

SUPPLY CHAIN DISRUPTION: FLOODING AND TORRENTIAL RAINS AT CHENNAI AND ITS IMPACT ON SUPPLY NETWORK

N. Chandrasekaran¹ and R. Arunachalam²

¹Jansons School of Business, India

E-mail: enchandru@gmail.com

²ProConnect Supply Chain Solutions Ltd, India

E-mail: arunachalam.r@proconnect.co.in

Abstract

Traditionally economists in earlier and middle of 20th century discussed about risks and uncertainty and related to theory of profits. Though risk is assumed to be predictable, measurable and insurable, uncertainty has subjectivity and largely remained “unknown” in statistical sense. Applications of mathematical and statistical techniques to risk definition, measurement and control through measurement of variability of outcomes and relate it with financial and corporate performance were popular in financial literature. Adoption of risk perspectives in supply network assumed greater importance with globalisation of business and movement of production to eastern part of the globe. Initially, supply risk was limited to upstream part of supply chain network and totality approach to supply chain risk gained more importance over the years. Happening of major disruptions across the globe due to terror attacks, geo-political changes, natural disasters like swine flu and Tsunami led to application of supply chain risk and uncertainties. There were discussions on an event based outcomes were considered uncertain event but raised debates about risk, uncertainty and return management. In this paper, authors have considered recent torrential rains and flooding at Chennai leading to disaster have been analysed for understanding managerial perspectives.

Keywords:

Supply Chain Disruption, Flooding and Torrential Rains at Chennai and Its Impact on Supply Network

1. INTRODUCTION

Modern management science facilitates understanding and controlling the macro environment impact on business. In contemporary business, technological advancements are judged by effectiveness in managing the “uncertainty”. When one discusses uncertainty, one may have to appreciate the fact that risks manifest in two forms namely normal and radical uncertainties. While normal risks are more predictable and estimated through historical trends, data and analytics, radical uncertainties are more like unforeseen or never experienced nature and extent of risk which leads to disruptions in production and supply chain network of production, distribution and services businesses. This article focuses on happening of recent heavy rains and flooding in Chennai on December 1st 2015 and its consequent impact on supply chain network.

2. REVIEW OF LITERATURE

In management theory and practice, risks have been extensively discussed especially since 1970s. In fact even earlier

Disclaimer: The views expressed in this article are the personal views of the authors and in no way reflect the views of the Organisation where they are employed

literature in economics, authors like Schumpeter have discussed about risk and uncertainty. Schumpeter, 1961, [17] has mentioned that profit is for entrepreneurial innovation and ability to manage uncertainty. Much earlier in 1921, Knight has discussed about risk, uncertainty and theory of profits. Brooke in this work titled, “Uncertainty, Profit and entrepreneurial action: Frank Knight’s contribution reconsidered” discusses risk and uncertainty defined in Theories of Profit by Knight and other works. It may be noted here that Knight held two distinct definitions of uncertainty. The first, most commonly accepted definition is that risk refers to outcomes that can be insured against, and uncertainty to outcomes that cannot be insured against [18], [19]. Further he goes to discuss whether profits are reward for risk and uncertainty or for the latter.

Chandrasekaran and Raghuram, 2014 [3] mentions that the situations of risk can be discussed based on possibilities of damages and probabilities of occurrence. It can be where the possible damages and their probabilities are known, and situations where probabilities are unknown or the decision takers are confronted with ignorance (‘unknown unknowns’ or ‘don’t know what we don’t know’ and how relevant it is for managerial decisions), indeterminacy (issue conditions and causal chains open, outcomes dependent on how intermediate actors behave), complexity (open behavioural systems and multiplex, often non-linear processes), and so on.

It is important to note that risks can be estimated by possible outcomes and which are rather predictable and uncertainty is unknown and managerial in case of agents and promoters is to handle the same with a lot of subjectivity. Though mathematical and statistical application of probability distribution has improved scope of scientifically managing both, still there are instances in real life which make us to be back and reconsider the academic discussion on the subject.

Progressing further on accepting definition of predictability then dimensions of risk and uncertainty can be seen from outcome uncertainty, outcome expectations, and outcome potential. It may be noted from transaction cost and agency theory perspectives, outcome uncertainty is associated with the variability of outcomes, lack of knowledge about the distribution of potential outcomes, and uncontrollability of outcome attainment. This statement is important from the angle that whether uncertainty can be treated from single event or point estimates/occurrence whatever may be the extent of impact it can have on profit by hampering business operation? Is there subjectivity in its approach while managing such instances in real life?

On measurement of risk, authors have defined risk as “the variance of the probability distribution of outcomes” [9], [12].

However, Shapira (1995) [12] found that very few managers define risk in those terms. Instead, managers identify (1) the downside of risk, (2) its magnitude of possible losses, (3) the act of risk taking involving the use of skills, judgment and control, and (4) risk as a concept that cannot be captured with a single number. The managerial practice is rather inconclusive in terms of risk definition and its management. For example, downside risk would vary based size of the firm and multiple versus single location where a disaster strikes. This again links up to magnitude of loss where a single location firm at disaster site is likely to face severe damages compared a multi-location firm which has spread its geographical risk. Precisely for this reason large firms which procure components and raw material spread geographic risk. Managerial approach to handling of such supply risk disaster is well documented through a case on Cisco's strategies and response after Tsunami in Japan. Contrary to this Stauffer, 2003 [5] mentioned that there's no small irony in this reawakening to long-standing risks being caused by high-profile events such as the attacks of 9/11. Based on statistical probabilities, risk managers view 9/11 as an "outlier" or exceptional event; but even so, it has spurred a host of defensive reactions. Stauffer quotes Anath Raman Harvard Business School Professor "Outlier events have much more influence than they should" supporting his argument that terrorist strikes, political instability in Third World countries, and shutdown of West Coast shipping docks in early 2000s have awakened managers as never before to supply chain risks.

Getting back to discussion on treatment of risk in academic literature, authors have further defined risk and uncertainty from measurement and controllability perspectives. Baird and Thomas, 1990 [1] have defined risk from eight different perspectives namely: Variability of returns; variance; market risk; innovation; lack of information; entrepreneurship; disaster strategies and accounting risks. These risk perspectives cover wide risk perspectives predominantly from financial risk angle. This has angle of Schumpeter's work on innovation and profit; estimation based on variability; fixing of causal factors of risks and then finally into governance by way of bankruptcy risk and accounting risks. These eight factors are comprehensive but more from corporate risk and financial risk perspective rather than from operations angle of business.

Yates and Stone, 1992 [13] note that risk can be: (1) the elements of loss, (2) the significance of loss, and (3) the uncertainty associated with loss. Within the elements of loss are three additional factors. First, risk is not limited to one specific loss that can occur. This is similar to the variance of outcomes discussed by March and Shapira, 1987 [9], with the exception that it focuses only on losses. Losses are also experienced in reference to an outcome. What is important is not the loss itself, but the actual outcome in comparison to an expected outcome. This leads to classical debate how to we handle disasters and can there be an expected outcome for such disasters built in risk management system?

It may be noted further that in all above discussions that outcome measurement if risk from financial perspectives. In reality, one may have to consider operating perspectives like disruptions impacting operations, loss of time and even in potential loss of future engagements. Though financial economists and risk managers would argue about pecuniary

estimates of operational parameters, in practice risk estimation could not been exhaustive especially for small and medium local enterprises in its approach risk management.

This where the aspect of risk figures which is the significance of loss. It is often assumed by decision makers that the more significant the potential losses in a situation, the greater the implied risk. This again would link up to uncertainty factor where uncertainty is associated with the degree of confidence a decision maker can develop probability and outcome assessments of decisions [11], [4]. Additional facets of uncertainty involve a lack of understanding by decision maker about the loss categories that exist, and which losses can occur. According to authors of this paper, such a scope exists for large firms who would have budgeted risk management costs and spread across large volume. Going back to profit theories, we are of the view that small and medium firms could hardly attempt such a practice.

In this article we are more interested to analyse risk from supply network perspective as mentioned in one of the cases of Cisco. One of the earlier discussion on supply chain related risk is by Kraljic, 1983 [8]. He defines supply risk in terms of supply market complexity. This broadly depends on theories competition and production wherein one classify and manage risk based on critically and value of purchase and superimposing on the same bargaining powers of buyer and seller.

Meulbrook's, 2000 [10] definition of supply risk: adversely affects inward flow of any type of resource to enable operations to take place; also termed as 'input risk'. This definition focuses on upstream risk perspective of a focal firm in a supply chain network. There are a number of downstream risk elements from distribution, storage, order management and customer fulfilment perspectives.

In this regard a more comprehensive definition and analysis of risk is done by Zsidisin (2003). According to George Zsidisin [7], "Supply risk is defined as the probability of an incident associated with inbound supply from individual supplier failures or the supply market occurring, in which its outcomes result in the inability of the purchasing firm to meet customer demand or cause threats to customer life and safety". This definition brings out various facets of risk including business and human life risk which potentially impact business in the long run. It may be concluded here that Supply chain risk refers to challenges in achieving supply chain objectives of overall supply network profit optimization and responsiveness. Many of the key risk factors have developed from a pressure to enhance productivity, eliminate waste, remove supply chain duplication, and drive for cost improvement, external factors like disruptions in operations due to terror, natural calamities and strikes [2].

In this article, we relate to the supply network risk with respect to a specific occurrence in Chennai.

3. DISCUSSION ON DISASTER AT CHENNAI IN DECEMBER 2015

Chennai and its suburbs were hit by rains since the first week of November 2015 and being pounded with rainfall exceeding normal limits by over three times of average till date for a normal season. The torrential rains happened on 1st of December

2015. Due to rainfall in Chennai and in its adjoining districts namely Kanchipuram and Thiruvallur district, all of its dams had reached its full capacity by 1st December, forcing local authorities to discharge high amount of water from Chembarambakkam reservoir and causing the flooding along Adyar River complicating flooding due to inadequate drainage of rain waters. One may have to reckon with the fact that there was heavy rains twice between November 10th 2015 and 27th of the same month. This has complicated reservoir management. There are media discussions about water discharge and its impact to flooding. It is more important in our perspective is that whether the disaster was predicable based on weather forecasts and how the outcome could have been managed by a supply chain manager. Like many common man, managers also felt that supply Chain was badly affected.

The rains have virtually broken a 100-year record. There was no power and all Mobile operator network signals got affected, except only 1 or 2 Telecom operators were having limited signals at few parts of Chennai during this period. Power supply in almost 70% of the city was suspended and continued to remain so, for 3-7 days. Chennai was officially declared a disaster area on the evening of 2nd December.

Supply Chain activities revolve around a few important functions and the impact that nature has on its function has a telling impact on it, the recent rains at Chennai and its surrounding areas had a created a deep adverse impact on the supply chain network system, as mentioned below:

3.1 WAREHOUSING

Warehousing being an important part of Supply Chain was largely affected in several parts of the city. With a gush of water entering many warehouses the loss suffered by the cargo owners are huge. With 1-2 feet of water in surrounding areas, the warehouse premises affected the entire service system. Warehouses were forced to shut down due to heavy water logging, power and network shutdown. Some of the large firms including own operators, three PL service providers and outsourced partners communicated to their Customers through e-mail about the situations at Chennai, and as per their guidance, declared holiday for the entire warehouses in Chennai on 2nd December and subsequently declared holiday till 6th December because of the continued flooding and rains.

Data synchronization failed due to unavailability of server in many warehouses. In some warehouses that functioned during the floods, the pick up and put away of goods were handled manually reducing the speed of operations and leading to accumulation of vehicles outside the warehouses. Yet, movement of materials came to a standstill as networks crashed and invoices could not be produced.

The rains also affected the outbound deliveries, logistics and supply chain for several business entities. While the warehouses remained closed from 2nd December to 6th December, warehouses were opened few hours every day for safety review purpose wherever possible. There are certain cases entry into warehouse was not possible even for five days. All major outbound got affected in types of Distribution centre and other facilities including open automotive and engineering yards across the city. Chennai being auto hub a large number of automotive plants and tier I and II operators had to lay-off

because of inundation and inability of workforce to resume normalcy. Operations in warehouses and stores which are serving for long distance suppliers to fulfil just-in-time operations suffered badly.

As the rains subsided, operations resumed work and were back in action attending to pending calls with priority and coordinated with business for sufficient stocks wherever necessary for giving replacement. Large firms who operate on trade were able successfully manage imports during this period and all the replacements were given to the satisfaction of the vendor and customers. It may be noted here that supply chain costs during this period of 10 to 15 days or till normalcy across the chain increases because of trigger to accomplish responsiveness rather than being cost focused.

3.2 TRANSPORTATION

All courier/Transporter have stopped their operation from 2nd December till 6th December. The airport was partly reopened for cargo flights on 5th December and fully reopened and rail services were slowly resuming from 7th December. Outbound deliveries, logistics and supply chain for several businesses were severely affected. All major outbound got affected at Distribution centre and other facilities including in assembly, process and manufacturing units. A few of operations got halted due to severe rainfall and flooding of major roads. It took a week's time for all modes of Transportation to get back to normalcy.

It may be noted here that these were more for large firms. Medium and small firms and retailers were more affected as resumption could not take place till middle of December. Further intra city movement of goods were hampers on three counts and affected supply network. These include:

Non availability of vehicles of intra city movement loads. This was mainly because truck owners and operators took some time again almost about middle of December to return normalcy. More importantly, priority was not given to SMEs and retail customer segment unless bound by contract.

Road and local conditions were not favourable and huge delays because roads caving in and repair works to be done across the city. This increased turnaround time for movement and hence truckers were not willing to operate. During the initial days one could see empty shelves in many stores especially those kirnas and pop and mom stores who dealt with general format.

Cost of operating intra city movement and hence rates escalated making it unaffordable for operators as they were not prepared for the same.

It may be important to note that how some of the service businesses like technology and knowledge companies intra city movement for their employees got affected. Many of such firms are located at flood affected areas in the city. Many of the employees who were at shift got struck at work place. The locations were there were severe floods they had to be evacuated. While some of the firms could speak to customers especially in abroad on support could have lean staff and move other in safe and large vehicles. Minimal essential staff required for operations were allowed to stay and provided with support for operations. Some of them can be lodged in nearby

accommodation to have maintenance. Those who were in not direct customer engagement were not that severely affected though there had been loss of mandays and billable time. Many of the employees spent long hours of time on roads and dissuaded to pursue work for next few days as transportation was not available.

Similarly, banks and other services also got affected as employees could not travel to work. ATMs went out functions and loading/stocking ATMs became difficult as transportations and bank chest could not be operational for a few days.

3.3 IT AND COMMUNICATION

IT and communication were major dislocation for supply chain network operation for most of the businesses. The central server connectivity through Internet Service provider became non-functional and hence all operations crippled. Ability to generate transactions for the first few days was almost impossible.

Due to inundation of water in many locations, the power authorities were compelled to trip power on safety grounds. The power resumption took between two days and more in some locations because of the severity of water logging. Many office/business locations suffered from water logging which difficult to run DG sets. Petrol pumps also suffered. Hence, no power and connectivity failed from evening of 2nd December without an alternative.

In case of large and some of the SMEs especially in IT sector, IT teams quickly responded to the situation and called on the “Disaster Recovery (DR) Server” which are located at different locations outside the city and enabled ERP and E-mail on 3rd December evening. However utilization at Chennai location could be minimal because of disruption to business process flows.

During this period, all warehouses except Chennai could connect to ERP and E-mail through “DR Server”. Generally, across “DR Server” was called off and ERP and E-mail server was up and running from 7th December without any issues.

Respective Key Accounts Managers at each warehouse were directed to manage the operations manually where WMS could not be accessed, tracking through excel from 3rd to 7th December. In some of the cases, Key account managers were closely coordinated with Customers to ensure their Pan India operations were not affected due to this disaster.

In IT services those who could support work from home were also not able to log on as network got badly affected at home locations almost till 7th December. Further many of the employees’ homes were badly affected and could not resume work. It may be important to note that those who have moved into Chennai and living alone in affected areas were badly affected without communication and power. In fact when city public transport system opened up, there was a rush for outbound movement from city to relieve of this system failure. One of the biggest problem for SMEs IT a knowledge firms is inability to connect with employees for understanding their safety, wellbeing and communicate during this period. Most of the cell phones went out of charge. Many of them did not have or provide landlines which resumed little ahead.

Similarly, banking services were badly affected as branches could not operate without power and connectivity. ATMs also face severe hit and many locations were out of service for almost a week. Apart from this business segment, insurance companies suffered quite a lot and had to operate on a combination of manual and local system driven to process claims. Employees were to go back to traditional system of managing claims and support to customers. We also understand hotel and restaurant industry suffered due to failure of communication.

It is pertinent to understand the trouble of education during this disaster especially because of communication failure. Chennai has a large number of students from other cities, states and nations. Some of the colleges and universities were badly affected and yeomen services were required to respond to this disaster to fulfil commitment to students and parent community by those institutions. Some of them have declared holiday till January 2016 and examinations were postponed by weeks.

3.4 HUMAN RESOURCE

Human Resource was the most impacted part of the system due to the disaster. Loss of property was the major reason for sorrow and loss of loved ones too was a major concern for some. Most of employees have lost their property like house, household items, vehicles etc. Some of the firms are offering loan to build them. The trauma left a lot of them disturbed and made it difficult to return to routine work. For many employees it is beginning from zero in terms of assets and other belongings including vehicles, laptops and mobile phones. Children have severe dislocation. Employees have lost documents and run around for handling through replacements or duplicate to operate. Some of the employees’ banks were affected and hence a larger question looms on safety of their items in valets and conditions to rebuild. More importantly, psyche is badly hurt and employees need to be motivated to be brought normalcy which is true of those who are not local citizens.

The above discussions can be captured in a schematic form as shown below:

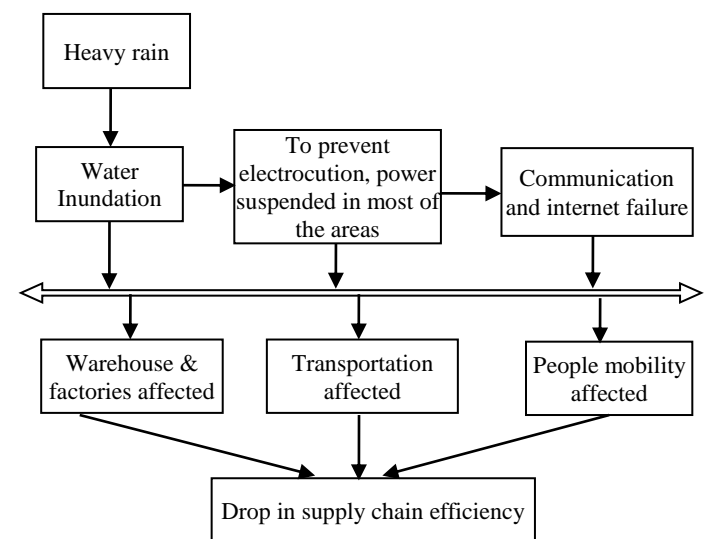


Fig.1. Impact of disaster through floods and rain on supply network at Chennai

4. CONCLUSIONS

This disaster at Chennai because torrential rains and flooding was least expected and not happened in a century. This is certainly an uncertainty event in risk perspective. However based on quantum of loss, large firms could still take it though there could be drop in their revenue, profits and market valuation if it is listed company. Assuming that disruption was for a week and impact could be lost for a month, range of loss could be anywhere between 2 to 8% of business revenue and potential revenue from this location. However, SMEs and individuals could be badly affected as it is going to take rebuild to their then operating capacity and efficiency over a period of time. Hence we may conclude that the disaster which is a single time event is still substantial and eventful for supply chain network disruption.

All six perspectives were affected and our observations based on discussions with experts and managers are shown in Table.1.

Trilogy of supply network namely technology, process and people also suffered badly. Immediate supply chain goal was to focus on responsiveness and reassess cost focus in a planning bucket. The impact of this uncertain event challenged the agility of supply network and ability to reconfigure in a short duration

for operating decisions. In some cases, planning and strategic decisions need to be taken which is especially for SMEs.

Thus, there is quite a lot of learning from this catastrophic incident and large firms and professionals are able to take it on stride and move on for restoring normalcy. Through CSR initiatives, many companies giving out relief measures to the large population. This fulfils responsible corporate relations and commitment to society and responsible procurement and operations.

The following steps could be incorporated to the current system, so as to avoid such an impact created on business:

Have a backup site for all IT requirements to ensure all other locations except the affected site are functioning.

Maintain a data base of alternate contact details of employees to reach them and understand their safe being.

Have a flood warning system in place at all the warehouse locations - A system that sends an alert to all major stake holders when the water level reaches a specific level in the outer area.

Track all shipments in transit from the affected location and assess damages if any to those in transit.

Contact service providers and understand their levels of losses in general and in particular to order fulfilment to make them understand the reality.

Table.1. Supply chain perspectives and nature of impact

Perspective	Nature of impact	Remark
Facility - Operations	Low throughput to stoppages for a few days	Loss in revenue and profit ranging from 2 to 8% of the location related for the large firms; bigger impact from planning to strategic level for SMEs
Facility - Warehouse, distribution centres	Stoppages to low throughput for a few days between 5 to 15 days	Loss in operations, customer fulfilment and increase in cost and likely capital outlays
Transport	Stoppages to poor turnaround for 5 to 15 days	Loss in operations, customer fulfilment and increase in cost
Transport operators	Stoppages, failure of workmen to report to operate	Loss of revenue and likely capital outlays
Inventory	JIT operations suffered	Drop in utilization and review of policy for exigencies like this
Procurement	Review of policy	Planning and strategic orientation
Pricing	Yet to ascertained	Likely to impact as cost needs to be passed on unless across network some adjustment happens as one off effect
Information	Disconnect to poor connect for 2 to 5 days	Loss of operations and failure to fulfil customer orders and need to engage with customers to appreciate ground reality

REFERENCES

- [1] I.S. Baird and H. Thomas, "What is risk anyway?", R.A. Bettis and H. Thomas Eds., *"Risk, Strategy and Management"*, Greenwich: JAI Press, 1990.
- [2] N. Chandrasekaran, *"Supply Chain Management: Process, System and Practice"*, Oxford University Press, 2010
- [3] N. Chandrasekaran and G. Raghuram, *"Agribusiness Supply Chain Management"*, New York: Taylor and Francis, 2014.
- [4] Todd H. Chiles and John F. McMackin, "Integrating Variable Risk Preferences, Trust, and Transaction Cost Economics", *The Academy of Management Review*, Vol. 21, No. 1, pp. 73-99, 1996.
- [5] David Stauffer, "Supply Chain Risk: Deal with It", Working Knowledge, Harvard Business School Publication, 2003.
- [6] Geoffrey T Brooke, "Uncertainty, profit and entrepreneurial action: Frank Knight's Contribution reconsidered", *Journal of the History of Economic Thought*, Vol. 32, No. 2, pp. 221-235, 2007.
- [7] George A. Zsidisin, "A Grounded Definition of Supply Risk", *Journal of Purchasing & Supply Management*, Vol. 9, No. 5, pp. 217-224, 2003.
- [8] Peter Kraljic, "Purchasing Must Become Supply Management", *Harvard Business Review*, Vol. 61, No. 5, pp. 109-117, 1983.
- [9] James G. March and Zur Shapira, "Managerial Perspectives on Risk and Risk Taking", *Management Science*, Vol. 33, No. 11, pp. 1404-1418, 1987.
- [10] L. Meulbrook, "Total Strategies for Company-Wide Risk Control", *Financial Times*, Vol. 9, pp. 2-4, 2009.
- [11] Vincent-Wayne Mitchell, "Organizational Risk Perception and Reduction: A Literature Review", *British Journal of Management*, Vol. 6, No. 2, pp. 115-133, 1995.
- [12] Zur Shapira, *"Risk Taking: A Managerial Perspective"*, Russell Sage Foundation, 1995.
- [13] J. Frank Yates and Eric R. Stone, "The Risk Construct", J. Frank Yates, Ed., *"Risk Taking Behavior"*, John-Wiley, pp. 1-25, 1992.
- [14] Chennai Floods and Aftermath; The Hindu December 14, 2015, <http://www.thehindu.com/specials/in-depth/the-chennai-floods-and-the-aftermath/article7916048.ece>
- [15] Joseph A. Schumpeter, *"The Theory of Economic Development: An Inquiry into Profits, Capital, Credit, Interest, and the Business Cycle"*, Cambridge: Harvard University Press, 1961.
- [16] J. Fred Weston, "The Profit Concept and Theory: A Restatement", *Journal of Political Economy*, Vol. 62, No. 2, pp. 152-170, 1954.
- [17] George J. Stigler, *"Frank Hyneman Knight"*, University of Chicago, Center for Study of Economy and State, 1985.