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**The Need for Flexibility**

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**The Need for Flexibility**

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**Thesis**

Presented to the Faculty of the Graduate School of

The University of Texas at Austin

in Partial Fulfillment

of the Requirements

for the Degree of

**Master of Science in Engineering**

**The University of Texas at Austin**

**August 2011**

## **Dedication**

To my family and everybody who supported me to pursue this degree and helped me overcome all the challenges.

## **Acknowledgements**

Thank you Dr. Robert Duvic for serving as my adviser throughout my research and for all the help, all the time and wise advice provided. I would like to thank as well to Dr. Kyle Lewis for serving as my reader. I would like to present special gratitude to the company I worked for, Futaba Industrial Texas, because without their support and the information provided this research would not exist.

## **Abstract**

### **The Need for Flexibility**

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The University of Texas at Austin, 2011

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In a world economy where globalization reaches almost every corner, the need for a company to attain flexibility has acquired tremendous importance to remain competitive and profitable. This Thesis would present the importance of flexibility in times of uncertain conditions (natural and socio-economic), it would present an analysis of the struggle of Toyota Motors Manufacturing Texas and one of its on-site suppliers Futaba Industrial Texas “FIT” to attain Manufacturing Flexibility through different economic crisis and a natural disaster presenting its strategies to mitigate economic losses and cope with the turbulent environment by developing robust systems.

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# **Chapter1: Introduction**

## **1.1 GENERAL PICTURE**

In a world economy where globalization reaches almost every corner, the need for a company to attain flexibility has acquired tremendous importance to remain competitive and profitable. It has become a necessity with an economy that has continuous ups and downs and an unpredictable environment the need for companies to be flexible, this has earned a remarkable importance to remain afloat and survive with the increasing instability of a volatile market. People have become reluctant to spend thus shrinking the market because of the fear of the unknown, where major companies from all sectors and backgrounds have suffered tremendous damage with several of them filing for bankruptcy. Additionally organizations have been downsizing their companies to subsist, creating an economic meltdown. The horizon have not look clear, even though during the end of 2009 and 2010 industries showed signs of some economic recovery all around. The uncertainty of the market and the entire environment that surrounds it will not cease to exist (An example of this is the current economical instability in Europe).

This thesis is about explaining what constitutes flexibility in manufacturing systems along with its difference ramifications, it is about showing the importance of flexible systems and its benefits in the manufacturing industry focusing primary in the Auto Industry following closely the reactions and strategies of the Toyota Motors Manufacturing Texas Inc. (Herein after Toyota Texas) Plant located in San Antonio and one of its suppliers, Futaba Industrial Texas “FIT”, which is the company I have been working for since August of 2007.

The thesis shows an analysis with the inside perspective of how Toyota Texas and FIT have been dealing with different crisis, following closely its short history reflecting back the importance of flexibility dating back to day one. Among the different crisis that directly and/or indirectly affected the auto industry and the Toyota Texas Plant in particularly we have the collapse of the housing market which peaked in 2008, which developed further uncertainty into the markets creating panic among investors around the world and subsequently short after, high increases of the gas prices causing huge damages in the automotive business in the US shifting suddenly the demand from big, low efficient and expensive vehicles to a more eco-friendly smaller cars.

Recently a triple disaster of massive proportions stroke the east coast of Japan in March 11, 2011, an earthquake, a tsunami and a partial nuclear meltdown, which halted supply chain and has been an ongoing struggle for the Toyota Texas Plant and FIT along with several Japanese Industries across the globe because of the massive supply chain disruptions which caused huge economic losses. The flexibility in the supply systems is often understudied which consequently leave companies unprepared and vulnerable because they did not understand the risks and factors that can lead to a disruption and a costly slow recovery lacking the agility and responsiveness flexible systems posses. The supply chain extends beyond the enterprise which means supply chain flexibility must also extend beyond one firm's internal flexibility (Duclos et al. 2003).

In the analysis section of this thesis, examples of companies building flexible manufacturing systems will be presented along with the struggle of major companies and small suppliers, and their strategies and risks undertaken to prevail and even become

stronger through the path of flexibility. Additionally suggestions will be provided based on the existent literature on flexibility.

To achieve flexibility, the approach must be from different angles, organizations need to be considered to be to a certain point organic systems, adaptable to continuous change, where its flexibility allows them to change along with the environment efficiently adapting to the seasonal changes to the market and environment. The theory and literature behind manufacturing flexibility will be presented along with its taxonomies focusing in three different aspects fundamental to the industry which based on pure observation I propose that have to be carry out to create resilient enterprises which can endure and adapt through the difficult times and ultimately obtain a high level flexibility to sustain a competitive advantage over competition. The three different types of flexibility are Manufacturing flexibility (focus on equipment/ facilities/product flexibility), flexibility in the Supply Chain system, which shares in many ways the same ground as manufacturing flexibility but with its unique features, and Labor Flexibility, which revolves around the flexibility of the human assets, and it also could be considered to be inside manufacturing flexibility, it possesses high importance and complexity by itself. Altogether those three pillars create a complex formula required in a complex world to compete successfully and cope with the uncertain.

## **1.2 THE AUTOMOTIVE INDUSTRY**

As mentioned before, the main focus would be around organizations in the automotive industry, the effects of the economic crisis and natural disasters upon them,

while trying to remain competitive and adaptable to the regular fluctuations of the market with limited resources with a continuously changing demand accompanied by shorter life of their products reflect the need for flexibility. Flexibility is desired in order to handle uncertainties and variations in both internal and external environment (Ramasesh and Jayakumar 1991). Where uncertainties exist not only in the market but, in the world in general, and as competitiveness is continuously increasing, the supply chains systems stopped being dependant from a single region or country, to reduced expenses the world has become the playing ground as organizations search for the cheapest or more convenient location to develop products and subcomponents of their products, the risk of a major disruption is present and companies do not acknowledge its dangers nor how to deal with the situation.

The inside perspective from one of Toyota suppliers “FIT” where I am currently working for, will be presented with its problems and challenges, where different factors face different needs, where having a single major customer could represent a burden resulting in a lack of flexibility. Management understanding of those needs will increase or diminish your flexibility. The degree of flexibility in a manufacturing environment each company can attain, will play a very important role on establishing a clearer picture in how well they are prepared to confront the ever existent uncertainties in a competitive world market.

The automotive industry in the US was affected enormously after the housing bubble exploded in 2008 which was followed side to side since 2007 by a record increase of the gas prices (Fig1.1), which triggered a massive shift in demand for more

economical vehicles. Because of those record gas prices, a massive transformation in the automotive industry began taking place to create more fuel-efficient vehicles to accommodate the newly shifted demand. The uncertainty of the market is pushing the automakers to try adapt to variations, and seek flexibility to cope with shifting demands. . Variations and uncertainties can be seen as attributes of changes, and since variation and uncertainty are often translated into changes, it has been proposed to refer to the concept of change as a reason for flexibility (Correa 1994).

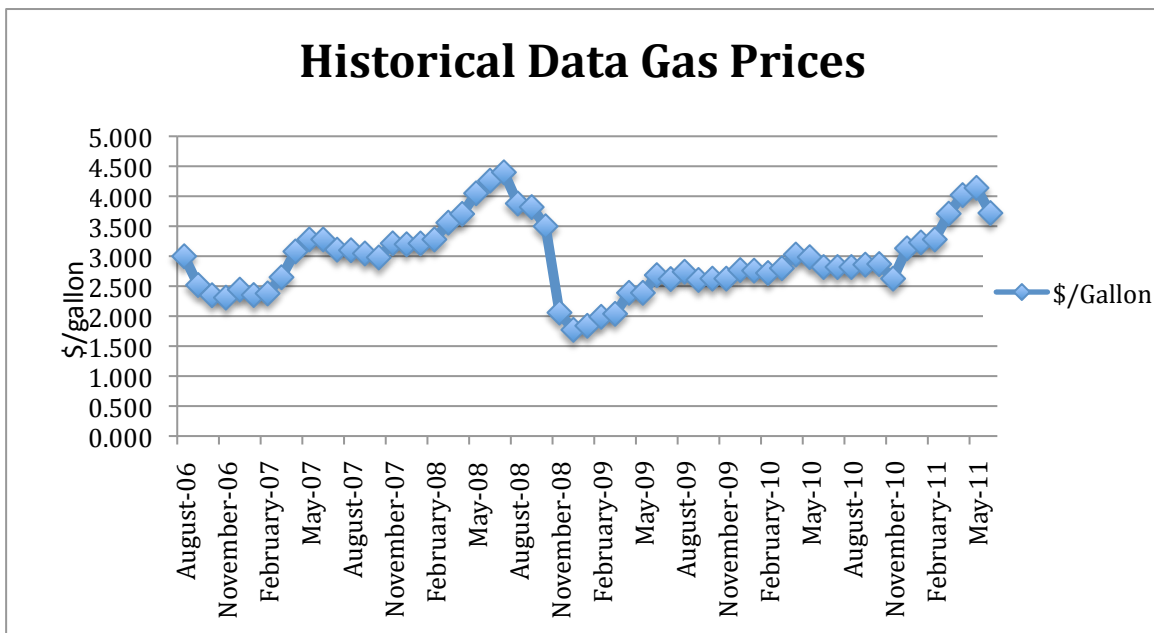


Fig. 1.1 Historical Data of Gas Prices (source: U.S, Bureau of Labor Statistics)

Wherein even big players have felled down and some have been trembling and threatening to collapse where several suppliers have been left unemployed or struggling with a continuous stream of negative income statements due to a poor demand. Some of

the major players like GM or Chrysler in December 19,2008 were saved by a \$13.4 billions in loans (\$9.4 billions for GM and \$4 billions for Chrysler) from the U.S. government (Isidore 2008), whereas in the other hand the Japanese automakers seemed to be in a better shape to confront the situation and yet, they are not exempt from damage, one of the advantages over the American automakers could be the flexibility of their systems. Flexibility is not a new concept for the Japanese, Gerwing (1993) pointed out that after achieving excellence in quality Japanese turned their attention to achieve flexibility, whereas Westerners where still struggling with quality issues, all this information was acknowledge over two decades ago. The fact the Japanese recognized earlier than their competition to prioritize on flexibility gave them a competitive advantage, which helped them to become or to transform in more resilient organizations capable and adaptable to different environments.

Being a worker inside the automotive industry, I have witness how the overall economy was reflected in the auto industry where sacrifices and trade offs had to be made, and unplanned changes had to be enforced for the survival of the company. Down at the automotive supply chain where suppliers have a smaller pool of resources, it is evident that a lack of flexibility will eventually sink them down, one needs to adapt and try to cope with a turbulent environment. Unplanned change happens independently of an organization's determination but to which the organization has to adapt. On the contrary, planned changes happen as a result of the organization's conscious managerial decisions, which are taken to alter some aspect of the organization or its relation with the environment (Correa 1994). Most people was not expecting in 2008 gas prices where

going skyrocket reaching average values above four dollars per gallon or the financial crisis which started in 2007 with the crash of the house market, these are unplanned events which affected the economy globally.

Many suppliers specially the ones working for the American car manufacturers have suffered greatly and are going through a difficult economic time; Motor Equipment Manufacturers Association (MEMA) which is a trade group for auto industry suppliers reported more than third of such companies say in a industry polling that they are in financial trouble. By 2008 more than 40 of those suppliers filled for bankruptcy. (David Mercer 2009)

Suppliers also are great contributors for employment all across the country. Parts suppliers manufacture more than two-thirds of the value in today's vehicles according to MEMA. It is a big community but with demand for cars dropping, those who lack flexibility may end up out of business. The United States are very competitive market where the auto manufacturers from around the world have being trying successfully to remove the market share from the Big Three (GM, Ford, Chrysler), which until recent years have beginning to show signs to evolve into more flexible systems to recover the competitive advantage they once had.

## Chapter 2: Literature on Flexibility

### 2.1 MANUFACTURING FLEXIBILITY

In defining manufacturing flexibility one has to consider the level at which it is being specified (Gerwin 1987). When talking about levels could be from the organization as whole or as specific as individual, machine, etc. Gupta and Buzacot (1991) defined manufacturing flexibility as “ability to cope with changes of its environment”, which corroborates to what was mentioned before where this could be a planned or unplanned change.

Manufacturing Flexibility is what determines the extent of the skills a company has to adapt the ever changing environment, several authors have studied all its variations and the areas where it upholds more relevancy, not all the definitions presented hold the same amount of importance, it will vary little depending on the nature of your business, nonetheless it is important to present them all to understand its diversity and complexity.

Slack (1991), talks about four identifiable types of flexibility in a manufacturing system:

*1. New product flexibility.* It is the ability to introduce and manufacture novel products or to modify existing ones. How easily can you re-invent your company to adapt to what the customer desires.

*2. Mix flexibility.* The ability to change the range of products being made by the manufacturing system within a given period.

*3. Volume flexibility.* The ability to change the level of aggregated output.



4. *Delivery flexibility*. The ability to change planned or assumed delivery dates.

In a summary, 13 different types of flexibility in manufacturing systems identified by the authors Sethi and Sethi (1990), and Ramesesh and Jayakumar (1991) are presented below:

1. *Machine flexibility* refers to the various types of operations that a machine can perform without requiring a prohibitive effort in switching from one operation to another.

2. *Material handling flexibility*. It is the ability of a material handling system to move different part types efficiently for proper positioning and processing through the manufacturing facility it serves.

3. *Operations flexibility*. Refers to ability of a part to be produced in different ways with alternative process plans by either an interchange or a substitution of certain operations by others.

4. *Process flexibility of a manufacturing system*. Relates to the set of part types that the system can produce without major set-ups (another preferred term for it is mix flexibility).

5. *Product flexibility*. Refer to the ease with which new parts can be added or substituted for the existing parts. In other words, product flexibility is the ease with which the part mix currently being produced can be changed inexpensively and rapidly.

6. *Routing flexibility of a manufacturing system*. It is its ability to produce a part by alternative routes through the system.

7. *Volume flexibility of a manufacturing system*. Refers to its ability to be operated profitably at different product overall output levels.

8. *Expansion flexibility of a manufacturing system* is the ease with which its capacity and capability can be increased when needed.

9. *Program flexibility*. It is the ability of the system to run virtually untended for a long enough period.

10. *Production flexibility* is the universe of part types that the manufacturing system can produce without adding major capital equipment.

11. *Material flexibility*. It is the capability to make parts with alternative composition and dimensions of raw materials.

12. *Labor flexibility*. It is the ability to change number of workers, tasks performed by workers, and other worker responsibilities.

13. *Market flexibility*. It is the ease with which the manufacturing system can adapt to a changing market environment.

## **2.2 JOB FLEXIBILITY**

Job Flexibility or Labor Flexibility it is part of a manufacturing flexible system but it is a very complex ramification and it is one of the pillars of a successful company. An enterprise's workforce should be thought of as the most significant and underperforming organizational asset (Huselid 2005). The workforce of an organization unfortunately most of the time cannot attain the level productivity management intends to which results in waste of valuable resources. The productivity and usability of the human capital will depend on the level of flexibility they can reach, and no matter how efficient, technological advanced and flexible the equipment is, without the right personnel it will

have little meaning. That is why it is critical to understand how human capital can be managed and developed to maximize its flexibility. Authors also have divided job flexibility into different categories or types. Reilly (1998) divide flexibility depending on the intention of the employer into 5 different types:

*1. Numerical flexibility.* Allows the numbers of staff used to vary according to the needs of the business. It includes fixed-period contracts, temporary, seasonal or casual employment, outsourcing, subcontracting, etc.

*2. Functional flexibility.* It allows employers to achieve a more effective internal allocation of labor through improved deployment. It can result, for instance, from removing work demarcations or training staff to be able to undertake a variety of tasks.

*3. Temporal flexibility.* It involves variation in working hours, including overtime, number of shifts working, flexi-time, part-time working, etc.

*4. Locational flexibility.* It describes the various ways of using employees outside the normal workplace. It includes forms such as home-workers, tele-workers, relocation, etc. This may not seem very useful when talking about car manufacturing systems, but one example is to relocate your workers in a different facility temporally in times of no production or just to provide temporal support in special cases like the launch of a new line or the start-up of a new facility.

*5. Financial flexibility.* It allows wages and associated benefits to rise and fall with economic conditions (e.g. profit-related pay, performance related pay, etc.). This is one of the most common resources applied by companies in times of crisis to cut costs.

Managing your workforce, is one the most important issues because when demand is going on through a rollercoaster jumping up and down constantly and the forecasts make no sense changing almost on daily basis, how can you identify and get the adequate workforce to function for each situation. Based on the product you produce, managers have the responsibility to identify the needs of their company and use the labor flexibility to create leverage in the best possible way to find the right balance between the permanent experienced and skillful workers who can give you higher productivity and the temporal workforce who are just filling out a temporal gap in the market demand.

If you are constantly hiring and letting people go, how can you maintain morale and keep your employees highly productive? What mindset are you going to create among your employees? How costly is to train a new employee(s)? These are challenges managers have to deal with constantly and the understanding of the labor flexibility could be the answer and the most feasible solution to approach those problems more efficiently.

Sometimes companies face very difficult decisions and in order to ensure the survival of a company in the long run, they have to reduce their workforce, cut salaries, benefits, etc. For some companies it may seem viable the constant use of temporary workers which result in benefits savings like insurance which with increasing costs represent a high economic expense, also gives the company the option to eliminate the employee services at any given time.

How long does it take for a temporal employee to become a skillful worker? The learning curve in the case of FIT to start being productive falls within a week or less, but to be able to reach maximum productivity in a single machine could take up to four

weeks where the team member is now able to easily identify defects and can attain the target cycle time of the machine with a minimum of down time. Now if we are talking about of cross-trained employees, that will take much longer to successfully master several production lines. How good does your training program is or has to be? Problems I recognize when hiring large amount of workers start when workers are left alone on the line and becomes harder to keep track of them individually. In FIT when production shifted in Feb 2010 to two shifts and up to something around 50 workers where hired at the same time, there was increase of defect flow outs to Toyota. All this information is important to know to be able to quantify the trade of benefits between the percentage amounts of temps vs. skillful workers and to identify loopholes in your training system. It is important to find out what is the right balance to be able to sustain drastic drops in production without loosing your skillful workers and still managing to get back on your feet when production increases again without jeopardizing the quality of your product.

### **2.3 FLEXIBILITY in the SUPPLY CHAIN SYSTEMS**

To understand better what flexibility in a supply chain system encompasses, let me start by presenting the definition of Supply Chain. The Supply Chain Council (2011) defines it as “a term now commonly used internationally – encompasses every effort involved in producing and delivering a final product or service, from the supplier’s supplier to the customer’s customer. Supply chain management includes managing supply and demand, sourcing raw materials and parts, manufacturing and assembly, warehousing and inventory tracking, order entry and order management, distribution

across all channels, and delivery to the customer. Due to its wide scope, supply chain management must address complex independencies; in effect creating an “extended enterprise” that reaches far beyond the factory door. Today, material and service suppliers, channel supply partners (wholesalers / distributors, retailers), and customers themselves, as well as supply chain management consultants, software product suppliers and system developers, are all key players in supply-chain management.”

The studies about flexibility in the supply chain systems are not extensive and had only been studied by very few authors. Vickery et al. (1999) in his study about supply chain flexibility identified 5 different flexibility types within the supply chain.

1. Product Flexibility (customization): The ability to handle nonstandard orders; to meet special customer specifications; and to produce products characterized by numerous features, options, sizes or colors.

2. Volume Flexibility: The ability to rapidly adjust capacity so as to accelerate or decelerate production in response to changes in production in response to changes in customer demand. This type of flexibility has been defined before as part of the manufacturing flexibility but it is closely related to a supply chain system because to be able to achieve volume flexibility the supply chain needs to be adjusted efficiently to cope with demand without originating major costs to the organization.

3. Newly product introduction (i.e., launch flexibility): The ability to rapidly introduce large numbers of product improvements/ variations or completely new products.

4. Widespread distribution (i.e., access flexibility): The ability to effectively provide widespread and/ or intensive distribution coverage.

5. Responsiveness to target market(s): The ability to respond to the needs and wants of the firm's target market(s).

As mention before this definitions share similarities to the ones presented in the manufacturing flexibility (Section 2.1) but with the difference these are been applied to the supply chain systems, Martinez and Perez (2005) go a little further by incorporating and identifying a conceptual bottom-up classification of the supply chain flexibility which are presented in the figure 2.1

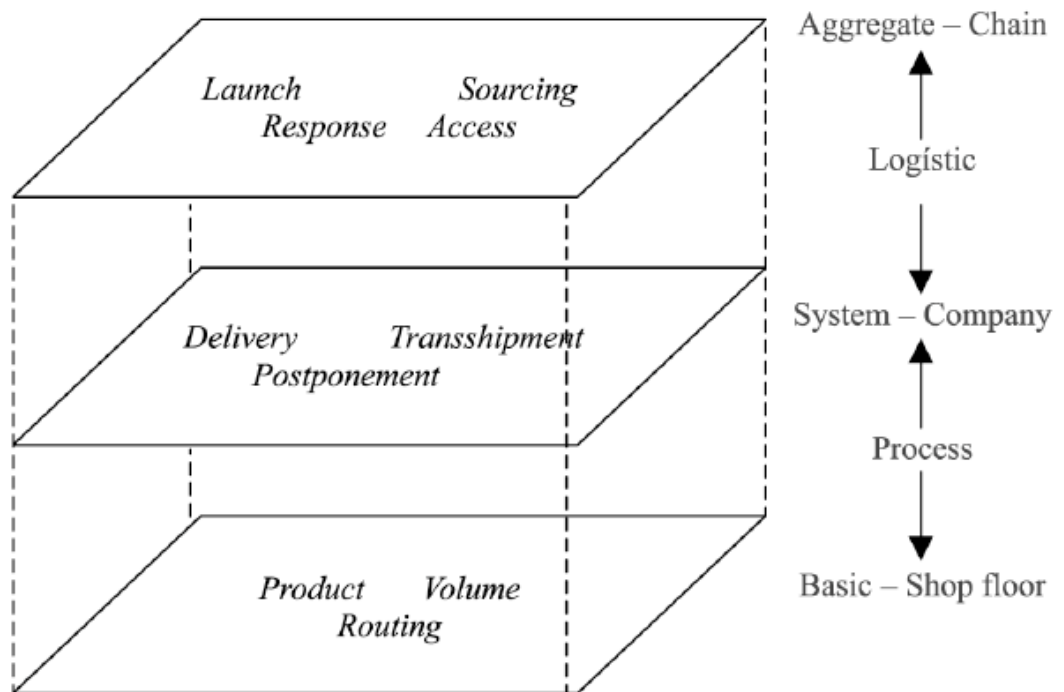


Figure 2.1 Bottom Up Classification of Supply Chain Flexibility

\*At the shop floor level, Product, Volume and Routing flexibility follow the already explained concepts in section 2.1. Response it is explained in section 2.3

Delivery flexibility: A company's ability to adapt to the lead times to the customer requirements. An example of this flexibility is the just in time system which is part of the Toyota Production System.

Trans-shipment flexibility: Involves movement of stock between locations at the same echelon level where physical distances between the demand locations and the supply locations are small (Barad and Sapir 2003)

Postponement flexibility: Is measured as the time/cost to transform a product from its generic form into a demanded specific product (Barad and Sapir 2003). This could be for example for FIT transforming the raw materials for the trucks into parts for a single-cab, cab and a half or double cab, common parts exist for some components.

Sourcing Flexibility: The ability to find another supplier for each specific component or raw material.

Launch flexibility: The ability to rapidly introduce new products or products varieties to the market, this type of activities usually requires the integration of numerous value activities across the entire supply chain. In the auto industry could also be related to the developing of a new model as well as a model change of a vehicle from one year to the next, which requires good planning and communication among all the suppliers involved in the change.



Access flexibility: This is related to the widespread distribution coverage explained before. This type of flexibility is facilitated by the close coordination of downstream activities in the supply chain.

### **2.3.1 Supply Chain Disruption Mitigation**

The supply chain extends beyond the enterprise which means supply chain flexibility must also extend beyond one firm's internal flexibility (Duclos et al. 2003)

There has been even fewer studies linking directly the use flexibility as a strategy or as a management tool during a sudden disruption to mitigate damages and ensure a quick recovery, Sheffi and Rice (2005), identify 5 facets in flexibility in that situation:

*Supply and Procurement.* This action could be achieved in two different ways one is about having more than one supplier for critical parts and the other way is about developing relationships with your sole supplier. The last one is the way Toyota tries develop its suppliers. The Texas plant has most of its suppliers on site, even though some suppliers do not manufacture parts on site, they still keep a representative or an engineer on site to make sure shipments arrive in a smooth way and issues are attended immediately. In addition to that Toyota have a representative for each of its suppliers to maintain a growing relationship and ensure any issues can be efficiently addressed. Unfortunately for FIT this practice is not followed and relationships with some suppliers is poor to none. These have caused costly and inefficient reaction to issues with suppliers in the past, where lack of communication has delayed the understanding of an issue resulting in defects, rushed shipments causing economic losses for both sides in the

supply chain. This is an issue where FIT should try to prioritize and emphasize to prevent future problems.

*Conversion.* Is related to the flexibility of a company to respond to a disruption in one of its own plants. Last year in one of FIT's sister plant in Indiana (Futaba Indiana of America "FIA") an engine for one of its Parts Press failed and the spare part was not going to be available from the Press maker for around a month. The commonality of the Press allowed for another sister plant in Chicago to overtake for the production of the parts once the dies arrived to the facility. Even though costs were incurred, the disruption was prevented. Futaba North America is currently in process to identify and unify on a single system to mitigate a disruption and facilitate the identification of critical equipment components.

*Distribution and customer-facing activities.* The authors talk about the fair allocation of limited resources in the post-disruption period. Which customers should be served first in case of a disruption or who should have priority or even which is the most profitable for the company? In the case of Toyota Texas for example for common components between both trucks (Tacoma and Tundra) could be to adjust the production ratio to increase the production of the Tacoma over the Tundra since it has greater percentage of market share and might be in greater demand. For FIT will not have much of a choice since there is no commonality between the parts assembled between among both trucks and the disruption of any of the components will leave the company without option. If a Tacoma component is short in supply, the customer (Toyota) will have the ultimate decision in how to

allocate the resources between Toyota Baja and Toyota Texas, but ultimately one will have to shutdown

*Control Systems.* The authors refer to the ability for a company to quickly detect disruptions. Can you detect in efficiently where are your shipments at all times? Do you have a way to contact and be able to rapidly react re-route your products. For FIT the leverage is limited, we use independent trucking companies to receive the raw material and the shipment for our customer Toyota Baja California are arranged by our customer. For FIT importance is high with the weather becoming so unpredictable every year, a great amount of our materials come from the North where in recent years intense snowing has halted highways. A flexible control system will boost reaction capabilities allowing a company to prevent any disruption.

*The Right Culture.* Company's culture is usually a symbol of their success and therefore an example for other organizations. Organizations that distribute decision-making power are successful in getting their employees to be passionate about the company's mission are fundamentally resilient (Sheffi and Rice, 2005). The level of culture of a company embedded within their employees will shape the reaction to difficult situations. The way a company behaves, the relationship with their own employees, customer and suppliers will link reaction in a collective effort. Few months after the natural disaster that devastated Japan, the country is still struggling to restore electric power to its normal levels. Toyota along with other car manufacturers have agreed to switch working days of Thursday and Friday to Saturday and Sunday to help ease the power consumption from July 1<sup>st</sup> to September 30<sup>th</sup> (Nunn 2011). This represent a huge jointed effort that requires

the support of every employee to help rebuild and restore their damaged country to its normal levels, the cooperative culture the Japanese demonstrate reflects in their success of their companies world wide. Additionally this effort will help prevent power blackouts which affecter directly the manufacturing industry in the immediate after math of the recent disaster.

Flexibility not only increases resilience in times of disruption but also garners benefits and operational efficiencies in the normal course of business. (Sheffi and Rice 2005). A company without flexibility regardless of its efficiency is doomed to fail because it will not be able to adapt and react fast enough to sudden changes without wasting vast resources, to have or increase your flexibility you need to understand all the factors surrounding the supply chain.

## **Chapter 3: Analysis of the Problem**

### **3.1 HISTORY OF THE PROBLEM**

To have a better understanding of the relevance of the study it is important to present the facts of the short history of the Texas Plant. Toyota Texas in San Antonio was designed with a platform to build solely the production of the Toyota Tundra, the project was ambitious and was designated also to have most of its suppliers within the same complex to reduce freight cost and at the same time allow Toyota to enhance its policy to build a close relationships and provide support to them. This type of design it's the first of its kind, no other plant posses the same characteristics as the Toyota Texas concept. In November of 2006 production started along with its 21 on-site suppliers to meet a production capacity of 200,000 Trucks/year, the investment was high along with the expectations. But with the economy booming at the time nobody was able to predict the changes that were coming to the U.S. economy.

Although for the first year production was close to full production it never actually reached full capacity (about 800 trucks/day), the fact is no matter how well the market and forecast look, there is always uncertainty. Kirk Kohler, general plant manager at Toyota Texas said . “Even Toyota, which typically is very conservative and deliberative and makes decisions for the long term, even we did not see the change that was coming in the market” (Krauss 2008). The Tundra being a full size pick up with a V8 engine with low fuel efficiency, in August of 2008 after struggling with high gas prices and the shift in demand that followed it, Toyota Texas had to close the plant for 3 months with the purpose to reduce existing inventories because Tundra sales plunged due to a switch in demand driven by smaller and more fuel efficient vehicles shrinking the market share. This situation was a tough wake up call, which made realize suppliers of the

magnitude of the situation and the uncertainty of road ahead. This was just the first call for a crisis that was barely starting.

According to an article by Michael Krebs (2009), 2008 represents the worst sales of cars in the US since 1992, were all the major automakers reported sales declines, and the total sales reached 13.2 million cars compared to a total of 16.7 million during 2007 in total, the industry sold 13.2 million vehicles for an 18 percent drop from 2007's 16.1 million, in the case of the Tundra, sales dropped about 30% in 2008 compared with previous year.

2009 was a year with very low production for Toyota Texas and its suppliers, where the workforce utilized was kept to a minimum limited to one production shift where Tundra sales continued declining another 42%. FIT made a very difficult decision by letting go about 30% of its management personnel (salary people) and some hourly employees as well, few workers were demoted due to low performance, this an example of FIT using financial flexibility adapting to volatile market. Toyota announced in the summer of 2009 the closure of its NUUMI plant in California. The NUMMI plant was a jointed manufacturing plant with GM where GM stepped out in 2009 as a result of its financial troubles and low success of their model produced. NUMMI produced the GM Pontiac Vibe, the Toyota Tacoma and the Corolla, as result of that, it was decided the production of the Tacoma was going to be moved to Toyota Texas by Summer 2010.

The Tacoma project launched successfully in July of 2010, this project not only brought business to Toyota Texas but to its suppliers as well. FIT added to its production line 7 new parts for the Tacoma as well a couple dozen of pass trough parts where FIT

gained a new function as a receiving dock before shipping those parts to Toyota. Little after the launch of the Tacoma, Toyota granted another part to be produced at FIT starting in the summer of 2011.

Just 8 months after Toyota Texas launched the production the Tacoma and regardless of the recent increases to the gas prices production levels were maintaining two shifts of production, when in March 11, 2011 an earthquake followed by a tsunami and a partial nuclear meltdown devastated Japan's east coast. The disaster halted the manufacturing industry along the area affecting indirectly different Toyota plants and some of its suppliers as well unchaining a massive supply chain disruption.

All of the sudden a new crisis was threatening Toyota Texas along with FIT and the others suppliers. The risk of disruptions in the supply chain are acknowledged for every one but not every company makes the investment to prepare accordingly to ensure the damage of a disruption in the supply chain can be efficiently mitigated ensuring a fast recovery. I am referring to the level of flexibility in the supply chain systems required to identify, sustain and recover as fast as possible from a major disruption.

### **3.1.1 Effects of the March 11<sup>th</sup> Disaster in the Texas Plant**

Fortunately for Futaba Corp. and FIT our suppliers from Japan were not affected by the disaster however several suppliers from Toyota Japan that make electronic components, paints and rubber were affected disrupting the supply chain according to David Crouch vice president of Toyota Motors Manufacturing Texas Inc. (Hendricks 2011). There were no immediate effects since there were a number of shipments in

transit which allowed the Toyota to get a better assessment of the situation and formulate a plan to mitigate the incoming damage.

No information was disclosed until last minute, however rumors started spreading about possible an imminent shutdown, the initial disclosure was that a production slow down was going to take place for the last two weeks of April where production was going to be null during Mondays and Fridays and 50% production for the rest of the working week. Overall the reduction was to the 30% of the total capacity of the plant. By the last week of April the measure was extended for the month of May with a non-production week from May 31<sup>st</sup> to June 3<sup>rd</sup>.

Even though some other Toyota plants in North America restored to 70% - 100% production starting in June 7, unfortunately the slow down was extended once more for Toyota Texas through August. There was some increase of the production of the Tacoma pickup increasing total production of the plant to 45%, but for the production regarding the Tundra, which is the major business source for FIT, it will remain roughly without changes till the end of August.

### **3.2 SUPPLIER PERSPECTIVE OF THE PROBLEMS**

It is necessary to examine the uncertainty faced by manufacturing managers in order to understand the flexibility that is built into the manufacturing processes (Gerwin, 1987). Since the first crisis started for Toyota Texas and FIT, which basically started with the three months shutdown within less than two years of the plant's opening, the need for flexibility became a vital necessity for FIT and a huge challenge for the company's



management. Three months with zero production represents a huge expense with no returns. The main problem was the fact Toyota Texas was the only client FIT had, therefore was the only source of income. As a result the company had no use of its workforce and labor flexibility became extremely important. The company had to figure it out how to manage its fixed and variable cost and some sacrifices had to be done.

Trying to attain labor flexibility was the strategy FIT attempted to use to confront this situation, there was very little time between the announcement and the actual three months shutdown, and in a situation like these one it is very difficult to argue there was a single best solution to the problem. Instead based on the level of flexibility that could be attained, the company looked for the most feasible solution based on its available resources. Sacrifices became a must, FIT applied to its maximum numerical flexibility and unfortunately all the seasonal or temporal work force had to be fired, but its permanent workers which were the most experienced ones were too valuable to let go because the process to go through staffing and training new personnel once production resumed were too high and the trade off was at disadvantage for FIT.

With some support from the unemployment office most of the hourly workforce were managed to be kept at smaller fraction of its salary through unemployment benefits, it was difficult times for the employees and at the same time it was risk the company was forced to take, but it was the only way management figure it out it was going to work because FIT did not had the resources like Toyota who kept their workforce in house in continuous training and full salary during the shutdown. Another strategy employed by FIT was the use of locational flexibility, most salary personal and some hourly workers

from Production, Maintenance and Quality departments, were managed to be sent to provide support to sister plants from the Futaba Corporation at Illinois and Ontario, Canada during most of the shutdown enhancing at the same time their employees skill. Indeed doing so, FIT tried to do the best of the situation cutting some of the expenses temporally but unavoidably the fact the plant remained without production still came at loss for the company.

Futaba Industrial Texas (FIT) one of the Toyota Texas On Site Suppliers had been struggling with dramatic drop in production from its only customer since 2008 and had been stretching its resources trying to maintain competitive in turbulent market. Companies like FIT which forms part of Futaba Corporation represent a big investment coming from a company which does not have the amount of resources a company like Toyota does. An investment like this is planned for example with an estimate rate of return to recover the investment in approximately 20 years, but when demand is not even reaching 50% of the what it was planned, the whole economic structure in which your foundations were set threatens to collapse. In 2009 the total production of Tundra's was below 95,000 trucks. The rate of return may diminish below expectation and therefore the return of the investment may take more than anybody foresaw. The rate of return of the investment is coming at a much slower pace and therefore how long will take to recover the investments is not clear.

### **3.3 MITIGATION OF A SUPPLY CHAIN DISRUPTION**

In a world where efficient systems are based in Just-In-Time inventory system (created by Toyota) where inventories are kept to a minimum improving profits by reducing waste, organizations increase their risk for supply chain disruption in an attempt to remain competitive. In order to be prepared to manage and mitigate a major disruption it requires to have a robust, agile and responsive system capable to cope to changes in the environment, and flexibility could be the most efficient path to create that system, and the challenge also lies in creating awareness to acknowledge that risk. What I am going to present is merely few of the tools identified by several authors which reflects the benefits of being flexible and at the same time I will try to compare to the actions taken by Toyota to restore the supply chain system to its normal levels and how its level of flexibility its making the difference.

Sheffi and Rice (2005) identify that a sudden disruption in a supply chain system can be characterized by eight different phases (Fig. 3.1). Relating those faces to the recent disaster in Japan, here is the following explanation:

1. Preparation: In the case of a natural disaster like the one from March 11 in Japan, there was hardly any warning but a few minutes where little could be done.
2. The Disruptive Event: The tsunami hit the west shortly after the earthquake, and the nuclear plant gets serious damage as a result of the event. The disaster halted manufacturing in most of the east coast of Japan.
3. First response: Since there was little warning, first response was probably focused in saving lives rather than protecting equipment or make preparations for the disruption.

4. Initial Impact: Production halted manufacturing production only in Japan initially.
5. Full Impact: The effects of the quake and the tsunami affected right away in Japan followed by the electric power disruptions because of the damage to the electric plant. In North American in the other hand operations took almost 1.5 months to be felt due to the shipments in-transit of parts.
6. Preparations for recovery: This involves the communication with the whole supply chain to create and execute contingency plans to restore it. On this phase the decisions to implement the production slowdown in the Toyota Plants across the globe to prevent sudden shutdowns was implemented to cope with disruptions and slowdowns from the suppliers in Japan. Nonetheless the Texas plant was the most affected in North America by slowing production for 5 months.
7. Recovery: The recovery stages for the Texas plant will begin in September of 2011 when the supply chain gets completely restored, where very high levels of production are expected along with overtime. This is with the purpose to recover some of the lost production, eventually production will return to normal levels before the end of the year.
8. Long Term Impact: This is typically the time to recover fully after the disaster, could be related to the loss of market-share, to recover the trust of the share holders, or to start being profitable to recover the from the huge losses for lost productivity during that period.

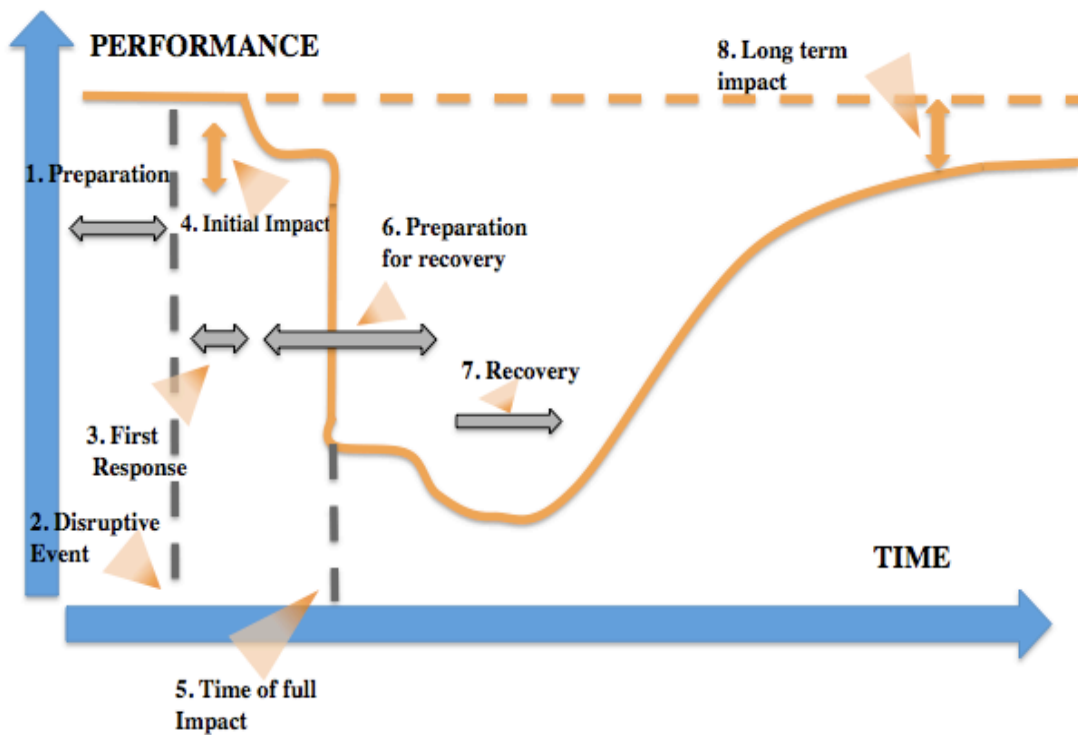


Figure 3.1 Phases of a Supply Chain Disruption

The magnitude of this disaster is a tough lesson to learn, and historically, shows the amazing resilience of Japanese to recover after a disaster only surpassed by the post World War II era of that country.

Companies are used to cope with small fluctuation of the market, which represent only a small risk of disruption, but not many companies really take action and make plans ahead to strengthen its supply chain system to augment their flexibility to deal with a major disruption like the current Japanese crisis. The damages caused by a sudden disruption caused by man-made or natural disasters can cause companies huge financial

costs, Rice and Caniato (2003) did a survey of one firm that estimated the impact of a supply chain disruption to be somewhere around \$50 to \$100 million dollars per day. Satoshi Ozawa CFO of Toyota estimated the impact of the recent disaster of Japan in a conference last May to be around 1.36 billion dollars of lost operating income (Schmitt 2011). In addition to initial financial cost to companies, long term effects like loss of market share, lost value in its stocks or even lost customer confidence could damage tremendously the life and stability of companies. In a study by Knight and Pretty (1999) they found in catastrophes the value of the stocks averaged a loss of to almost 8% and take over 50 trading days to recover completely. The Toyota Motors stock suffered a loss up to 11.1% loss of its value (Fig. 3.2) as result of the natural disaster once the full impact of the catastrophe reached the U.S. But at the same time we can appreciate the confidence of the investors that was almost completely recovered and back to levels previous to the disaster in less than three months from the time the stocks hit the bottom, which is about little less than 60 trading days. This shows the resilience of the company to recover after a major disaster and corroborates to the findings of Knight and Pretty (1999).

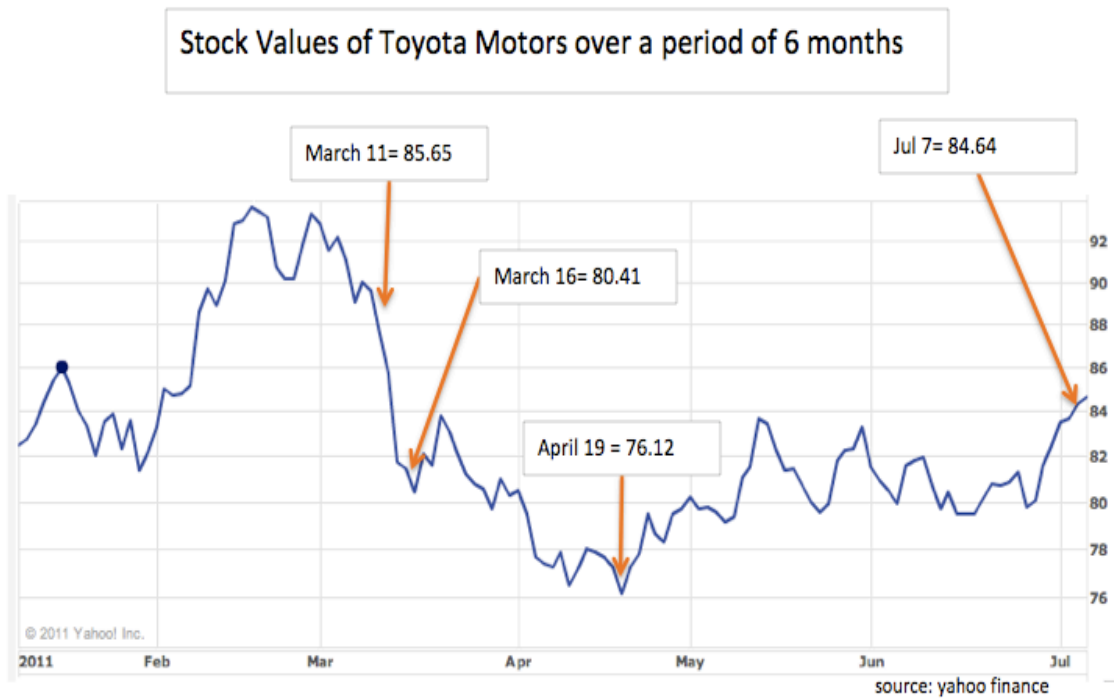


Figure 3.2 Stock Values of Toyota Motors over a period of 6 months

With that much uncertainty nobody could have anticipated a natural disaster could cause that much damage to a country and its industry with the highest investment in natural disasters mitigation. Companies must recognize the need for flexibility in its supply chain and recognize as serious danger the ever-existent uncertainty identifying potential threats and improving its adaptability to cope with possible disasters because the costs could be too high to sustain if all threats are disregarded to save some money in the short run. One of the conclusions after extended studies from Sheffi and Rice (2005) concluded, “An organization’s ability to recover from disruption quickly can be improved by building redundancy and flexibility into its supply chain. While investing in

redundancy represents pure cost increase, investing in flexibility yields many additional benefits for day to day operations”. Redundancy can be reflected as keeping extra inventory or safety stock, it represent the cost to occupy extra space and goes against its Just-In-Time inventory system, nonetheless can help a company to sustain a sudden disruption from shipments from the suppliers. Redundancy will only prove to be efficient if a disaster occurs, for the rest of the time will only be a waste of space and cost. A different costly example of redundancy is maintaining different suppliers for the most critical components.

Only supply chains that are agile, adaptable, and aligned provide companies with a sustainable advantage (Lee H. 2004). This can be seen as three different attributes that give the necessary flexibility to become stronger than your competition. Lee argues that all three components are necessary at the same time to really have an advantage over competition. So how does agility can be defined in a supply chain system or how is this related to the flexibility of the system? Agility is the key skill that a company needs to handle a disruption, it shows the awareness a company has of its surroundings it takes preparedness to whole different level.

Sheffi and Rice (2005) also recognize that two variables determine a company’s resilience: (1) The Competitive position of the enterprise, and the (2) Responsiveness of the supply chain. Toyota its known to be very competitive and its currently the biggest automaker in the world (as of 1<sup>st</sup> quarter of 2011). Toyota Texas assemble the Tacoma and the Tundra with virtually not switching cost between both vehicles, the Tacoma is assemble in Toyota Baja California as well, which allows flexibility between both plants.



Toyota's responsiveness has been tested in the past, on February 1<sup>st</sup>, 1997, a fire in the Aisin Seiki's plant which was the only supplier of proportioning valves, a break-related part used in all the Toyota vehicles, caused a shutdown through out Toyota due to JIT system, where little stock was kept. Thanks to a well-organized action between the supplier and Toyota, where able to rapidly produce alternate production sites and within two days after the part shutdown, the component was back in production in alternate sites (Nishiguchi and Beaudet, 1998). The responsiveness of Toyota has been tested once more, after the great natural disaster from March 11. It is known by the end of April was short 150 components and by May 11<sup>th</sup> that amount was reduced to 30, by June most models in North America with the exception of the Rav4 (Made in Canada) and the Tundra and Tacoma (Toyota Texas) were back to normal, still the situation is to be unfolded but Toyota is showing great signs of fast recovery given the magnitude of the disaster. Figure 3.1 shows a graph with the history of production of vehicles at Toyota Texas where the effects of the disasters and the benefits of increasing the plants flexibility by the platform expansion for a new vehicle can clearly be appreciated.

Production History Toyota Texas 2007-Jun 2011

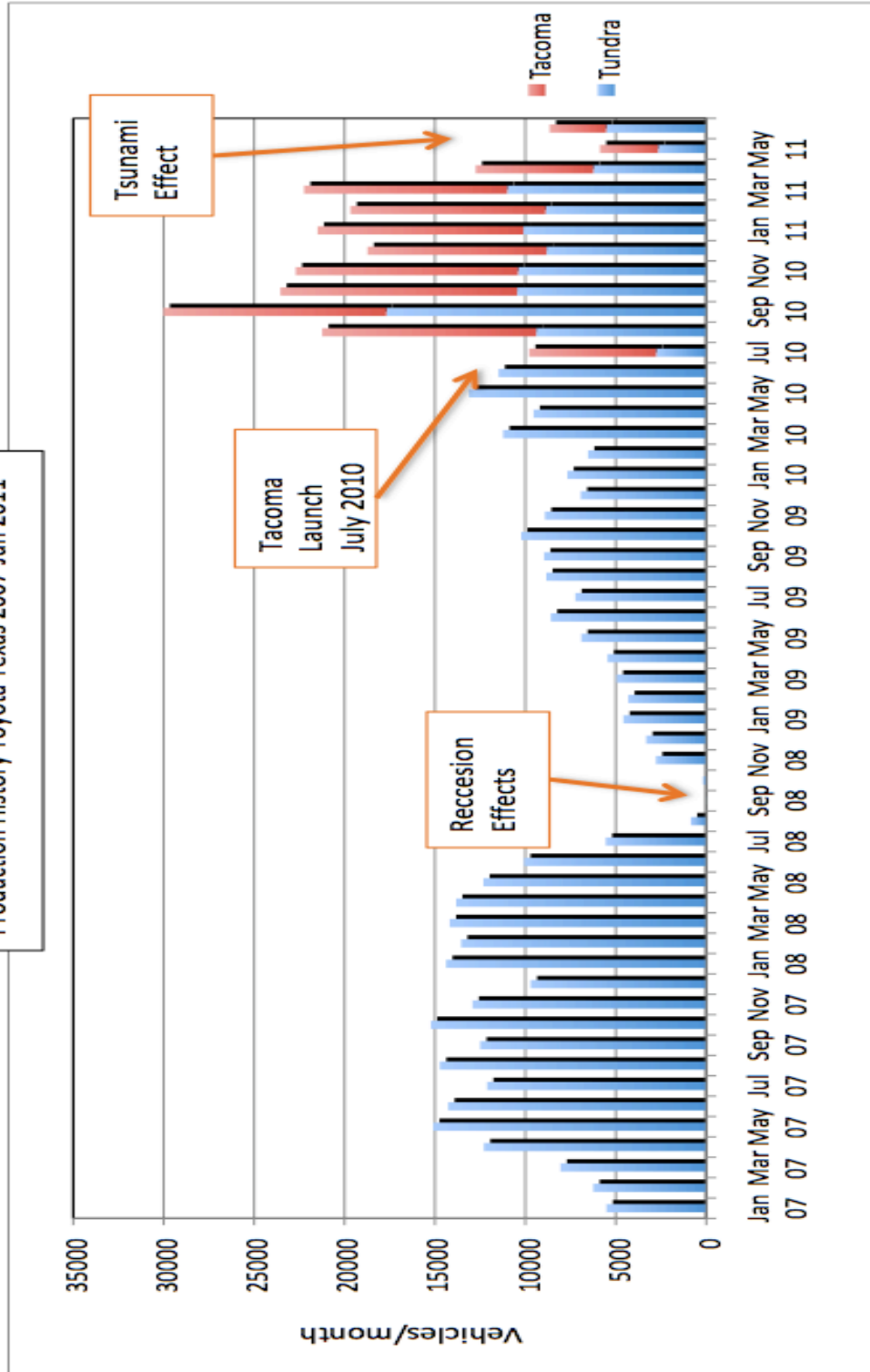


Figure 3.3 Production History of the Texas Plant

# Chapter 4: Attaining Flexibility

## 4.1 WHY IS IMPORTANT TO SEEK FOR FLEXIBILITY?

Kara and Kayis (2004), identified different factors the urged the need for flexibility being related to the market or to the manufacturing process, I proposed and improved model where the supply chain is included as a major factor that determines the need for flexibility (Figure 4.1)

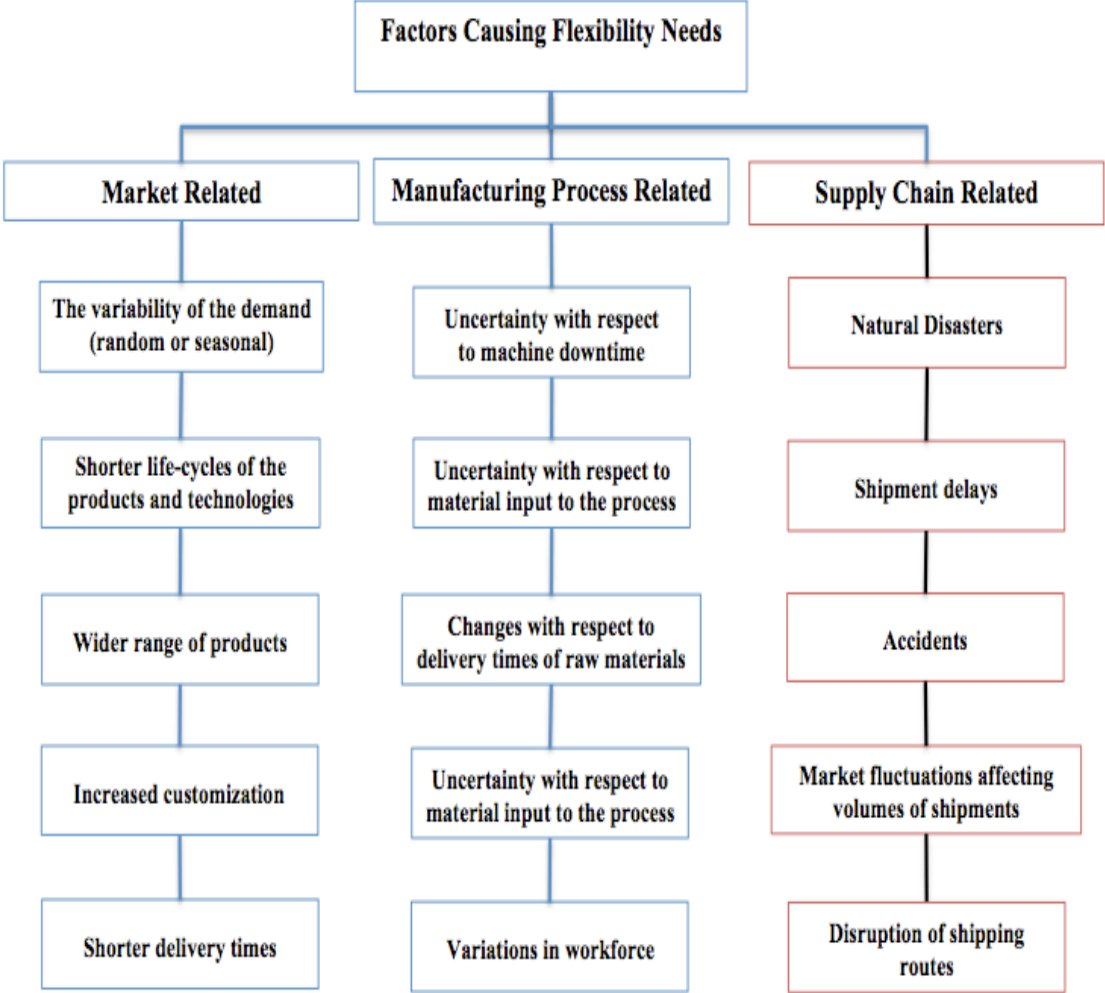


Figure 4.1 Factors causing Flexibility Needs

Labor Flexibility was not included directly because it is indirectly part of manufacturing process related and market related.

During those turbulent times the main reasons I identified for the Toyota Texas and FIT to be seeking to gain flexibility based on its troubled history are the following:

*Overall economy.* High unemployment, low spending and unstable markets create a rough road for a vehicle with the characteristics the Toyota Tundra has.

*Having a single customer.* Toyota is the major car manufacturer in the world and they do business building a very close relationship with its suppliers. Still for Futaba to be depending only on a single customer limits its flexibility to cope with the market where as a supplier you do not have control of it.

*Build a single car model, the Tundra pickup.* When a company produces more than one product or, in this case a vehicle, it can adapt more easily to the market demand switching production based on the customer demand. Being in FIT situation makes you vulnerable to the sales of the single product you manufacture and gives you limitations to affront a sudden a drop in demand which was exactly what it has been happening for the past couple of years.

*Actual Sales and Market Share.* Market Share of the Tundra hold only 7% of the market and with gas prices on the rise, demand is rapidly switching to more fuel-efficient vehicles.

*Volume and Labor Flexibility.* Ever since the crisis started demand has been changing very rapidly and production volumes vary from quantities requiring two eight hrs shifts per day to only 6~8 hrs of production. Keeping up with production demand

while still trying to remain profitable while protecting your human assets it is a very complicated task managers need to deal with, where loyalty and morale can easily disappear, and quality and productivity can be compromised

*Bad Public Image.* Toyota has been in the eye of the beholder for the past three years where it has been slammed harshly by the media and the U.S. government regarding some safety issues about an unintended acceleration pedal. The issue affected several models including the Tundra causing the company to recall in the U.S. alone a total of 5.3 millions of vehicles (Valdes-Dapena 2010). Toyota has long being recognized for its quality and safety, and an event of this magnitude can jeopardize the trust it has achieved.

*Globalization of the supply chain:* Despite a tremendous effort to bring most of its suppliers, to remain competitive and keep costs down more than likely raw materials and components will come from more than a single country or region and the risk of a sudden disruption will be present at all times.

## **4.2 WHAT ARE OTHER COMPANIES DOING?**

To understand or better asses the situation the first move should be to analyze what others have done in similar situations, what strategies are different car manufacturers doing to try to improve their manufacturing flexibility.

What are other companies doing to keep that balance and to think and prioritize about flexibility? In the Detroit area where must of the manufacturing companies depended heavily on the car industry and where the automotive crisis had felt the worst, suppliers in the auto industry have been force to look for new ventures, now some are

switching to a different type of business like wind industry, parts for army vehicles, aircrafts, batteries and even solar panels (Peter Engardio, 2010 NY Times). They haven't left completely the auto business but nonetheless are still finding some light in new and emerging markets balancing their production to accommodate to current demand and therefore increasing their manufacturing flexibility.

In the other hand, big auto companies to remain competitive and be able to accommodate market demand have designed manufacturing plants with high flexibility for example we have the Nissan's Canton plant in Mississippi, which started in May of 2003 already with a diverse variety of vehicles producing the Nissan Armada, Nissan Titan, Nissan Quest and the Infinity QX56 where by 2004 added the production of its popular sedan the Altima. (Nissan USA, Wall, 2003.). This type of platform possesses high level of machine flexibility allowing them to use the same equipment to produce different models.

Following the article by Wall (2003) about the manufacturing flexibility he refers to Honda, which has emerged as a benchmark player in the area of flexible manufacturing. The company has made various investments and plant infrastructure changes, which ensure its major North American production facilities, can assemble nearly any vehicle sold in the market. He compares the versatilities and flexibilities of the Asian market to the US big three, GM, Ford and Chrysler.

That amount of flexibility like the one Nissan and Honda are betting comes with major investment and not every player is willing to gamble. Even if flexibility can be seen in the one hand as an important strategic option, on the other hand one must

consider that the competitiveness of a firm can be strongly affected by the burden of capital intensive investments in system flexibility (Tolio 2009). Flexibility is very important but when the investment is high it is important to figure it out where the investment can give you the highest rewards otherwise you are at risk of losing the competitive advantage you are seeking through an investment in flexibility.

This type of flexibility to be able to re-design your manufacturing platform for a better use of your resources is nothing new in the manufacturing business. As demand for vehicles is continuously changing and the major auto-makers compete for a bigger slice of the market, the old time strategy that made the T-model from Ford a success with a single manufacturing platform are long gone.

### **4.3 TOYOTA TEXAS AND FIT STRATEGIES TO INCREASE FLEXIBILITY**

#### **4.3.1 High Gas Prices / Three Month Shutdown Strategy**

a) *Consolidate production on a single plant.* Before the three months shutdown in 2008, the Tundra production was produced in Toyota Indiana as well than in Toyota Texas, by 2009 the Tundra production in Indiana Plant was ceased to move on to a different project allowing Texas to have the 100% of the Tundra production adding more strength to the plant. Suppliers as well got benefits from that decision. Still a door remains open, if in the future demand surpasses capacity of the Texas Plant, the Indiana Plant may hold the answer to compensate the exceeding demand.

b) *Getting New Business.* Gratefully for Toyota Texas, the foreclosure of the NUMMI plant in California created the perfect opportunity for them because Toyota Corp. decided to bring the Tacoma production to San Antonio. With an underutilized plant with extra space and current low production levels, that decision represented the perfect opportunity to maximize the productivity to finally be able to run the plant at full production capacity. In contrast with the Tundra, the Tacoma has been very successful in the U.S., in 2009 was holding 44% of the market, making it the leading brand in its class (See Fig 4.2).

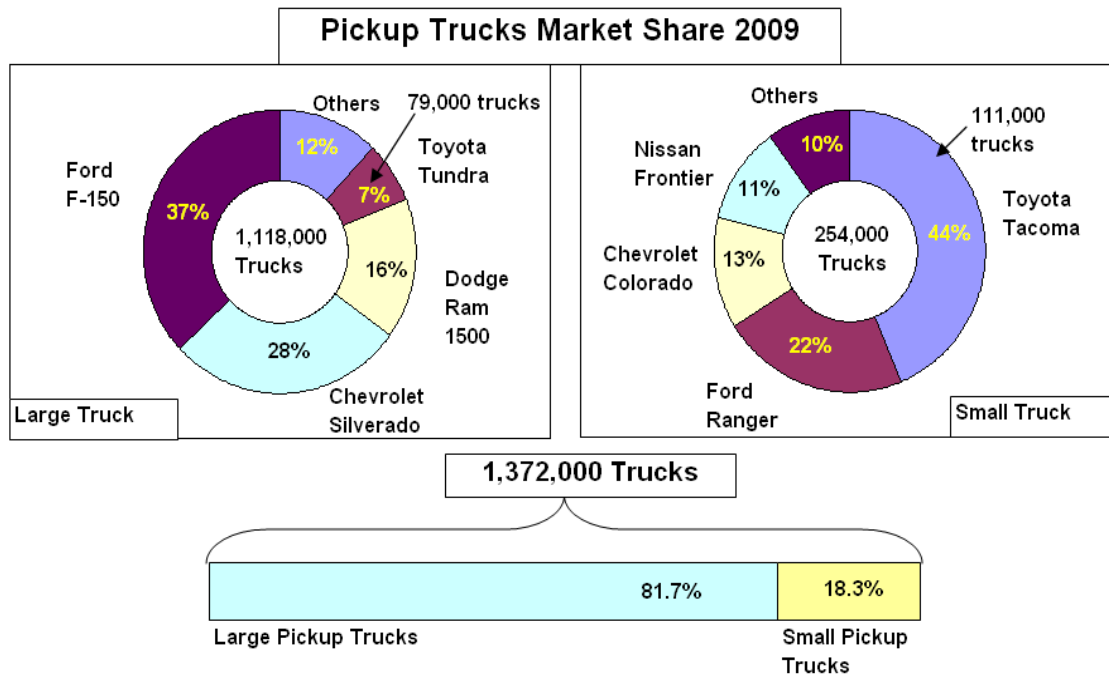


Fig 4.2 Pickup Trucks market share in 2009 by J.D. Power

As mentioned before, the Texas manufacturing plant was built with the intention to produce only the Tundra, but the way Toyota builds its manufacturing platforms have a given advantage because are well equipped with automated systems and robots that



have high machine flexibility and can be easily re-program to perform new or additional operations, this type of flexibility it is useful to approach the uncertainty of the environment and aid in diminishing the cost of introducing new products, these type of flexibility is one of the reasons bringing the production of a new vehicle was a feasible option.

Cheng et al. (1997) suggest that operational flexibility and configurational flexibility for the analysis of robotic systems. Where the first one involves having the physical capability to respond to unforeseen problems while performing a specific task. Configurational flexibility is the ease with which a new task can be undertaken. The ability to change its infrastructure in such a short time to remain competitive reflects the vision Toyota has. Within less than a year Toyota and its suppliers managed to plan and move the Tacoma business to Texas, the scheduled time in which everything occurred was very tight but it was required to maintain the supply of the popular truck in the market. In the case of FIT flexibility came at the Operations level where the plant layout had to be re-arrange to accommodate the new products and logistics routes internally had to be modified, it was a challenge but at the end we got it.

The ability to be flexible and be able to produce more than one model in a facility gives a company the ability to adapt to market demand and switch back and forth production percentages for each model maximizing its capabilities with higher profits.

As a result of the Tacoma project, FIT received new business to assemble seven different parts for that truck and will serve as logistic station for a dozen more of what we call pass-through parts assembled at a different facility. Even though it does not solve all

the problems in the company because full production at the Toyota Plant will not mean full production at FIT necessarily, it will depend on the percentages of production between both vehicles, the new business represent an important increase in flexibility and will represent a challenge where if volume, expansion and labor flexibility are managed positively, a new source of revenue will be successfully implemented. The Tacoma it is also assembled at different manufacturing facility in Baja California, Mexico, and one of the six new parts assembled we will also be providing for Toyota in Mexico, expanding our business for the first time outside the Toyota Texas facilities. The production lines for the new parts FIT earned, are a reflection of the trust our customer has for us and are an example of the support and commitment Toyota have with its suppliers.

By the end of the summer of 2011 FIT will be installing another production cell to build one more assembly component for the Tacoma which will increase a little more the flexibility this company has.

c) *Human Capital*. The human factor is suggested as an essential flexibility component as well as a key contributor for selecting, developing, improving and implementing flexibilities in order to succeed in markets that are accelerating and becoming more turbulent. (Kara and Kayis 2004). For FIT this is one of the biggest challenges, while the uncertainty of the market is continuously oscillating, labor flexibility will play a major role to ensure productivity is achieved.

The current target or strategy for the company is to keep the workforce with 70% permanent workers and 30% temporal workers, with low production levels FIT will only work with the permanent workforce. How to get the most of it will rely heavily on

managerial decisions and strategies, which may enhance or inhibit the flexibility of the workforce. To increase the flexibility in the workforce in FIT, it is very important to design and implement a more effective training system to reduce learning curves and be able to successfully keep track of individual progress so FIT can manage a more efficient deployment of their employees. Gupta and Somers (1996) concluded that one of the most effective ways to increase flexibility is by investing in the training of their work force as well as investing heavily in flexible manufacturing capabilities (technology, organizational systems).

An effective training system will increase the productivity and reduce the learning curve of the temporal work force through the transition from a low productive inexperienced employee to a skillful status. At the same time will increase the flexibility of your permanent work force by enhancing their productivity in different areas in the plant. Gerwin (1989) suggests a system with intensive human resources may be volume flexible if the workforce is useful elsewhere when production volumes decrease.

FIT follows Toyota's philosophy regarding its ways of work and the way relationship are sustained with employees, keeping the morale high, and trying to establish the Toyota Production System across the plant helps to develop flexibility among the employees. All these factors are very important, and for example the news of getting a new business, lifted hopes a little bit increasing the sense the job security which gives motivation to the employee. But to really keep workers happy and with a sense of pride requires much more. Because human capital cannot be owned (or even transferred), extracting the maximum advantage from it requires that an organization first understand

what people want and then give it to them (Bhutoria 2006). FIT have always promoted the philosophy of continuous Kaizen (Continuous Improvement) which encourage the team members to look for ways to improve their working environment, any improvement no matter how small it may seem, it counts, and get a small recognition. The idea is to get direct involving of everybody in the transition to become a better facility. For every kaizen a small economic incentive is given along with recognition at the general meeting at the beginning of each month where also an employee of the month elected through public management vote. Additionally any employee who caught defects in house preventing flow-outs to the customer gets recognized publicly as well. This is strategy is used for FIT as a strategy to create some pride and loyalty to work for FIT. Although I disagree with the economic incentive program because of the effects on the employees have been divided because its been perceived insignificant for some, the intentions are good and hopefully in the near future that program can be revised to created a more positive and motivational effect among the majority of the workforce.

**d)** *Marketing Campaign.* Toyota has launched a massive marketing campaign to regain customer loyalty in addition with several incentive plans with new vehicles in an attempt to flip all the discredit campaign due to all the recalls where supposedly its vehicles safety has been compromised. The amount of damage caused by these recalls is not clear and to how much time will take to regain the trust of customers is hard to say, in the mean time during these uncertain times the amount of manufacturing flexibility Toyota Texas and its suppliers can attain will keep them competitive in the market. Continuing with the economic crisis, according to Narasimhan and Das (2000), market

booms or recessions create a need for volume flexibility, and discounting and promotion create volume fluctuations.

#### **4.3.2 Strategies Regarding the Production Slowdown**

a) *Human Capital*. The problem arising with a sudden slowdown is the excess of personnel, with a reduced production limited to three days a week for a single shift, once again, management's strategy for its human capital acquires great importance to reduce costs without compromising productivity, quality, etc along with its responsiveness to get back to full production after the complete restoration of the supply chain. Toyota Texas same as in the past with a bigger budget than any of its suppliers allowed everybody to stay during the slowdown to prevent the risk of losing their skilled workforce but for FIT the strategy had to be different due to limited resources. How many people can FIT keep? How much flexibility can FIT attain? How different is this crisis compared to the previous shutdown?

The strategy was to maximize as much as possible its labor and volume flexibility. The temporary workers were the most affected one again, they were placed in temporary layoff through the duration of the production slowdown, but now that it was extended all the way to August it is hard to say if any of them will return once production ramps up once again. In the other hand the permanent workforce was placed in a temporary layoff only for Mondays and Fridays and other nonproduction days (Last week of May, first 2 weeks of July) to minimize expenses as much as possible while attempting to keep all of them. It is important to clarify temporary work force belonged to the

Logistic and the Production departments, the departments of Maintenance and Quality Control did not have any temporary members. Maintaining the quality of the products and an adequate maintenance of the equipment remained a high priority regardless of the situation to maintain the quality of our products. Before the slow down FIT kept its workforce ratio as before 70% permanent and 30% temporal workers, this balance is what allowed FIT to have high numerical flexibility. In addition temporal flexibility is being successfully applied by keeping most hourly workers working only 24 hours a week with 16 hours of unemployment benefits thanks to government support. Keeping 70% of the original workforce still left an small excess of workers in the plant, the company used that excess of time to enhance functional flexibility, which is reflected in cross-training around the different production cells and quality activities to try to involve regular production employees in the “Quality Way” enhancing the awareness about parts defects and ultimately reducing the scrap, which is one of the company’s goals for the current year to reduce unnecessary expenses. This strategy tries to increase its volume flexibility, because during the production slowdown keeping profitable seems almost impossible regardless of its reduction of personnel, therefore creating awareness to reduce or eliminate any other unnecessary expense during this difficult time should allow to cushion to some extent the economic losses. This is formula it is still under trial and the end results will be reflected at the closing stages of the fiscal year by March of 2012.

The situation has been really hard on the employees because of despite the fact they are receiving unemployment benefits for the non-production days it only accounts for 60% of what they were used to receive and holding on with that salary for four

months it is no easy task and creates a risk for the employees to jump to different jobs. Management has a very important responsibility towards the employees to maintain motivation and maintain the loyalty and commitment to the company. Risk loosing key employees, and FIT will risk loosing its leverage to deal with the aftermath of the disaster in Japan which we are currently enduring and its future recovery time which will come with a sudden high increase in production. The strategy to deal with this issue has been approached by being as direct and honest with employees about the situation as possible, in the Toyota Culture, part of its core values is to always present “The Bad News First”, and by following this principle FIT has been using what its called process fairness by disclosing all the information presented from our customer Toyota to the employees every time within the same day even when no action plan was structured, by doing this, it helps the employees perceive the harshness of the situation as fair game and help maintain the morale through the difficulties.

### **4.3.3 Flexibility Supply Chain Systems**

Toyota is a corporation with worldwide presence and a long history who has dealt with disruption in their supply chain more than once and has worked greatly to build efficient, flexible and robust systems to mitigate any disruption effects. The approach Toyota has is based in the relationship with its suppliers, there is whole culture built around them. Toyota Texas has most of its suppliers in the same complex and Toyota is providing continuous support to ensure there are no disruptions to the supply chain ensuring rapid responsiveness and quick recovery in case of a disruption. This system

creates a great advantage over competition because all the problems can be tackle right from the start reducing potential disruption threats with great efficiency. Toyota maintains very close communication assigning representatives to be taking care of the needs of their suppliers and vice versa. When Toyota lost one motor for one of the robots and had no spear in 2009, FIT had a spear and gave it to Toyota within a couple of hours of the incident saving Toyota of an imminent disruption.

An other example of flexibility in the supply chain by Futaba Corporation using sourcing flexibility occurred when an appointed supplier of rolled steel to make blanks for the stamping of one of the components for the new line to be launched on September 2011 announced that was not going have the required steel on time for the initial trials. As a response to the problem Futaba Corp. found a temporary supplier within the short amount of time available and received approved by the customer (Toyota) on time to meet the deadlines of the initial trials at the beginning of the 2011.

As mentioned before not the most efficient systems are always the best. FIT in an effort to reduce freight transportation costs has been allocating maximum capacity of the trucks. This result for example in uneven inventories because in an attempt to reduce freight cost more material than needed is bought leaving sometimes an excess of inventory and a waste of space as well, the argument lies that every certain amount of travels, a truck is saved but there lies some risk in using this strategy. Lee H. (2004) have found after extensive studies that efficient supply chains often become uncompetitive because they don't adapt to changes in the structures of markets. For FIT that strategy comes with trades-off because responsiveness and agility are diminished and can be



compromised with a sudden increase. Additionally FIFO (First in, First out) strategy gets compromised because shipments might get confused and there is risk to end up with rusted components, which could end up in higher labor costs to restore the parts.

Based on the study of Sheffi and Rice (2005), they suggest companies should build a vulnerability map to identify and categorize the relative likelihood of potential threats of disruption to the supply chain. Although FIT has not done that in the following figure I identified some the threats based on its history and type of business and categorized in a vulnerability map (See Fig 4.2)

Companies are increasingly vulnerable to events with high impact and low probability (Sheffi & Rice, 2005), therefore for FIT is very important to recognize the consequences of any of those disasters and the factors that can contribute or signal the occurrence of them. By acknowledging the dangers surrounding the environment and preparing for them an organization can increase its flexibility in case of a disruption ensuring better responsiveness and agility to handles catastrophes.

We can appreciate in the vulnerability map Economic recession to have high impact and high probability because all the economic recession have been historically cyclical, and as FIT experienced the effect on large vehicles. In the other hand one of the worst things it could happen to almost any industry and economy especially with all the globalization in which the supply chain depends on is War.

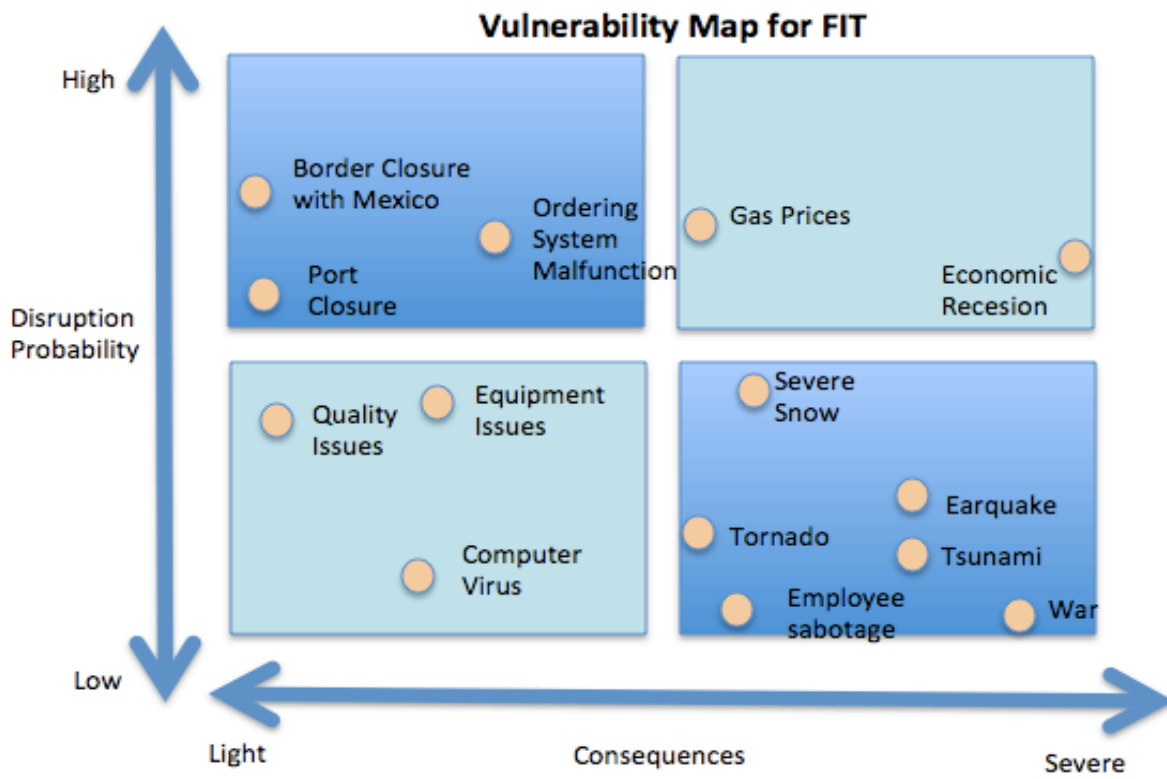


Figure 4.3 Vulnerability Map for FIT

## Chapter 5: The Takeaways

The need for flexibility must be taken into account to remain competitive in a global economy. Literature about Manufacturing Flexibility shows us the different ramifications and variability of flexibility exerting organizations to carefully study and plan the area where flexibility is most needed because it will represent an investment for the organization, and a wrongful approach will not bring any benefits.

The auto industry depicts a very good example of the advantages of having flexible manufacturing systems because it has become an industry where the effects of a flexible manufacturing system can be easily recognizable and have made a difference in a highly competitive environment. History has showed us that no company is exempt from their inherited vulnerability of the uncertainty of environment and that flexibility could be the solution to remain competitive in any industry. An example from the previous statement can be the rapid recovery of Toyota after the disruption after the natural disaster that struck the country on March 11<sup>th</sup> of the present year

In the auto industry resource management and careful planning can give you the edge to attain flexibility. Manufacturing flexibility not only applies to the equipment and the facility but also carries great importance with its human assets, and the supply chain stretching from the supplier's supplier to the customer's customer. The effective allocation of the workforce can make a difference the balance between temporary and permanent workforce FIT has allowed the company to reduce its size during a crisis without

compromising the productivity of the company or its ability to bounce back to a rise in demand.

Companies must learn the best way to cope with the ever-changing environment and the volatile market is through the use of flexibility to maximize their capabilities and responsiveness.

The recent disaster of Japan represents a true example of the unpredictability of the nature and at the same time we are becoming witnesses of the resilience of the Japanese companies like Toyota, which are rapidly recovering and becoming once again a profitable organization surpassing the adversity and low expectations. Toyota has become well known because of the close relationship it keeps with its suppliers, providing support and maintaining transparency in their business where bad news comes first. This type of relationship has nurtured their supply chain flexibility making the Toyota Culture an example for organizations around the world.

Toyota Texas started their business with high hopes of a profitable business but the short recession triggered by the collapse of the housing market, high gas prices and most recently the natural disaster that struck Japan on March 11<sup>th</sup>, have forced their business to invest to improve their level of flexibility to become a more competitive and cope with the market more efficiently. The task is not over, with the successful launch of the Tacoma by increasing their production platforms have been able to achieve production levels accommodating production levels to increase their flexibility, the next step is to keep localizing the assembly lines of the subcomponents of Tacoma truck to keep reducing costs and at the same time mitigate the risk of a disruption. For FIT the

strategy remains by showing the customer the level of manufacturing flexibility that exist within the facility to bring more business to the company an balance out the Tacoma and Tundra production. The launch of a new line on September is an example of the confidence the customer has with Futaba and an example of the capability this small company can offer.

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