IMPROVING READINESS AND ROBUSTNESS FOR A RESILIENT SUPPLY CHAIN

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Abstract
The purpose of this paper is to present a way to achieve a resilient supply chain by means of increased robustness and event readiness. Based on the literature available, this paper proposes a conceptual framework for the understanding of supply chain resilience. The paper also derives a correlation between event readiness, robustness and resilience based on extant literature. In order to improve readiness and in turn improve resilience this paper conducts a pareto analysis of 23 causes of disruptions to find out the most critical ones which are examined and further implications for research are pointed out.

Keywords: Resilience, Readiness, Robustness, Supply chain disruptions

INTRODUCTION
Today manufacturers and suppliers are spread all across the globe and each product travels through the supply chain network before reaching the customer. There are more than a dozen definitions of supply chain and one of them is as follows: the network of companies involved in the upstream and downstream flows of products, services, finances, and information from the initial supplier to the ultimate customer (Christopher, (1992); Lambert, García-Dastugue & Croxton, (2005); Mentzer et al., (2001)). The Council of Supply Chain Management Professionals (CSCMP) explains supply chain management as follows: Supply chain management encompasses the planning and management of all activities involved in sourcing and procurement, conversion, and all logistics management activities. Importantly, it also includes coordination and collaboration with channel partners, which can be suppliers, intermediaries, third party service providers, and customers. In essence, supply chain management integrate supply and demand management within and across companies. In the recent years a new term ‘supply chain resilience’ has evolved which helps the supply chain cope with the disruptions and disturbances in its network which can be attributed to a variety of factors. Resilience can be defined as “the capacity for an enterprise to survive, adapt, and grow in the face of a turbulent Change” (Fiksel (2006)). A survey of worldwide businesses states that 70% of the industries faced at least 1 supply chain disruption and 34% of the industries report cumulative losses of at least 1 million euros. Only 6% of organizations say that all of their suppliers have business continuity in place (Business Continuity Institute Supply Chain Resilience Report (2016)). Natural disasters or other human activities are bound to affect the supply chain. The disruptions caused by a natural disaster cannot be eliminated, instead we can equip our network to deal with the disruption and enable recovery of the supply chain. This paper firstly conducts a literature review to identify amount of research within the various aspects of supply chain resilience. The research also focuses on identifying and analyzing the causes of disruptions and suggesting various necessary tools to mitigate risks and improve the robustness of a chain. The paper is structured as follows. It begins by giving an introduction to supply chain resilience and the various aspects of supply chain resilience. The paper then proposes a conceptual framework for understanding of supply chain resilience. It also contains a systematic review of supply chain resilience literature from 2014 to 2017 to identify the area of focus of each paper. The results of this review are analyzed and the paper delves into the ‘readiness’ aspect of resilience. Following this, the paper analyses causes of supply chain disruptions to find the most critical ones. It then focuses on the most critical ones and conducts a literature review of the risks posed by them and the ways to mitigate those risks. The paper concludes itself by indicating the scope for future research.

STUDY SELECTION, FINDINGS AND EVALUATION
While writing our literature review, we restricted our sources to published peer-reviewed journal articles to ensure the quality of this paper (Denyer & Tranfield (2009)). The peer review process is a measure of the quality of the paper and measures the study's conceptual thoroughness. Firstly, we scanned the databases using the keywords “supply chain”. There was no time limit set. The databases used were Google Scholar, Wiley, Emerald, Pro Quest, EBSCO and Elsevier. The research paper “Research on the phenomena of supply chain resilience” by Nils-Ole Hohenstein, Edda Feisel, Evi Hartmann and Larry Giunipero in 2014 had conducted a literature review of supply chain resilience articles from 2003 to 2013. Hence we decided to conduct a literature review from 2014 to 2017. By using the same keywords we found a total of 896 articles. We then narrowed our search by using the following terms “supply chain resilience dimensions”, “aspects of supply chain resilience”. This yielded a total of 249 articles. We then used the advanced search option by searching articles containing all the terms. For instance our
search looked similar to this: supply chain (AND) resilience
(AND) dimensions. We then individually searched articles
pertaining to each aspect of resilience as follows: “supply
chain resilience” (AND) “dimensions” (AND) “readiness”.
Similarly articles pertaining to response, recovery and
growth were searched. The result was as follows: 19 articles
pertaining to readiness, 246 pertaining to response, 117 and
187 pertaining to recovery and growth respectively.
Following this, many papers were eliminated due to
duplication and non relevance. Next, the abstracts of each of
the papers were read to determine the relevance of the paper
to SCRES and the aspects of SCRES in the context of
engineering discipline. To make sure the process was
systematic, the papers were independently read by three
authors to reduce bias. We not only relied on the search
eengine results but also classified the selected papers based on
the aspects of resilience. We classified 35 peer reviewed
articles related to supply chain resilience aspects. We found
only 6 papers pertaining to readiness while there were 9, 13
and 7 papers pertaining to response, recovery and growth
respectively. Based on this we decided to delve further into
the ‘readiness’ aspect of supply chain resilience. We also
studied the BCI 2016 Supply Chain Resilience Report and
have used its results in our literature review. This paper is
unique in a way that it analyzes the critical causes of
disruptions in an attempt to improve resilience.

RESILIENCE

Nowadays, organizations are much more at risk than
yesterday. Välikangas (2010, p. 19) mentions that resilience
can be conceptualized, both as the proactive capacity to “take
action before it is a final necessity” and the reactive capacity
to “recover after experiencing a crisis”. Resilience at its core
is the ability to prevent and being disrupted by an event. It
deals with the ability of the supply chain network to cope with
the disruptions and return back to a normal or better state.
Supply chains must be designed to incorporate event
readiness, provide efficient and effective response and be
capable of recovering to their original state. There are a
number of definitions with regards to supply chain resilience.
Martin Christopher and Helen Peck in 2003 defined resilience
as “the ability of a system to return to its original state or move
to a new desirable state after being disturbed”. From 2003 to
2017 there have been numerous papers which have defined
supply chain resilience. Nils-Ole Hohenstein, EddaFeisel and
Evi Hartmann in their research have provided a
comprehensive detail about the various definitions of supply
chain resilience which is present in the extant literature. They
have also classified supply chain resilience literature into 4
aspects or dimensions of supply chain resilience. The four
dimensions of supply chain resilience include supply chain
readiness, response, recovery and growth. A tabular account
of the number of papers in each dimension of supply chain
resilience gives us an idea about the status of research in each
of these areas. According to Research on thephenomenon of
supply chain resilience(2014) Nils-Ole Hohenstein,
EddaFeisel and Evi Hartmann have observed that number of
papers devoted to readiness have been the least over the past
decade. There are three phases of supply chain resilience and
these are pre disruptions, during disruptions and post
disruptions (Sheffib& Rice(2005)). Agility and robustness
have also been stated as dimensions of resilience (Wieland
&Wallenburg(2013)).Based on the various aspects or
dimensions of resilience we have prepared a conceptual
framework for the in depth understanding of supply chain
resilience. (Figure 2)
CONCEPTUAL FRAMEWORK OF RESILIENCE AND ITS DIMENSIONS
On the basis of the definitions we can define resilience as a combination of agility and robustness. Moreover event readiness is an integral part of robustness. Similarly event response, growth and recovery after disruption fall under the category of agility. Our framework is actually a venn diagram which combines all these features into a single integrated one. In this venn diagram resilience is shown as an intersection of robustness and agility. The various aspects of resilience event readiness, recovery, response and growth have been placed under their suitable areas. Also we further focus on the robustness part of the venn diagram. Since, event readiness is directly related to robustness, an improved event readiness leads to increased robustness which in turn leads to improved resilience.

ASPECTS OF RESILIENCE

READINESS
Readiness means being prepared or available for service. This definition means that whether the supply chain is capable of providing goods/services at reasonable costs according to the consumers' requirements (Spiegler et al., 2012)). Readiness as the fourth part of SCRES definitions was first referenced in 2007 by Datta et al. Complete understanding of SCRES is of vital importance as supply chains of different organizations must develop both proactive and reactive resilience capabilities to increase the level of readiness or else such disruptions would adversely affect revenues and costs (Ponomarov & Holcomb(2009)). Moreover, readiness capability is important to establish a control on the supply chain.

RESPONSE
Response is the reaction to a specific stimulus. A quick response not only focuses on the time needed to react to disruptions but also on the start of the recovery phase (Spiegler et al., 2012). It is concerned withreducing the effects of the disruptions at the earliest and with the least impact to the organization(Pettit et al., (2013)). The capability to respond to the needs of the market during critical situationis an important determinant of SCRE (Sheffi& Rice (2005); Wieland &Wallenburg (2013)). Underresponse, agility is the capability to rapidly respond to changes(Braunscheidel& Suresh(2009)).

RECOVERY
Recovery is defined as “a return to 'normal' stable or steady-state conditions” (Spiegler et al., 2012). To recover from a catastrophic event is important and is one of the capabilities of the supply chains. It is as important as readiness and response. According to the research of Wang et al. (2010), Sheffi& Rice (2005) and Välikangas (2010), the capability of recovering "can be attributed as the resilience of a dynamic system." Along with the speed of the recovery process, the rules that guide the process are equally important.

GROWTH
Growth can be stated as not only recovering from the current situation to the previous state or to a better state but also surpassing it by developing specific elements to boost performance (Hohenste in et al.(2015)). Since it is a subjective concept and depends on each company's investments in each element of SCRES, growth and readiness phases have not been included by all authors in their SCRES definitions. Nonetheless, in the next years, response, recovery and growth were part of several definitions. All of these evidences suggest that the universally adapted definition of SCRES has to include in it all four phases to ensure common acceptance and theoretical validity (Hohenstein et al. (2015)).

EVENT READINESS AND ROBUSTNESS
Disruptions tend to disturb the existing flow in any supply chain. The ability of the chain to withstand disruptions and continue its operations is known as “robustness of the supply chain”. The term robustness and robust supply chain has been defined in various literatures in numerous ways. Robustness is defined as the ability of the supply chain to resist or avoid change (Christian Felix Durach Andreas Wieland Jose A.D. Machuca(2015)). It has been defined by numerous authors since the 1900s. Event readiness is the preparation and design of the system to counter the various kinds of disruptions which could affect the supply chain. Hollinagel et al. (2006) states the
readiness of a system as the capability to recognize, to anticipate and to defend against the changing shape of risk before adverse consequences occurs. Hence, it can be concluded that event readiness is the capability of the supply chain to defend itself and mitigate the risks posed by the various kinds of disruptions. Preparing the supply chain to withstand or resist disruptions can be termed as event readiness. Event readiness can effectively contribute in making a supply chain robust. Resilience being a combination of agility and robustness will improve with increased robustness. To attain improved event readiness it is essential to understand the causes of disruptions and then look into ways to mitigate risks and cope with disruptions. Hence we have analyzed the cause of disruptions and analyzed the necessary tools to improve the supply chain readiness. Scope for further research in these areas has also been elucidated.

**CAUSES OF DISRUPTIONS**

Supply chain disruptions are unplanned and unanticipated events that disrupt the normal flow of goods and materials within a supply chain (Svensson(2000); Hendricks &Singhal (2003); Kleindorfer&Saad (2005)) and, as a consequence, expose firms within the supply chain (SC) to operational and financial risks (Stauffer (2003)). It has also been defined as “unplanned and unanticipated events that disrupt the normal flow of goods and materials within a supply chain” (Craighead et al. (2007)). A SC disruption can be defined as any occurrence which has negative consequences for regular SC operations and hence, causes some degree of “confusion/disorder” within the SC. Natural and man-made catastrophes disrupt supply chain operations and some of the causes of disruptions have a significantly higher impact. The severity of supply chain disruptions has been well analyzed in past. In 2011 alone, the damages and losses caused by natural disasters for the region exceeded US$ 250 billion, accounting for more than two thirds of worldwide disaster losses (CRED(2012)). Disruptions can be attributed to many sources: operational contingencies including failures and systems malfunctions, natural disasters, terrorism, political instability (Paul R. Kleindorfer, Germaine H. Saad (2005)). Supply chain disruptions can be classified on the basis of cause, supply chain life cycle, type and managerial decisions (Asoo J. Vakharia&ArdaYenipazarli (2009)). According to BCI Supply Chain Resilience Report 2016, Unplanned IT and telecommunications outages (60%) remain the top cause of supply chain disruption for the fifth consecutive year. The loss of talent and skills jumps three places from fifth in 2015 (33%) to second in 2016 (45%). This is at its highest ranking yet from placing fourth in 2012. Cyber-attacks and data breach meanwhile drop one place from second in 2015 to third in 2016. The ranking of these causes of disruptions have been done on the basis of impact. This ranking is valid only if the number of people considering the respective cause to be of a high impact is taken into consideration. The report also mentions a total of 23 causes of disruptions. It also classifies the various disruptions on the basis of high, medium and low impact. We conducted a Pareto analysis of the 23 disruptions to determine the most critical causes of disruptions. We have taken into account the total number of people who would consider each cause of disruptions to have an impact. Pareto analysis has been used in this case to find out the root causes of disruptions. Since, the causes of disruptions are high in number it was necessary to shortlist and prioritize a specific set of disruptions which have the maximum impact.

**Table 1: Tabular account of causes of disruptions and their impact (Business Continuity Institute Supply Chain Resilience Report 2016)**

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Sources</th>
<th>Impact</th>
<th>Percent of total</th>
<th>Cumulative percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Unplanned IT or Telecommunications outage</td>
<td>333</td>
<td>7.2930</td>
<td>7.2930</td>
</tr>
<tr>
<td>2</td>
<td>Loss of talent/skills</td>
<td>280</td>
<td>6.1323</td>
<td>13.4253</td>
</tr>
<tr>
<td>3</td>
<td>Adverse weather</td>
<td>275</td>
<td>6.0228</td>
<td>19.4481</td>
</tr>
<tr>
<td>4</td>
<td>Transport network disruption</td>
<td>274</td>
<td>6.0009</td>
<td>25.4490</td>
</tr>
<tr>
<td>5</td>
<td>Outsourcer failure</td>
<td>267</td>
<td>5.8476</td>
<td>31.2965</td>
</tr>
<tr>
<td>6</td>
<td>Cyber-attack and data breach</td>
<td>266</td>
<td>5.8257</td>
<td>37.1222</td>
</tr>
<tr>
<td>7</td>
<td>Human illness</td>
<td>239</td>
<td>5.2343</td>
<td>42.3565</td>
</tr>
<tr>
<td>8</td>
<td>New laws or regulations</td>
<td>234</td>
<td>5.1248</td>
<td>47.4814</td>
</tr>
<tr>
<td>9</td>
<td>Health &amp; Safety incident</td>
<td>233</td>
<td>5.1029</td>
<td>52.5843</td>
</tr>
<tr>
<td>10</td>
<td>Insolvency in the supply chain</td>
<td>214</td>
<td>4.6868</td>
<td>57.2711</td>
</tr>
<tr>
<td>11</td>
<td>Currency exchange rate volatility</td>
<td>208</td>
<td>4.5554</td>
<td>61.8265</td>
</tr>
<tr>
<td>12</td>
<td>Fire</td>
<td>181</td>
<td>3.9641</td>
<td>65.7906</td>
</tr>
<tr>
<td>13</td>
<td>Industrial dispute</td>
<td>176</td>
<td>3.8546</td>
<td>69.6452</td>
</tr>
<tr>
<td>14</td>
<td>Product quality incident (e.g. Product recall)</td>
<td>172</td>
<td>3.7670</td>
<td>73.4122</td>
</tr>
<tr>
<td>15</td>
<td>Intellectual property violation</td>
<td>158</td>
<td>3.4604</td>
<td>76.8725</td>
</tr>
<tr>
<td>16</td>
<td>Lack of credit</td>
<td>156</td>
<td>3.4166</td>
<td>80.2891</td>
</tr>
<tr>
<td>17</td>
<td>Business ethics incident (e.g. Human rights, corruption)</td>
<td>156</td>
<td>3.4166</td>
<td>83.7057</td>
</tr>
<tr>
<td>18</td>
<td>Act of terrorism</td>
<td>155</td>
<td>3.3947</td>
<td>87.1003</td>
</tr>
<tr>
<td>19</td>
<td>Energy scarcity (i.e. loss of supply or rapid price increase)</td>
<td>149</td>
<td>3.2633</td>
<td>90.3636</td>
</tr>
<tr>
<td></td>
<td>Cause</td>
<td>Frequency</td>
<td>Impact</td>
<td>Likelihood</td>
</tr>
<tr>
<td>---</td>
<td>--------------------------------------</td>
<td>-----------</td>
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<td>------------</td>
</tr>
<tr>
<td>20</td>
<td>Civil unrest/conflict</td>
<td>140</td>
<td>3.0661</td>
<td>93.4297</td>
</tr>
<tr>
<td>21</td>
<td>Environmental incident (e.g. pollution, waste management)</td>
<td>129</td>
<td>2.8252</td>
<td>96.2549</td>
</tr>
<tr>
<td>22</td>
<td>Earthquake/tsunami</td>
<td>100</td>
<td>2.1901</td>
<td>98.4450</td>
</tr>
<tr>
<td>23</td>
<td>Animal disease</td>
<td>71</td>
<td>1.5550</td>
<td>100.0000</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>4566</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Figure 3: Pareto Chart of Causes of disruptions**
UNPLANNED IT OR TELECOMMUNICATIONS OUTAGES
Information technology disruptions can affect the entire delivery chain of any business. Outages can affect businesses ranging from manufacturing to banking and other financial sectors. Organizations increasingly rely on the internet to enable supply chain processes, and each firm's information network has an impact on its suppliers, collaborators, and channel partners (Davis & Spekman (2004)). With the advent of Enterprise Resource Planning (ERP) many companies today rely on their IT systems for their scheduled working. The importance of information systems and ERP in the context of supply chain management has been analyzed by several authors. Implementation of ERP has led to shorter cycle times, better financial management and has helped in the integration of information (Mabert et al. (2001); Davenport & Brooks (2004); Shang & Seddon (2000); Murphy & Simon (2002); Al-Mashari et al. (2003)). ERP can provide the digital nervous system and the backbone in an organization to respond swiftly to customers and suppliers (Cox et al. (2000); Mabert et al. (2001)). Unplanned IT and telecom outages have caused many disruptions in the past. Unplanned outages have huge impacts on the financial and operational dimensions of any business. An unplanned outage is the unexpected failure of a computer or network hardware system or software application in a business (Katherine O’Callaghan & Sugumar Mariappanadar (2008)). The effects of an outage are important when we consider a supply chain. Information systems and IT infrastructure is highly important because these technologies serve as a backbone for the majority of existing supply chains. In 2007 Scott Dynes, M. Eric Johnson, Eva Andrijcic, Barry Horowitz analyzed the impact of an outage on the supply chain of manufacturing companies. It was found that organizations relying on concepts of lean supply chain and just-in-time processes were affected severely rather than companies working on concepts of forecasting. Unplanned outages, failures can severely affect a supply chain's visibility. Supply chain visibility is the ability to see from one end to the other (Christopher & Peck (2004)). Increasing the visibility of demand information across the supply chain reduces the risks (Chopra & Sodhi (2004)) and hence there should be continuous visibility across the chain. The major reason for disruption due to this cause is the lack of preparedness for such a disruption. Since, such a disruption occurs in an unanticipated manner the disruption causes heavy damage in terms of scale. Hence it is necessary that organizations should be prepared for such outages. Solutions for dealing with such outages include the installation of failover servers or backup servers which would still be able to supply information in the event of such an outage. We have also observed that there is scant amount of research pertaining to IT outages and its implications on the supply chain of an organization. Future scope for research exists in this domain and it is necessary to conduct future research in this area as this remains the most important or widely attributed cause of disruption.

LOSS OF TALENT AND SKILLS
The loss of talent and skills both has been cited as the second most important cause of disruption. Talent shortages are about to become a serious concern and the biggest shortfalls are in key supply chain areas. Employees working in the supply chain domain generally interact with other corporate disciplines and hence they are also involved in strategic planning. The importance of supply chain management professionals in areas such as inventory positioning and supplier relationship management distinguishes supply chain from other departments (Ken Cottrill (2010)). There are numerous reasons for shortage of talent and they include growing demographic gap, expanded skill set requirements, profession’s image problem and shortage of faculty (Lisa Harrington (2015)). Loss of talent also happens due to high demands placed by employers. Growing skill set requirements is a reason for talent shortage. Talent shortage and talent loss affects the supply chain adversely in case of any disruption. Since there is not enough talent which knows how to deal with disruptions, even a minor failure exacerbates with time and causes severe damage to the supply chain. For instance, Lisa Harrington mentions an example of an automotive company which experienced significant delays leading to a drop in the market share. Primary reasons were lack of supply chain expertise in the requisite markets which increased the budget by 15% and delayed the product launch by 3 weeks. Ken Cottrill (2010) has examined the reasons for talent shortage and also reviews the solutions for the following problems: The demanding skills for supply chain professionals, where these skills can be found and how companies should retain talent. The demanding skills today not only include technical and analytical skills but also include soft skills (Ken Cottrill (2010); Lisa Harrington (2015)). These include the ability to communicate horizontally and vertically. Part of the problem is selecting individuals with the appropriate industry and academic backgrounds. “Executives are struggling to find the best compromise between a solid grounding in supply chain and more general experience” (Ken Cottrill 2010). There are solutions proposed for preventing the loss of talent in this domain. One of them is bringing education in line with the industry needs and making students aware about the diverse role of supply chain management. Firms should also develop in house education programs to provide the necessary knowledge to bridge the gap (Lisa Harrington, 2015). Preventing talent loss is as important as nurturing talent. Literature has also emphasized on job rotation as one of the techniques to prevent talent loss. “Rotating supply chain professionals through different departments and functions enriches their skills and gives them broader perspective of the business” (Ken Cottrill (2010)). Also, companies need to include incentives to make supply chain management a lucrative role. Finally, industry commitment is necessary to cope with this cause of disruption. Scope for future research exists in the implementation of the above practices to mitigate the risks posed by this cause. Further research also needs to answer the following questions.
• Are the above stated solutions adopted by various supply
chains?
● If adopted, how efficient were these solutions in reducing talent and skill attrition?
● And if already implemented, why does loss of talent still retain such a large share in the listed cause of disruptions.

ADVERSE WEATHER
Natural and man-made catastrophes disrupt supply chain operations and some of the causes of disruptions have a significantly higher impact. Global supply chains are becoming more vulnerable to disaster risks, especially in the Asia-Pacific region. In 2011 alone, the damages and losses caused by natural disasters for the region exceeded US$ 250 billion, accounting for more than two thirds of worldwide disaster losses (CRED (2012)). Supply chain disruptions can be classified into natural and human induced disruptions. Adverse weather comes under the category of natural disasters. There is significant amount of research pertaining to strategies to deal with natural disasters. Some of the strategies are: selecting suppliers on the basis of risk criteria rather than on pure cost minimization (Christopher (2011)), shortening the supply chain and increasing supply-chain visibility through a monitoring system (Masato Abe & Linghe Ye (2013)) and diversifying risks by using different distribution channels and suppliers (Masato Abe & Linghe Ye (2013)). Masato Abe and Linghe Ye propose increased collaboration between public and private entities and also suggest strategies for improving disaster resilience. Another way to improve supply chain design and competitiveness is by the usage of predictive analytics and big data. Big data analytics is a significant part of supply chain management because of the massive amount of information used by SCM (Tobias Schoenherr & Cheri Speier-Pero (2015)). One of the benefits of using predictive analytics in SCM is that it would help organizations respond faster to changing environments (Tobias Schoenherr & Cheri Speier-Pero (2015)). Faster response in case of changing environments would give professionals enough time to plan for the disruption. Big Data can help in both alleviating and recovering from the negative consequences of disasters, as well as in building social and natural capital and enhancing adaptive capability to cope with the future (Folke et al. (2010); Redman (2014)). A survey of professionals using predictive analysis in supply chain management indicated that about half of the sample did not use or does not plan to use them in the future (Tobias Schoenherr & Cheri Speier-Pero (2015)). Predictive analysis would give us insight about upcoming weather situations which will help supply chains cope with uncertainties. It can help supply chain networks to change suppliers, scheduling deliveries and forecasting production before the situation. Though adverse weather cannot be controlled or modified such techniques can help networks cope with situations and plan accordingly to make their networks robust. Further scope for research exists in increasing awareness about predictive analytics and its implementation for the benefit of supply chain networks.

CONCLUSION
This paper gives an insight into the correlation between resilience and robustness of a supply chain networks. In doing so, we have developed a conceptual model which gives an in depth understanding of resilience and its various dimensions. This paper also gives an insight into event readiness, recovery, response and growth aspects of supply chain resilience. It explains the relation between robustness and event readiness and the overall effect of improved robustness on supply chain resilience. This paper specifically focuses on three major causes of disruptions and contends that by incorporating tools mitigating effects of these causes an improved event readiness would be achieved. With an increased event readiness there would be an increase in the robustness of the supply chain. An increased robustness contributes to improved resilience as pointed by the conceptual framework. For an improved robustness this paper primarily focuses on event readiness elucidating the various risks and causes of disruptions which hamper the working a supply chain network. On the basis of the analysis of the various causes it has been found that further scope for research exists in the implementation of the various tools which would mitigate the severity of such disruptions. Hence we would like to indicate further research in the following areas.
● Further research on tools, which would mitigate the effects of disruptions.
● Research on the implementation of such tools
● Further research on the efficacy of such implementations.

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