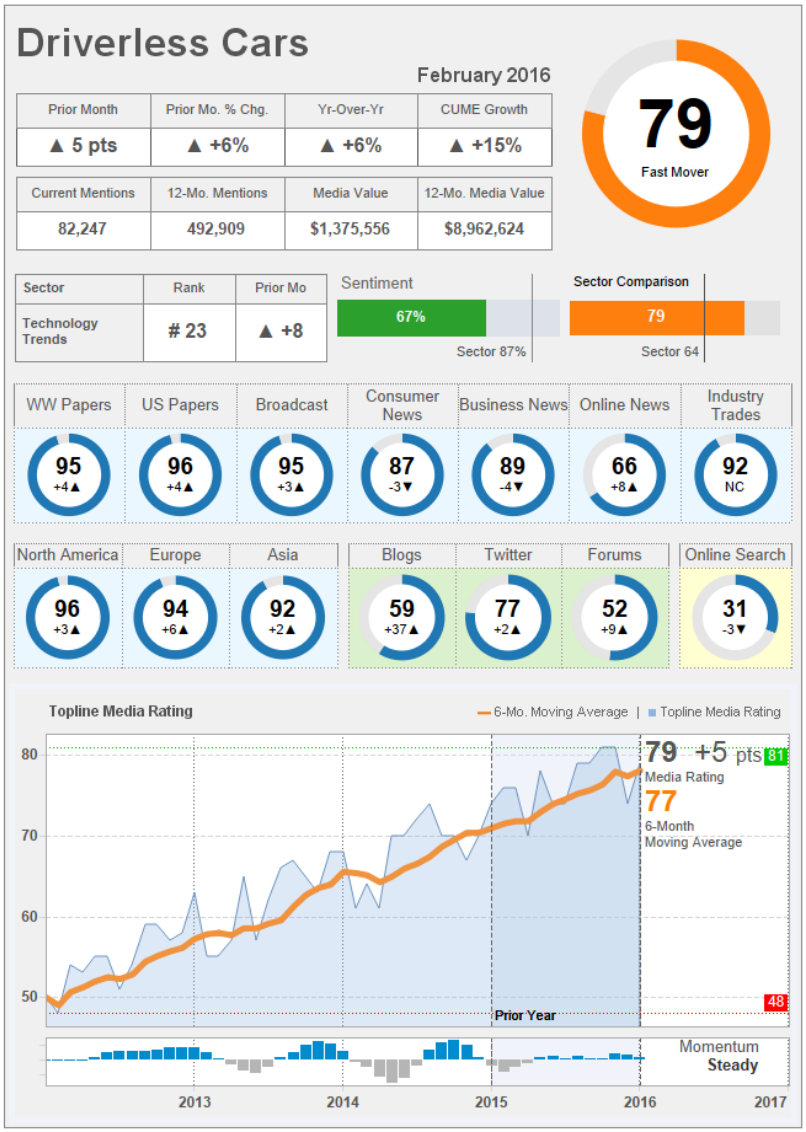
As previously mentioned, the concept of autonomous cars is widely trusted and addressed by the automobile market and almost all the manufacturing companies are doing its research in this field. The number of conference are increased during the past 4 years. During the year 2013, the conferences were sporadic and limited events were hosted. Currently, the number of conferences are increased in which professionals discuss the future of the industry, brainstorm ideas and network with professionals associated with the concept of autonomous cars. (iv2016, 2016)

Some of the famous conference for autonomous vehicle are "Automated Vehicles Symposium", "Autonomous Vehicles Silicon Valley", "Intelligent Vehicle Initiative". The attendance is growing

as professionals, innovators and car maker organization are participating the events. The average attendance of each conference is between 400 to 550 participants. (America, 2016)

11.4. What is the current business and trade press coverage devoted to the innovation? Is it growing or declining, and at what rate?

Autonomous vehicles (likewise called self-driving, driverless, or robotic) vehicles have for quite some time been anticipated in science fictions and discussed in mainstream media. As of late, significant companies have reported plans to start offering such vehicles in a couple of years, and some jurisdiction have passed enactment to permit such vehicles to operate lawfully on open streets. If media attention is any indicator, the future of driverless cars is already here. In January 2016, autonomous vehicles earned around 82,247 media mentions over worldwide news channels, which is like media rating of 79 (out of 100). In the innovation trend sector division, this wins it an associate rank of #23. The versatility of trends gives an intriguing vantage point into corporate strategy and competitive dynamics which we can illustrate through a look at autonomous vehicles. (Senatori, 2016)



These days' autonomous vehicles are getting more attention from the media, however little from transportation organizers. Given the innovation's potential effects on our transportation system, it's the ideal opportunity for organizers to begin contemplating it.

As the innovation progresses, the media now treats self-driving autos with seriousness and regard. Developers are designing self-driving car use into future retirement communities, while car makers like Mercedes promote passive "self-driving" security highlights. Expert analyst anticipate that completely autonomous vehicles will be on sale by 2020. (Bottigheimer, 2014)

11.5. What is the current level of adoption of the innovation among companies? What is the growth rate, and is it increasing or declining?

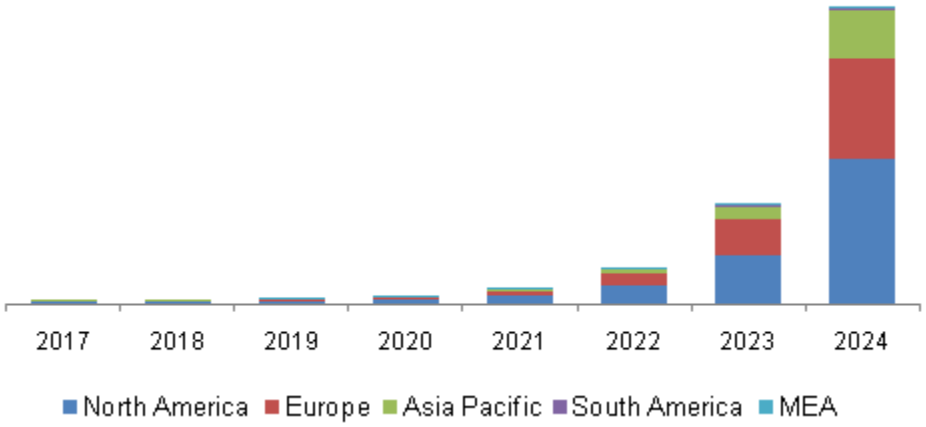
An in-depth analysis on autonomous cars have been conducted by Boston Consulting Group. The study pulled together several elements of research, including an analysis of autonomous-vehicle

technologies and economics; US consumer survey data; interviews with executives of automobile companies, suppliers, and technology companies around the world; and an extensive review of industry publications.

By 2035, more than 12 million fully autonomous cars are expected to be sold per year globally. By 2035, more than 18 million partially autonomous cars are expected to be sold per year globally.

“The market for partially and fully autonomous vehicles is expected to leap to nearly $77 billion in 2035.” (Group, 2017)

The rate of adoption of autonomous cars is expected to shoot up at very high rate. The Autonomous Cars/Driverless Cars Market demand is expected to reach 138,089 units by 2024. This growth is attributed to the need to curb the rising number of accidents caused particularly due to human error. According to the International Organization for Road Accident Prevention, more than 90% of road accidents across the globe are caused primarily due to human errors. National Highway Traffic Safety Association (NHTSA) estimated that the adoption of autonomous vehicles, also known as driverless vehicles, in the U.S. alone could save more than 69 lives every year. (Grand View Research, 2016)



11.6. What vendors have branded their offerings under the innovation's buzzword, and how rich and compelling are these offerings?

Private companies working in auto tech are on pace to attract record levels of deals and funding in 2016, with autonomous driving startups leading the charge. As expectations, around self-driving vehicles have risen, major corporations have ramped up their own initiatives, racing to deploy technology onto public roads. (33 Corporations Working On Autonomous Vehicles, 2016)

- At CES 2017, BMW, Intel and Mobileye announced their partnership that was initially announced in July 2016 aimed to put a fleet of around 40 self-driving BMW cars on the road by the end of 2017.
- Google has been working on driverless cars for several years and last year unveiled a working prototype. What's more, Google has also equipped other car manufacturers with driverless car technologies such as the Toyota Prius, Audi TT and Lexus RX450h. Google's own autonomous vehicle uses Bosch sensors and other equipment from LG, and Continental. In 2014, Google revealed their concept of a driverless car, without a steering wheel or control pedals with plans of making these cars available for public purchase by 2020.
- Earlier this year (2016), Volvo launched 'Drive Me UK', an extensive UK-based autonomous driving trial, involving up to 100 driverless cars being driven on real roads by real people in 2017.
- Tesla's CEO Elon Musk claims that all Tesla cars will be fully driverless in two years. Tesla already has a semi-automotive car, namely the Tesla 'S' model that can train each other using 'deep learning' algorithms sent out and processed by the fleet's sensors. This

information teaches the cars about in-lane changing and spotting obstacles and should improve day-by-day. (Mercer, 2017)

With all this companies competing over Autonomous vehicle technology, Toyota have been a silent observer. Toyota has notably reversed from its 2014 claims that it would not develop a driverless car on safety grounds. In 2015, it announced a $1B budget for autonomous driving research, establishing its advanced Toyota Research Institute. Toyota has also also hired professors and researchers from Stanford University, MIT, and the entire staff of the autonomous vehicle company Jaybridge Robotics. Just in April 2016, it also announced its third US university partnership with an automotive engineering stalwart, the University of Michigan. Toyota plans to divide labor among its research partners, with the University of Michigan campus responsible for fully autonomous cars, Stanford working on partially autonomous vehicles, and MIT working on machine learning. August 2016 has seen it double down on its university efforts, with a further $22M investment to the University of Michigan to drive robotics and self-driving research. The company has targeted 2021 as a goal for deploying “AI car features” to the road. (33 Corporations Working On Autonomous Vehicles, 2016)

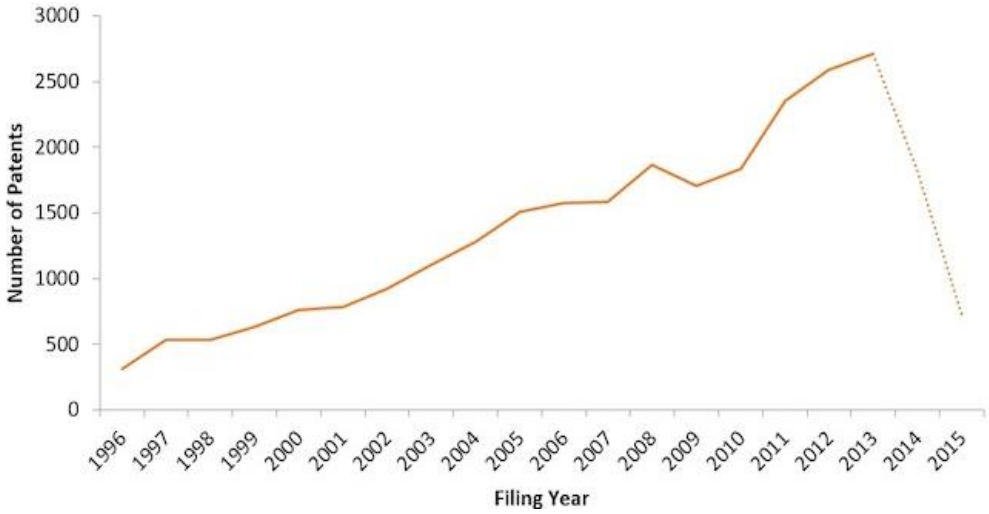
11.7. Is there a discernible fashion bubble associated with current adoption of the innovation, and how large is it?

There is no visible fashion bubble associated with so many companies jumping in to build autonomous vehicles. There certainly are roadblocks for autonomous vehicles to be a reality on public roads on a mass scale. Companies are testing prototypes currently and commercialization of driverless technology is far away. One of the major roadblocks is to prepare the autonomous vehicles to behave like humans in emergency situations by calculating and choosing the appropriate response for each scenario. There are major ambiguities related to legal implications ahead. But, why the fashion bubble is not visible yet is because of the aggressive testing being done by companies to overcome these challenges. Semi-autonomous cars like Tesla already exist and are functional on public roads. Moreover, the fashion bubble is not yet visible because of the success being achieved in the testing. Companies have managed to dodge major hurdles until now and continue to invest into development of autonomous vehicles. While the traditional auto industry is in the race to command autonomous vehicles, there is a boom of startups in self-driving sector. The reason behind this is recent acquisitions of startups by auto giants. Experts in car division are leaving the industry to initiate startups in self-driving vehicles industry. There is a visible bubble not too large though for the startups but not for the traditional auto industry organizations and other establishes enterprises with hefty financial backup. While the automotive manufacturers are future proofing themselves by developing self-driving cars, other companies which can use these are future proofing themselves by understanding how their business model would change with autonomous vehicles. This clearly indicates that there is no visible fashion bubble around autonomous vehicles.

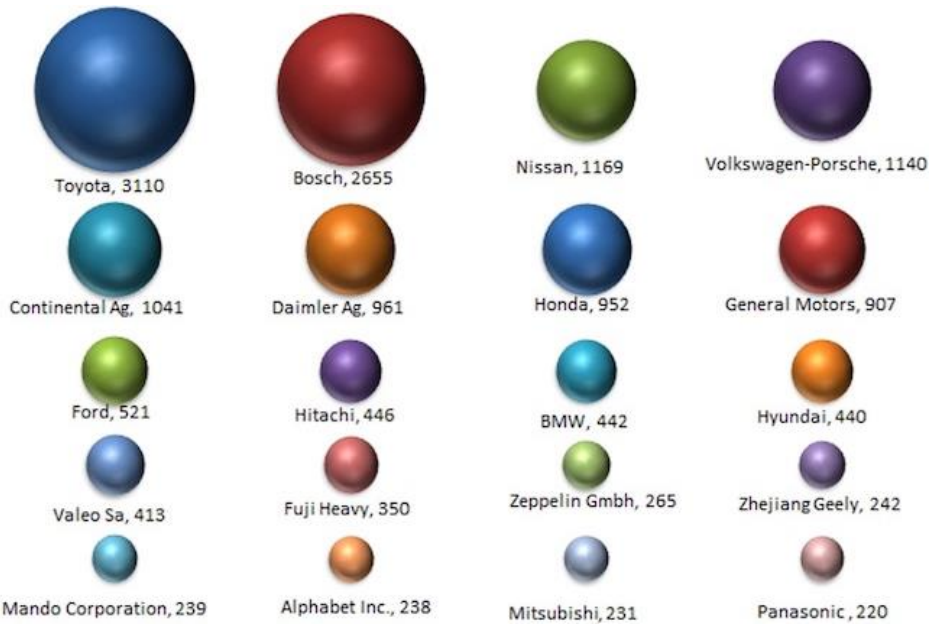
11.8. What is the current implementation gap among adopters of this technology — that is, the gap between the number of companies who have announced they will adopt the technology and the number who have successfully implemented it?

Autonomous Vehicle technology have been widely adopted by many companies. Google car make the rounds each afternoon, testing the suburban streets. Uber is planning to launch a fleet of self-driving cars in Pittsburgh in a month and it seems that companies all over the globe are trying to make them work. One recent drawback was the crash of a Tesla in a "hands-free" mode, despite Tesla claiming that the technology is not ready to be used without human supervision. Yet all this means that the technology is on the street already and might be ready for widespread adoption sooner than the decade Gartner anticipates. (Katzenelson, 2016)

If we look at the patents for autonomous vehicles, the number of application filings has constantly increased from 1995 to today – with some deceleration in 2009 due to the economic recession of 2008-09 when most the automobile makers saw cash flows dwindle. The graph shows a dip after 2013 as many of the applications filed haven't been published yet but we can assume that the number of filings in 2015 will cross the 2500 mark and the growth in this technology would continue.



Looking at total patent ownership, as shown in the image below, Toyota, Robert Bosch and Nissan have the most patents relevant to autonomous cars with 3110, 2665, and 1169 patents and applications respectively. Volkswagen-Porsche (1140) has strong a portfolio in signaling and collision responsive systems while Daimler (961) has a strong portfolio in Collision Responsive Systems, Collision Detection and Pedestrian Safety Systems. Mitsubishi (231) has so far concentrated on signaling and Vehicle Steering Systems, while Panasonic (220) has patents on Vehicle Steering and Passenger Safety Systems. (Vijh, 2016) Though Toyota has highest patents filled, it is yet to come up with the product.



11.9. Which consultancies provide implementation services for the innovation? What are their capacities, and at what rate are those practices growing?

The traditional industry is adopting the autonomous vehicles technology and many startups have come into the picture with self-driving cars as their acumen. Tesla first came up with semi-autonomous cars through its auto-pilot system. Tesla is working on fully autonomous electric cars. Google and Apple not being a part of the traditional industry are also working on the pioneering technology of self-driving cars. The automotive manufacturers GM, Daimler, Volvo, Ford, Jaguar Land Rover, Audi and BMW are all also developing solutions. Smaller companies and groups are also developing and testing the technology. Uber is also trying to build self-driving cars that could be used as taxis. There are some startups which were acquired later. General Motors bought Cruise Automation, Ford bought majority stake in Argo AI. Even electronics company Panasonics has envisioned an autonomous car with bubble like cabin.

11.10. What implementation "horror stories" associated with the innovation are being reported, and what lessons are being drawn from them?

Self- driving cars from Google and other companies are coming and without doubt they will be safer and more reliable than human drivers. They won't get tired, drunk, angry or distracted and will even share navigational data with other cars enabling them to make better decisions on the road. But the primary concern about self-driving cars stem from what happens when things go wrong. What would happen if the software in the car is corrupted or hacked, if the hacker could commandeer control of the vehicle and kidnap someone in their own car driving them to a location holding them as ransom. Hackers will no doubt cause traffic jams by wirelessly hacking several cars at once, creating chaos on the roads.

Recent information from the California trials give convincing bits of knowledge into the present components impacting disengagements of autonomous vehicles. One of Google's self-driving vehicles caused critical damage on Friday, Sept. 23,2015 after it met with an accident while navigating the city boulevards in Mountain View. The organization has effectively affirmed the episode and immediately issued an official reaction, which incorporated a confirmation that the auto was without a doubt in charge or under self-driving mode. This could prove critical because it was the first case where the vehicle has been seriously damaged. Accounts from witnesses uncovered that the autonomous vehicle was a Lexus that was hit by a business van after its driver took the red light. The van collided with the vehicle's passenger side. Luckily, nobody was harmed in the occurrence. As per the police, there was a passenger inside the autonomous vehicle when the crash occurred. A different report demonstrated that this passenger took control of the vehicle when crash was unavoidable and attempted to apply the brakes. The Google representative was allegedly obviously shaken as he was awaiting tow service. (Loterina, 2016)

Despite several attempts by Google and other different engineers of self-driving cars to extend their projects, it appears that the idea to move from driver-driven to self-driven cars will be evolutionary, not revolutionary. Regardless of the possibility that the innovation representing a car's conduct is perfected, how other different drivers behave out and about is an inherent source of process variety that current innovation can't completely address.

Responsibility regarding vehicle development can't change overnight. Instead, slowly shifting driver control from active management to passive management is the answer. The recently proposed regulation in California requiring drivers to act as supervisory pilots to autonomous cars represent a cautious step toward greater automation in over-the-road vehicles. Rather than being “gravely disappointed,” developers such as Google should cautiously embrace such regulations to encourage this evolutionary step or the disruptive innovation may never come to fruition. (Jin, 2015)

11.11. What is the current gap, among organizations that have implemented the innovation, in achieving promised business value?

It is too early to determine the gap between the adopters of autonomous vehicles technology in terms of its implementation as it is still being tested or is pilot project based. Autonomous vehicles are yet far from touching the production lines. Considering that some of the organizations are testing the prototypes while some are still researching and building the technology, it is difficult to analyze the gap. But per reports, Google, Volvo, BMW, Ford, Audi and Daimler have their prototypes ready and are testing them. While there is foreseen business value with autonomous vehicles in terms of business value, it is believed that the autonomous vehicles would lead to new business models that could expand the revenue pools by about 30 percent, adding up to $1.5 trillion in the future. The automotive revenue pool will significantly increase and diversify toward on-demand mobility services and data-driven services. This technology is being termed as disruptive as it will completely change the markets and mobility solutions.

11.12. What are the compelling success stories among organizations that have adopted and implemented the innovation and gained value from it?

The market of autonomous cars is growing and it has not taken its complete form yet. We have witnesses some prototypes of Uber's and Google's self-driving car and came across several notifications that multiple organization are researching in this space. Till now, not any organization had utilized the technology completely and no such success stories are reported yet. This field is growing fast and we can expect new success stories coming across our ears. Considering self-driving semi-autonomous mode of the Tesla (also called autopilot and Tesla does not recommend car owners to rely on that), it is getting great advantage of that and Tesla is gaining value because of its no-fuel dependency along with heavy technology loaded on the car. The whole business model of Tesla gave it success comparable to other car companies and it is direct implication of success using autopilot in the cars. Recently, Tesla passed Ford in terms of Market Value which is a satisfying indication for autonomous cars industry. (BOUDETTE, 2017)

11.13. Explain how Toyota could use this technology to help their location

The advancement of autonomous vehicles now undermines to change the very essence of driving. In the race to build up that innovation, Toyota lingers behind a few of its competitors and Silicon Valley startups like Google and Tesla Motors. It's possible that an era from now everything from roadway configuration to driver certification will be profoundly reshaped by the pervasiveness of semi-or completely autonomous vehicles, and carmakers without the essential innovation will be as risked as the venders of silver-halide film in the age of the digitalized selfie.

Resolved to compensate for lost time, Toyota's 60-year-old CEO, Akio Toyoda, is investing around $1 billion for a new Toyota Research Institute with branches in Michigan, Silicon Valley, and Cambridge, Massachusetts, that will concentrate on autonomous vehicles and robotics. He has selected Gill Pratt, a top robotics specialist, to run the organization, giving him authority to contract hire many engineers and scientists. In the meantime, Toyota is hitting up organizations with Stanford, the University of Michigan, and MIT to reexamine cars' capacities, regardless of the possibility that provocative new methodologies may take 10 years or longer to appear in dealer showrooms.

Unmistakably Toyota, as most other established carmakers, isn't making a hard and fast offer to match Google's endeavors to build completely autonomous vehicles. Rather, Toyota imagines drivers and software sharing control for a considerable length of time to come. Pratt is championing "guardian angel" technology that could locate the best evasive strategies in an instant if trouble looms.

Still, while the pieces come together, Toyota will enjoy special access and collaboration. Also, auto innovation's long adoption curve may give Toyota the time it needs. Loads of battles still lie ahead in winning administrative endorsement and client dependability, regardless of whose early innovation is most promising. History demonstrates that breakthrough technologies such as

airbags and advanced transmissions can take 20 years to gain mass acceptance after their marketplace debut.

Toyota additionally figures to move faster now that its supervisor has renounced his earlier doubts. In May 2016, the CEO encouraged every one of his representatives to grasp the "earth shattering change" related with automated driving and robotics. Such new technologies will be as transformative to the company, Toyoda vowed, as was his own grandfather's decision in 1930 to create a motor-car division within what was then a small loom-making company. (Anders, 2016)

11.14. Rationale to adopt or not adopt the autonomous vehicles by Toyota

Toyota is one of the biggest brands in automobile industry and the future trend for automobile industry is autonomous or self-driving cars. By 2035, the demand of autonomous cars is going to increase many folds. Automobile industries biggest focus is customer satisfaction and operational excellence. There are many benefits of autonomous cars listed below:

1. Overnight Journey can be done easily.
2. 80% of the car crashes in the USA are caused by the driver error. The error rate can be reduced many folds with the implementation of autonomous cars.
3. Sensory technology could potentially perceive the environment better than human senses, seeing farther ahead, better in poor visibility, detecting smaller and more subtle obstacles, more reasons for less traffic accidents.
4. Efficient travel also means fuel savings, cutting costs.

Between now and 2021, according to the World Economic Forum, driverless vehicles are expected to generate $67 billion in economic value and $3.1 trillion in societal benefits. By 2040, autonomous vehicles are expected to comprise around 25 percent of the global market. (Brookings, 2017)

If Toyota wants to continue being a market leader, they should focus a lot on autonomous cars for better operational excellence and customer satisfaction.

Toyota spends $10 billion a year on research, more than any other automaker except Volkswagen. That pays for endless incremental improvements in everything from lithium batteries to seatbelt design, but such tweaks may not be enough anymore if Toyota is to remain the world's top seller of cars. (Anders, 2016)

In the race to develop this new technology, Toyota lags fellow carmakers like Google and Tesla Motors.

As a matter of fact, Toyota unveiled the concept-i, it's vision for motoring in 2030 at CES 2017. Rather than designing and building the body first, as happens with the normal design process of the car, started with the design of the cockpit, with a clear emphasis on the driver and the AI that will help. Being innovative and different at the same time will make Toyota thrive. (Stewart, 2017)

12. Why Toyota should Adopt - Autonomous Vehicles?

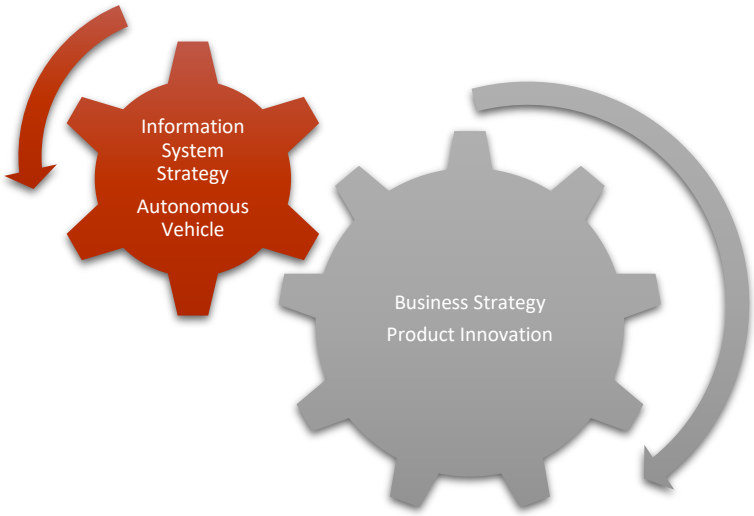
Digitization, increasing automation, and new business models have revolutionized other industries, and automotive will be no exception. These forces are giving rise to four disruptive technology-driven trends in the automotive sector: diverse mobility, autonomous driving, electrification, and connectivity. Autonomous cars are believed to bring disruption in the car industry. Toyota hence, should be aggressive on adapting this new technology. Other companies are already researching in this space and we can expect fully functional autonomous cars by 2021. Up to 15 percent of new cars sold in 2030 could be fully autonomous.

It is easy to enter or explore the space as Toyota has resources and technology that can be utilized to focus on autonomous vehicle industry. Autonomous cars are efficient and efficient travel also means fuel savings, cutting costs. By 2035, the sale of autonomous vehicles is expected to reach 12 million and 18 million per year for partially autonomous cars. By 2035, 25% of new car market will be of autonomous cars. (Gao, Kaas, Mohr, & Wee, 2016)

Toyota spends $10 billion a year on research out of which it is spending $1 billion for a new Toyota Research Institute with offices in Michigan, Silicon Valley, and Cambridge, Massachusetts, that will focus on autonomous cars and robotics. Toyota lags several other carmakers and Silicon Valley upstarts such as Google and Tesla Motors. As car technologies usually have a long adoption curve, this gives Toyota the time it needs to catch up.

13. How does Autonomous Vehicle technology align to Toyota's Business Strategies?

Toyota has started to adopt and should continue to develop autonomous vehicles technology as part of their product innovation business strategy. The Year 2016 is the second consecutive year the United States Patent and Trademark Office has issued more patents to Toyota's innovative designers and engineers than to any other automaker. This achievement is according to a recently released publication by the Intellectual Property Owners Association (IPO). In 2015, Toyota received 1,636 patents and over the last eight years has been awarded more patents than any other automotive company. This achievement illustrates the company's commitment to ever better cars that achieve greater safety, environmental and technological advancements. Whether it's creating an artificial skin for pedestrian safety mannequins, helping autonomous vehicles detect and safely react to emergency vehicles or fabrics that clean themselves, Toyota leads the way in anticipating and engineering the cars of tomorrow for today.



"As companies in the automotive industry transform themselves into broader mobility providers, no auto company better demonstrates innovation and technology for the future than Toyota," said Jeff Mickiewicz, senior vice president, Toyota Technical Center (TTC), Toyota's North American research & development headquarters. "We're focused on delivering great experiences for our customers, a cornerstone of Toyota's product commitment, and this recognition is proof we're living up to that promise." (Toyota Leads Auto Industry in Innovation, Again!, 2016)

The growth of Autonomous vehicles also depends on other technologies like Artificial Intelligence. Showing progress in Autonomous vehicles is necessary as a current marketing strategy for automobile manufacturers.

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