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How to Mitigate the Impact of Supply Chain Disruptions and Risks?

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Abstract :In this dynamic environment, supply chain disruptions are increasing and leading to more pressures toward adapting and quickly responding in an agile way to that change. The purpose of this article is to explore how organizations can mitigate the effect of Supply Chain disruptions and risks. The researcher proposed a model designed to link all needed factors that can be used by managers to improve supply chain performance and reduce the impact of supply chain disruptions and risks. The research design, guided by a Qualitative philosophy, was inductive in nature. The researchers conducted an extensive review on the general risk management and Supply chain risk management literature. The proposed model offers a structured approach to provide support for managers in decisions related to improve supply chain performance and reduce the impact of supply chain disruptions and risks. Proposed model will enable organizations to identify, analyze and mitigate supply chain disruptions. It provides an important contribution to the area of supply chain risk management, and highlights a systematic approach to manage these risks. Although many literatures are available related to supply chain risk management, recent academic research stressed the importance of supply chain risk management and the need to develop new approaches for its management. This research proposed a new model represented by six critical components and steps needed to facilitate the mitigation of supply chain disruptions.

Keyword – Supply chain disruption, FMEA, Supply chain risk Management
Paper Type – Research Paper

I. INTRODUCTION

Supply chain is the lifeblood of any business organization that connects suppliers, producers, and final customers in a network to create and deliver products and services to the customers (Stevenson, 2012, p. 665). Mentzer et al. (2001, p.2) defined supply chain as "a set of three or more entities (organisations or individuals) directly involved in the upstream and downstream flows of products, services, finances, and/or information from a source to a customer". "Supply chain management is the task of integrating organizational units along a SC and coordinating materials, information and financial flows in order to fulfil (ultimate) customer demands with the aim of improving competitiveness of the SC as a whole" (Stadtler 2005). Organizations need to ensure smoothly production and aims to match supply with demand effectively and efficiently. However, organizations are facing a large number of disruptions both external and internal that disrupt productions' processes, minimize its performance and business results and in some situation it ends up with a standstill operations. "Cousins et al. (2004) identify the wider consequences of a failure to manage risks effectively. These include not just only financial losses but also reduction in product quality, damage to property and equipment, loss of reputation in the eyes of customers, suppliers and the wider public, and delivery delays" (Khan and Burnes, 2007, p.204). "Disruptions can prevent manufacturers and retailers from satisfying market demands and add unexpected organizational costs by requiring organizations to increase inventories, adjust production and shipping schedules, incur excessive backordering, and offer discounted prices to customers when goods or products are not in the right place at the right time (Co, David, Feng, & Patuwo, 2012)" cited in (Bowman, 2015, p.34). Further added "a disruption in the supply chain directly affects an organization's solvency and the sustainability of the supply chain as a whole (Tang & Musa, 2011). However, flexibility in the supply chain allows the chain to respond to changes stemming from the supplier to the end customer with minimum penalty in costs, quality, delivery, labor, and performance (Tiwari et. al., 2013)"

Research has shown that most organizations lack the knowledge of the different types of organizations disruptions and risks and are still facing difficulties on how to manage these supply chain risks. A number of studies under the (Supply Chain Risk Management) and (Enterprise Risk Management) have suggested a number of solutions to reduce the effect of these risks, however there is still a number of questions on how exactly to approach risk management and what factors can be considered to minimize those risks. Sodhi et.al. say that risk management is still emerging and has rather unclear boundaries at this stage (2012, p.1). Khan and Burnes say that "rather than broad-brush approaches to managing risk, what is required is a contingency model of risk which shows when

and how particular approaches are effective" (2007, p. 209). Further added "the general literature on risk offers a wide range of tools and techniques for managing risk, these do not appear to have been adapted for use in managing supply chain risk. Rather, what appears to be on offer is a narrow range of general prescriptions on how to reduce risk (Mitchell, 1995)" (2007, p.210). Kumar et al (2014a) agree to the fact that in literature, most of the studies considered only one risk factor such as uncertainty or disruption in a single stage and very little has been done for developing quantitative model to manage other risk and disruption incidents, such as imperfect production process, and disruption in production, supply and demand, and their combination. A very few study considered multiple types of risk and disruption incidents. In similar to above context, there is lack of research in benchmarking Risk mitigation strategies.

Researchers and practitioners have not comprehensively addressed the selection of the most appropriate strategies in particular scenarios (William et al., 2015, p.5061). George et al. say "there is a need for a formalized system that identifies such risks, qualifies the associated risks and then provides procedures, strategies and tactics aimed at either minimizing or eliminating such risks (George et al., 2003, p.3).

Based on the above, the researchers in this study proposed a model that provides managers with a new lens to be proactive to document analyze and act upon different organizational risks in the supply chain. From a practical angle, the proposed model represents the six critical components and steps needed to facilitate the mitigation of supply chain disruptions:

A. Using FMEA tool to apply predictive risk analysis approach
B. Concentrating on the three main types of flows in an organization to reveal the most expected critical risks that affect the business
C. Defining the main critical nodes in the supply chain that needs the critical assessment of risks
D. Developing a recovery plan
E. Communicating results to the whole organization to increase the awareness of that risks and solutions on how to minimize its negative impact on the business.
F. Establish a process to monitor and control the (Risk management process) performance.

Below is a brief introduction into the general area of supply chain risk management followed by the grounding theories and relevant literature that led to the deduction of the proposed model. This is followed by a description of the integrative model and how it can be applied in practice.

II. BACKGROUND

Supply Chain Management is the synchronization of the organization's processes with those of its suppliers and customers to match the flow of materials, services, and information with demand. It is the design, operation, control and improvement of the systems that leads to produce and deliver satisfactory products and services to the consumers (Krajewski et.al. 2013; Jacobs and Chase, 2011; and Stevenson, 2012). As organizations are moving into global sourcing network, more opportunities for risks are there (Khan and Burnes, 2007). Dittmann says that "companies with global supply chains face an addition potential for risk, including, but not limited to, the longer lead times needed in the global environment; supply disruptions due to global customs, foreign regulations and port congestion; political and/or economic instability in a source country; and changes in economics such as exchange rates" (2014, p.1). "Economic globalization and the resultant complexity of the supply chain network plus the uncertainty of the environment makes risk and vulnerability a major challenge to related firms" (Yu et al., 2015, p. 95). Risks in supply chain are growing significantly therefore Supply chain risk management has emerged as an effective method of reducing vulnerability in a supply chain. Tummala et al. defined supply chain risk as the "threat or probability of supply chain disruptions that adversely affect the smooth flow of products, impacting operational performance measures such as responsiveness and cost" (2014, p. 29). Friedrich et al. emphasized "the need for professional supply chain risk management activities along the risk management process – risk identification, risk assessment, and risk mitigation, and insists that companies with higher competencies in these three process steps of supply chain risk management show superior performance" (2010, p.23). Organizations cannot fully eliminate all disruptions. They can implement strategies and models that enable them to act at the right time with the right action to minimize the effect of these devastating incidents when they occur. Successful risk management cannot be applied in one single step. Instead, risk management process need to be formulated in several steps. Based on extensive literature review, the researchers deduced six critical steps needed to achieve a successful supply chain risk management:

A. Using Failure Mode and Effect Analysis (FMEA) Tool

As attention to products and services design's quality and failure assessment can greatly reduce the possibility of product liability, improve product safety and functionality attention to flow quality in supply chain and risk assessment can greatly reduce possibility of production disruption and improve organizational business results. "Understanding of the supply chain risk sources which disrupt the performance and the severity of their impact on the supply chain can help an organization design efficient supply chain networks. It can also help to decide the right supply chain risk mitigating strategies that mitigate the adverse effects due to these risk sources" (Punniyamoorthy et. al., 2013, p. 80).

One of the tools that have proven to be successful in enabling defect prevention in product design is Failure Mode and Effect Analysis (FMEA) (Geisler, 2014, p.1; Welborn, 2007, p.17; Evans and Lindsay, 2011, p. 622; Teng and Ho, 1996, p.9). Evans and Lindsay say that " FMEA can be used for processes to identify hazardous conditions that may endanger a worker or operational problems that can disrupt a production process and result in scrap, down time or other non-added value costs" (2011, P. 623). For example Welborn in his study recommended decision makers to use the FMEA tool to help in evaluating the risk of outsourcing options (2007, p. 18). Sharma and Bhat in their study investigated Supply Chain Risk Management practices and identify the tools and techniques used by the Indian automobile companies. Findings revealed that Supply chain risk assessment practices can be improved by using techniques like FMEA (2014, p. 67). Tummala et al say that "the combination of failure mode and effect analysis with a supply chain risk management process enhanced the manufacturer's confidence in its supply chain design decision, and enabled the firm to proactively manage its supply-side risks" (2014, p.27).

Li and Zeng (2014) used FMEA in the supplier selection method to assess the risks in the decision process further added that "Welborn (2007) has developed more details about how to use FMEA for assessing supply chain risks. In the development of Supply Chain Risk Management Process, Tummala and Schoenherr (2011) have used FMEA to identify supply chain risk at the stage of risk identification" (2014, p. 4).

Friedrich et al. in their study say that "accurate risk assessment is only possible with excellent prior risk identification just as risk mitigation is impossible without prior risk assessment" (2010, p.23). Many literature and studies shows how organizations can adopt and integrate FMEA tool into a supply chain environment with more details on how exactly to apply it which is not part of the aim of this study.

Based on the above, as FMEA is applied on product/service design to review as many components, assemblies, and subsystems as possible to identify failure modes, and their causes and effects, the researchers in this study propose using FMEA to review core processes in the supply chain to identify, and prioritize different risks in the supply chain and identify recommended actions to lower severity or occurrence of these risks.

B. Concentrating on the three main types of flows in an organization

An enhanced supply chain management supports the company attaining a competitive advantage. It involves the control of material, information, and finance flows in a set of networked organizations consisting of customers, suppliers, manufacturers, and distributors (Zhang, Gunasekaran and Wang, 2015, p. 1145). " Material flows refer to the transfer of physical products, information flows refer to the transfer of coordinating data and financial flows refer to the transfer of monetary resources, all relating to the exchange of products or services" (Edwards et. al., 2013, p. 444).

Ali et. al. conducted a study that concluded that the three dimensions of Supply Chain Integration, financial flow, physical flow and information flow are positively associated with firm performance. Hence, the supply chain process integration should be focused and leveraged to achieve operational excellence and revenue growth (2010, p.216). Supply chain disruptions are defined as "unplanned events that may occur in the supply chain which might affect the normal or expected flow of materials and components (Svensson, 2000)" (Blackhurst at al., 2008, p. 143). Habermann defines in his dissertation the word disruption as "an unplanned stoppage of the material, information, or monetary flow within the supply chain." Further added that "disruptions are unplanned as opposed to planned interruptions (during preventive maintenance, for example), actual (stoppages) as opposed to productivity losses, and occur in the material, information, or monetary flow" (2009, p. 32). The unplanned reflects the uncertainty and stoppage capture the disparity between the supply and demand, thus, a stoppage in the material flow implies a mismatch of supply and demand within the material flow From the definition of supply chain management above, it is clear that modeling supply chain risk assessment as a process need to consider the different type of flow that exist in the supply chain. For example Sinha et al. say that "the objective of the supply chain is to synchronize customer requirements with the flow of material from suppliers by balancing the conflicting goals of high service level, low inventory investment, and low unit cost (Walker and Alber, 1999)" (2004, p. 155).

Further added the information should be made transparent across the supply chain. This helps in developing an integrated network (2004, p. 157). "Tang (2006) suggested that robust supply, demand, product and information management strategies have the ability to improve the efficiency and resiliency of a supply chain" (Kumar and Routroy, 2014a, p.145). Zhang (2008, p.4) focuses in his research on analyzing the likelihood and impact of the uncertain variations or disruptions that affect the flows of information, materials and products from a supply chain perspective. He specifies how "the increasing unpredictability of the customer's demands, unreliable suppliers' performance, and fast changing technology make it difficult to ensure the flow of information is accurate and reliable, which may reduce the supply chain effectiveness and increase uncertainty in the interaction between supply chain partners".

The three types of flow that need to be managed in the supply chain are: product and service flow, information flow and financial flow (Stevenson, 2012, p. 666). "Harland et al. (2003), referring to Meulbrook (2000), described supply risk as adversely affecting inward flow of any resource that hinders scheduled operations" (Tummala et al. 2014, p.30). There are many sources which cause risk in the supply chain. In order to assess risk, the risk categories must first be specified. Tang and Musa (2011) "adopted the literature citation analysis on 138 journal articles published between 1995 and first half of 2008, and identified and classified potential risk associated with material flow, financial flow, and information flow" cited in Ho et al., 2015, p.5031). The proposed model partitioned risks into disruptions that are associated with the three types of flow that leads to the transformation of materials into goods and services and that directly affect the smooth flow of the operations.

1) *From the perspective of information:* From the perspective of information, "effective supply chain management practices, built on holistic concepts of strong strategic partnerships founded on inter-organisational trust and a high degree of information sharing between firms, creates a competitive advantage that, in turn, improves organisational performance (Dyer and Singhe, 1998; Li et al. , 2006; Kannana and Tanb, 2005; Zaheer et al. , 1998; Delbufalo, 2012; Carson et al. , 2003; Handfeld and Bechtel, 2002)" cited in (Wang et. al., 2014, p. 865). Lin and Zhou defined information risk as "the inability to share information among different supply chain roles and make it visible, accurate, and secure across the whole supply chain" (2011, p. 178). Further added that high transactional cost, other unnecessary costs, and chaotic behavior arise when the information cannot be effectively and efficiently communicated and shared through the supply chain. "The sources of information side risks addressed in literature include "unavailability of information" (Guo et al., 2006), "information delay" (Cucchiella and Gastaldi, 2006), "break down of information infrastructure" (Chopra and Sodhi, 2004; Blackhurst et al., 2008) and "security of the information system" (Blackhurst et al., 2008)" cited in (Punniyamoorthy et. al., 2013, p. 91). Ngniatedema says that "information systems architecture enables enterprise - wide integration, reduces systems complexity as well as the Bullwhip effect, and streamlines business processes in mass customization environment" (2012, p.60). Further added "The bullwhip effect - one of the limitations of mass production systems - causes problems such as excessive or inadequate inventory, poor production and capacity planning, cash flow utilization, and customer service. In contrast, integrated operating network that links critical business functions and value network partners enable flows of information and coordination of activities across functional units and geographic regions" (2012, p.61). "Throughout the supply chain, key operational metrics and status reports such as inventory, demand, forecasts, production and shipment plans, work in progress, yields, capacities, backlogs, etc., should be accessible easily by key members of the supply chain. Such information should be accurate and timely, rendering it useful for all parties for planning and re-planning purposes" (Christopher and Lee, 2004, p. 399). Munoz and Clements explain that "the integration of supply chains as a mechanism for value creation is largely dependent on continuous flow of real time accurate information from the customer back upstream to the manufacturer. This ideal is often unachievable when disruptions in the flow of information and materials are known to regularly occur in some manufacturing supply chains." (2008, p. 38) further added that the use of technologies such as radio frequency identification (RFID) to increase visibility throughout the supply chain presents an attractive solution to the problem. Power (2005) says that information technology enables supply chain entities to share all information, resulting in minimizing the inventory level and improving the partnerships in the supply chain networks (p.255). Simatupang and Sridharan (2008, p. 407) approve that by affirming that advanced information technology such as decision support systems, enterprise resource planning, and the internet can be used to convey up-to-date data about demand planning, product movements, workflow, costs, and performance status. Information systems improve the quality of forecasting, decision, planning and control, mitigate the uncertainty caused by the external market environment and internal factors of the supply chain, and consequently improve the efficiency and effectiveness of supply chain operations." (Zhang, Gunasekaran and Wang, 2015, p. 1145).

2) *From the perspective of financial flow:* With respect to financial flow "the vulnerability of financial strength of a supply chain member, may easily affect the entire supply chain network" (Tang, 2006, p. 15). Ali et. al. (2010) in their study emphasized that effective and efficient management of financial flow integration is essential to improve the supply chain performance. Popa say that "financial Supply Chain Management consists of the holistic and comprehensive activities of planning and controlling all financial processes, which are relevant within a company and for communication with other enterprises" (2013, p.142) further added "the financial supply chain is different from the physical supply chain as it deals with the flow of cash instead of goods, being a flow with an opposite direction"

"Both suppliers and buyers in the supply chain should cooperate to improve the financial efficiency of the supply chain as a whole, i.e. to globally optimize the financial performance of the whole supply chain. Therefore, in the last several decades, financial managers in the supply chain have spent great efforts in improving the cooperation between firms" (Liu, 2012, p.2). "Inventory costs due to obsolescence, markdowns and stock-outs, can be significant. Personal computers devalue by more than one percent per week. In the USA retail markdowns constitute about 20% of total retail volumes. Mismanaged supply chains, leading to excessive or mismatched inventory, are thus liable to huge financial risks.

Financial risks can also present themselves through the risk of reworking stock and penalties for non-delivery of goods" (Christopher and Lee, 2004, p. 388). Due to lack of control and visibility financial flow risk involves the inability to settle payments and improper investment. The common risks are exchange rate risk, price and cost risk, financial strength of supply chain partners and financial handling/practice (Tang and Musa, 2011, p. 13). "Disruptions experienced in current financial markets obviously are leading to previously unanticipated consequences ranging from unavailability of capital for financing capacity expansions, changing consumption preferences due to a drop in the value of retirement assets, and volatility in exchange rates" (Vakharia and Yenipazarli, 2008) further added that these disruptions would impact almost all the links in an SC and hence, would require a simultaneous coordinated risk management effort.

3) *From the perspective of product flow:* With respect to product and material flow, "the material flow integration is still commonly seen as the concentration of a supply chain integration process. Material flows include both physical product flows from suppliers to customers through the chain and reverse flows via product returns, servicing, recycling, and disposal (Wu, 2006)" cited in (Zhang et. al., 2015, p. 1144-1145). "Material flow is described as execution flexibility, which is the ability of the physical flow to adapt to changes. Flexibility means the ability to produce different sizes, volumes, or variations of products with minimum penalties in costs, quality or time (Upton, 1994). It incorporates the aspects of volume, mix, timing and new product flexibility, as well as responsiveness to the market, which have been identified to be the most important aspects of supply chain flexibility (Vickery et al., 1999)" (Kaipia, 2009, p. 153-154).

A supplier failure to deliver inbound purchased goods or services can have a detrimental effect throughout the purchasing firm and subsequently through the distribution channels that eventually reach to consumers (Zsidisin and Ellram, 2003 p.24). For example "the airport closure in Bangkok in 2008 caused one month delay of products, and transportation cost was incredibly increased since final products could not be shipped by planes as scheduled. Instead, they were carried by trucks to airports at nearby countries. The manufacturing plants in Thailand were almost shut down because the final products could not be shipped from the plants" (Kungwalsong, 2013, p. 5-6). Lin and Zhou say that "supply chain managers need not only to concentrate on product design, but also to devote time into managing risks arising from quick responses to customers' changing requirements" (2011, p. 163). Therefore "One mitigation capability for supply chain disruptions to which the different data sources consistently alluded to is recovery capability or the interactions of supply chain entities and the corresponding coordination of supply chain resources to return the supply chain to a normal and planned level of product flow. These purposive interactions and coordination of resources allow interventions to be designed and implemented to overcome the slowing or stoppage of planned product flow within the supply chain" (Craighead et al., 2007 p. 144). Material flow integration will lead to the outcomes of reduced inventory, lower cost, shorter lead times, less product damage, and better service to customers. The material integration is recognized with four levels: material handling, handling management, delivery decision support, and logistics alliance level (Wu, 2006)" cited in (Zhang et. al., 2015, p. 1144-1145).

Based on the above the researchers in this study believes that to manage disruptions effectively in the supply chain, organizations need to consider the risks that are associated with the three types of flow (products/services, information and finance) that leads to the transformation of materials into goods and services that directly affect the smooth flow of the operations.

C. Defining the main critical nodes in the supply chain that needs the critical assessment of risks

"A supply chain can be modelled as a network by a set of "nodes" that represent autonomous business units as firms who are able to exercise sovereign choices, and a set of "connections" that link these firms together for the purposes of creating products or services. Connections between firms represent exchange relationships and the underlying contract if present. When modelling exchange relationships, numerous connection types can be considered, but the critical connection types are the presence of contracts and various flow types including material flows, information flows and financial flows" (Edwards et. al., 2013, p. 444).

"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 to operational and financial risks (Stauffer, 2003)" (Craighead et. al., 2007, p. 131). "Links on the chain typically include material suppliers, production facilities, distribution services, warehouses, service centers, and customers. To reduce the likelihood of a breakdown at any point on the continuum and to plan for disruptions that cannot be avoided, a company must identify, assess, rank, and manage its supply chain risks" (Gilbert and Gips, 2000, p. 70). Many studies managed risks and developed strategies to risk assessment at the level of individual firm, single process or applied mainly to supplier relationship.

"Identifying risks, a company should first consider the range of likely risks and their possible impact on operations. Because the list of risks may be long, only risks with potentially significant impacts should be the focus of business continuity planning" (Gilbert and Gips, 2000, p. 70). "The intensity level of risk management activities needs to be aligned with the strategy for allocating core activities within the network" (Dressler and Muller,2003, p.11). Craighead et al. say a "supply chain comprises different entities that are connected by the physical flow of materials. These different entities, generically referred to as nodes" (2007, p. 134). Further added that "each node within a supply chain, in theory, should play a value-adding role and, as such, is important by nature. Even then, some nodes may be deemed to be more important than others, simply because of what they do and/or what their relative contribution is to value" (2007, p.142). Kumar and Routroy in their study concluded that most of risks along the supply chain belong to functional areas related to supplier stage, internal manufacturing stage and customer stage (2014a, p. 158). Processes in an organization can be divided into core -sometimes called core activities- and support processes (Krajewski et al., 2013; Stevenson, 2012; and Fosters, 2010). Krajawski et al. defined Core processes as a set of activities that deliver value to external customers and include: supplier relationship process, new service/product development process, order fulfillment process and customer relationship process. While Support processes is defined as processes that provide vital resources and inputs to the core processes and internal customer and is essential to the management of the business. Krajewski et al. say that "minimizing supply chain disruptions begins with a high degree of functional and organizational integration. Integration must include linkages between the firm, its suppliers, and its customers. The new service or product development, Supplier relationship, order fulfillment and customer relationship processes, as well as their internal and external linkages, are integrated into the normal business routine" (2013, p.435).

The Proposed model in this study moved the focus of attention to the whole supply chain concentrating on the core processes of the whole supply chain but not neglecting the support processes as they are still valuable to the success of the core processes to deliver product or service to the customers. Risk assessment that are associated with the three types of flow that leads to the transformation of materials into goods and services and that directly affect the smooth flow of the operations need to be investigated first at the critical nodes, which in this study we refer to it as core processes.

D. Developing a recovery plan

Organizations are working in a dynamic environment were changes happen all the time. "In order for organizations to not just survive but prosper, they must be knowledgeable about how to implement appropriate organizational changes that will be embraced by their employees (Armenakis and Harris, 2009, p. 128)" cited in (Jaros, 2010, p. 107). "Although organizational leaders cannot avoid supply chain disruptions completely but they must have the ability to respond successfully by combining the right innovation capabilities and effective strategies" (Golgeci & Ponomarov, 2013, p. 607). Regardless of the ability of the organization to identify risks, what is more important is how to mitigate its effect. The main aim in this phase is to identify options and sets of activities to either reduce negative consequences, or to reduce the likelihood of adverse outcomes (McCormack et al.2008 p. 26-27; Natarajarathinam et al., 2009 p.543; Zsidisin, 2001, p. 8). Hallikas et al. (2004) say once the risks are assessed, a number of strategies can be used to manage the risk: transferring risk, taking risk, eliminating risk, reducing risk and subdividing risk into individual levels for further analysis, cited in (Blackhurst at al., 2008, p. 146).

"The depth and degree to which risk is mitigated depends on how risk-averse a company is and what they are willing to invest in such strategies that minimize the risk" (Kumar et al., 2014 b, p.888). To improve mitigation clearly requires an intimate knowledge

of the organization, the market in which it operates, the legal, social, political and cultural environment in which it exists, as well as the development of a sound understanding of its strategic and operational objectives (McCormack et al.2008 p. 27). "Severe disruptions require firms to question existing strategies, structures, offerings, and activities (Hedberg, 1981), and provide a good opportunity to change them" (Golgeci& Ponomarov, 2013, p. 607).

Mitigation and preparedness are crucially important to eliminate or reduce the damage caused by disasters. These two stages lead to proactive decisions in crisis management (Natarajarathinam et al., 2009 p.544). Preparedness is developing a crisis response plan and training all the involved parties so that in the case of a crisis people know their roles and will effectively be able to managing supply chains in times of crisis deal with it (Natarajarathinam et al., 2009 p.543). Most models assume a single type of mitigation strategy. However, in practice, it can be quite effective to use multiple strategies and especially to develop both proactive and reactive mitigation strategies simultaneously (Snyder et al., p.104; Makharia et al., 2012, p.35). While definitions of proactive behavior may vary, each draws upon a central theme which is that proactive employees take an active approach to performing work" (Marler, 2008, p.15). Proactive approaches are aimed at anticipating the causes of disruptions (McCormack et al.2008 p. 8). Reactive approaches deal with the consequence of the occurrence of an event, disruption management in that they react after the disruptive event takes place, focusing on the resilience of the company or the ability to promptly recover from disruption (McCormack et al.2008 p. 8). Proactive behavior is more important today than ever for both individual and organizational effectiveness "Today's competitive, fast-paced environment requires that individuals spark initiative and guide their own creativity, rather than simply react to fires burning out of control" (Phelan, 2001, p.3).

Based on the above the researcher in this study believe that successful managers don't wait for success to come to them instead they deal with expected difficulties, potential future threat and uncertainties in advance. Sander say that " a profile of the proactive manager might show that he/she plans ahead, makes changes before problems occur, maintains contact with people in the organization's environment (boundary spanning), and values the change process" (1990, P11).

E. Communicating results to the whole organization

"To mitigate supply risks and develop competitive advantage today, supply professionals need to coordinate the relationships in the supply chain and increase the flow of information and communication efforts" (Larry et al., 2004 pg. 711). "Risk managers' involvement in communicating, both to high-level decision makers and line people working close to the risk sources and risk consequences can stimulate the process" (Berg et al., 2008). In essence, "the quicker a supply chain disruption is detected and the quicker that pertinent information about it is communicated, the more time the supply chain would have to inoculate itself from the negative effects of the disruption and the less severe a supply chain disruption would likely be occur" (Craighead et al., 2007, p.147). Kessinger and McMorrow (2012) outline three crucial abilities for Risk Management in Supply Chain: 1. Collect, communicate and respond 2. Assess the impact of uncertainty 3. Quantify supply chain performance and design supply strategies across uncertain business outcomes.

Larry et al. highlighted in their study the importance of internal communication and emphasize that interpersonal communication, ability to work in teams, and negotiation skills, which are needed to support the integration of the supply chain (2004, p. 711). The factor that would influence an effective disruption reaction is the continuous sharing of information among different actors in the supply chain (Dani and Deep, 2010). Christopher and Lee (2004) suggest that an important way to mitigate supply chain risks is improving "end-to-end" visibility of the supply chain and thereby improving confidence. Governance of Supply Chain mechanism should be established with predefined consultation and communication channels facilitate the flow of information to the right key person. "To establish a high awareness, the senior management can express its attention to Supply Chain Risk Management regularly over the intranet, in monthly newsletters or in quarterly staff meetings. It is crucial for all employees to know that risk reporting is relevant to the success of the entire company and that ignoring risks may cause major harm" (Denis et al. 2014, p. 15).

Along with internal communication, external communication is valuable, "in the case of supply chain disruption, a proactive genuine dialogue and responsible approach should be establish with stakeholders; external communication can create serious challenges for ensuring that suppliers and products comply with expectations, risk perspectives, agreements, and relevant policy mechanism" (Magnus et al., 2013 p.66). Mitsubishi Electric Corporation's initial focus was on determining the impact of the crisis and maintaining clear communications throughout their business. It took them only ten days to fully assess the availability of supply for all components at thirteen of their Japanese factories, while offices maintained close daily communications with factories to provide accurate updates to customers (Souza et al., 2011 p.12).

Therefore to make the review process or supply chain disruption more transparent, business result or specific changes should be

shared with employees. Conveying them how a supply disruption was handled, what was done well and what could be improved upon. Communication provides an opportunity to make sense of an organization's progress, and for members to discuss improvement to an organization and the impact of using different risk mitigation strategies (Carey, 2001, p. 27).

The researcher in this study strongly believe that staff at all levels of the company, stakeholders, suppliers and customers need to be encouraged and empowered to report any suspected and emerging risks. There is a need to improve communication process to improve the performance of the supply chain and facilitate risk management process.

F. Establish a process to monitor and control the (Risk Management Process) performance

Even after a successful mitigation activity for an occurred risk, continuous monitoring is necessary to control the risk, analyze the mitigation effectiveness and adjust measures if necessary at each step of the supply risk management process (Craighead et al., 2007: (McCormack et al., 2008 p. 21). It is evident that the risk monitoring process has received the least attention by researchers compared with the other three processes, including risk identification, risk assessment and risk mitigation. Among 224 articles reviewed, there is only one article studying early warning monitoring of risks in the food manufacturing supply chains (William et al., 2015, p.5061; Blackhurst at al., 2008, p. 146). A survey shows that 63% of the corporates believe they do not have control over interruption of their supply chain. And after any Supply Chain Management interruption, it will averagely take 63 days to come back to the normal situation (Bashar, 2016, p. 495).

Risk management as a process need to be monitored. The goal of process management is to achieve the highest level of process performance (Evans and Lindsay, 2011). "Performance analysis can provide important feedback information to enable supply chain managers to monitor implementation, reveal progress, enhance communication and diagnose problems. It can also provide insights about the effectiveness of the systems in place and procedures practiced, and help to identify success and potential opportunities. It can facilitate inter understanding and integration among the supply chain members (Sharma and Bhagwat, 2007)" cited in (Chithambaranathan et. al., 2015, p. 310). "Examining processes from the perspective of the value they add is an important part of a successful manager's agenda, as it will be helpful in gaining an understanding of how core processes and related supply chains are linked to their competitive priorities, markets and the operations strategy of a firm" (Krajewski et al., 2013). Risk monitoring and continuous improvement help to optimize effectiveness and efficiency of all previous risk management steps. Continuous improvement process to risk identification implies that companies that monitor their risk management actions, regularly assess their task and adjust their risk management processes accordingly are found to excel also in their risk identification activities (Kern et al. 2012 p.19).

According Melnyk *et al.* (2004, p.211) the performance metrics have three basic functions: control, communication and improvement. Control means that the metrics enable managers and workers to evaluate and control the performance of the resources. The performance is communicated for internal needs and external stakeholders' purposes by the metrics. Improvement means the possibility to identify the gaps between performance and expectations and to identify the areas where the development work is needed. Cernauskas & Tarantino (2009, p.3) in their study propose an approach for the modeling, monitoring and control of operational risk in financial institutions based on a methodology that integrates business process modeling with statistical and engineering process control.

Further added that although control theory is more commonly associated with manufacturing, it can be applied to improve the quality of and reducing the losses associated with the business processes of any firm.

Based on the above, the researchers in this study believe that there is a need to implement a process to monitor and control the (Risk management process) performance. Performance measurement is an essential element of effective planning, control, and improvement. The measurement results reveal the effectiveness of risk management strategies and potential opportunities to improve its performance.

III. PROPOSED MODEL

The proposed model represent a risk analysis methodology achieved by applying a continuous cycle of strong risk management practices that integrates risk identification, analysis, mitigation actions and recovery plan communicated at all levels, and evaluating the process of supply chain risk assessment as a whole to ensure its success. The model act as a communication means by providing a common and consistent view as well as a structured way of the risk management process. Organizations can use this framework (see figure 1) in a proactive and preventative manner to help avoid disruptions before they occur or at the very least, lessen their effect and negative impact.

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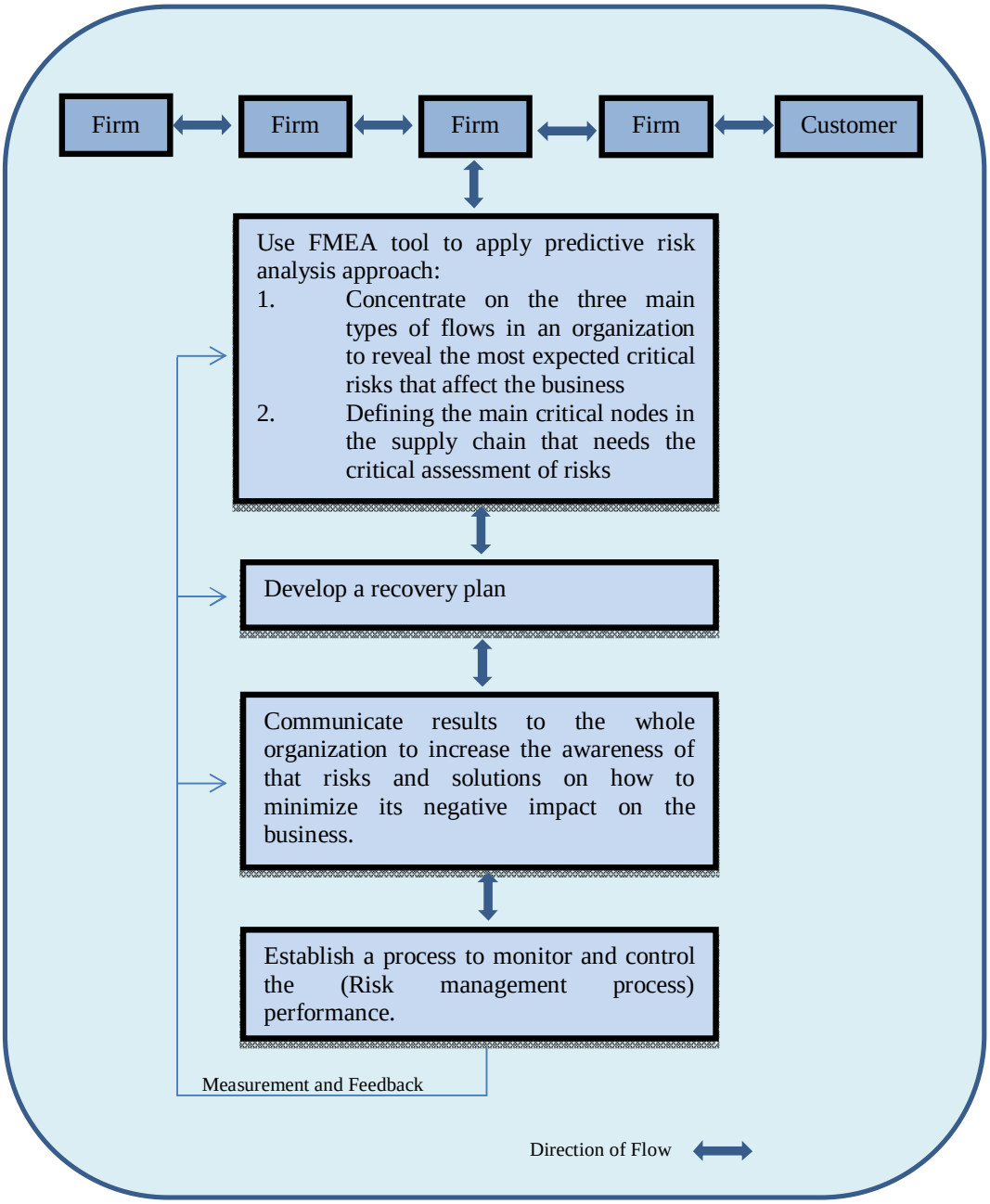

Figure 1: Proposed New Model for Supply Chain Risk Management

From a practical angle, the proposed model represents the six critical components and steps needed to facilitate the mitigation of supply chain disruptions.

First the firm needs to use FMEA tool to apply predictive risk analysis approach, second step is concentrating on the three main types of flows in an organization to reveal the most expected critical risks that affect the business. During the analysis as a third step it is essential to define the main critical nodes in the supply chain that needs the critical assessment of risks. Fourth step will be developing a recovery plan followed by communicating results to the whole organization to increase the awareness of that risks and solutions on how to minimize its negative impact on the business. Finally there is a need to establish a process to monitor and control the (Risk management process) performance.

IV. CONCLUSION

Supply chain is operating in a highly dynamic environment. To sustain competitive advantage and achieve high organizational

performance requires that managers respond quickly to different strategic challenges and disruption in the supply chain.

No matter how organizations apply different tools and strategies to improve the supply chain performance, disruption cannot be totally eliminated as organizations supply chain is dynamic in nature. The goal is to have a systematic technique, the right strategies and apply the right tools and models to track these disruptions and respond in an agile way to minimize its negative effect on the business. Employees and stakeholders at all levels need to have the awareness of the importance of how to deal with organizational risks and be trained on how to respond quickly to minimize the negative impact of organizational disruptions.

V. FUTURE DIRECTIONS

While the focus of this study was on a detailed description of the six critical steps that represent the proposed model, further empirical research is required to fully appreciate the breadth of application of this proposed framework.

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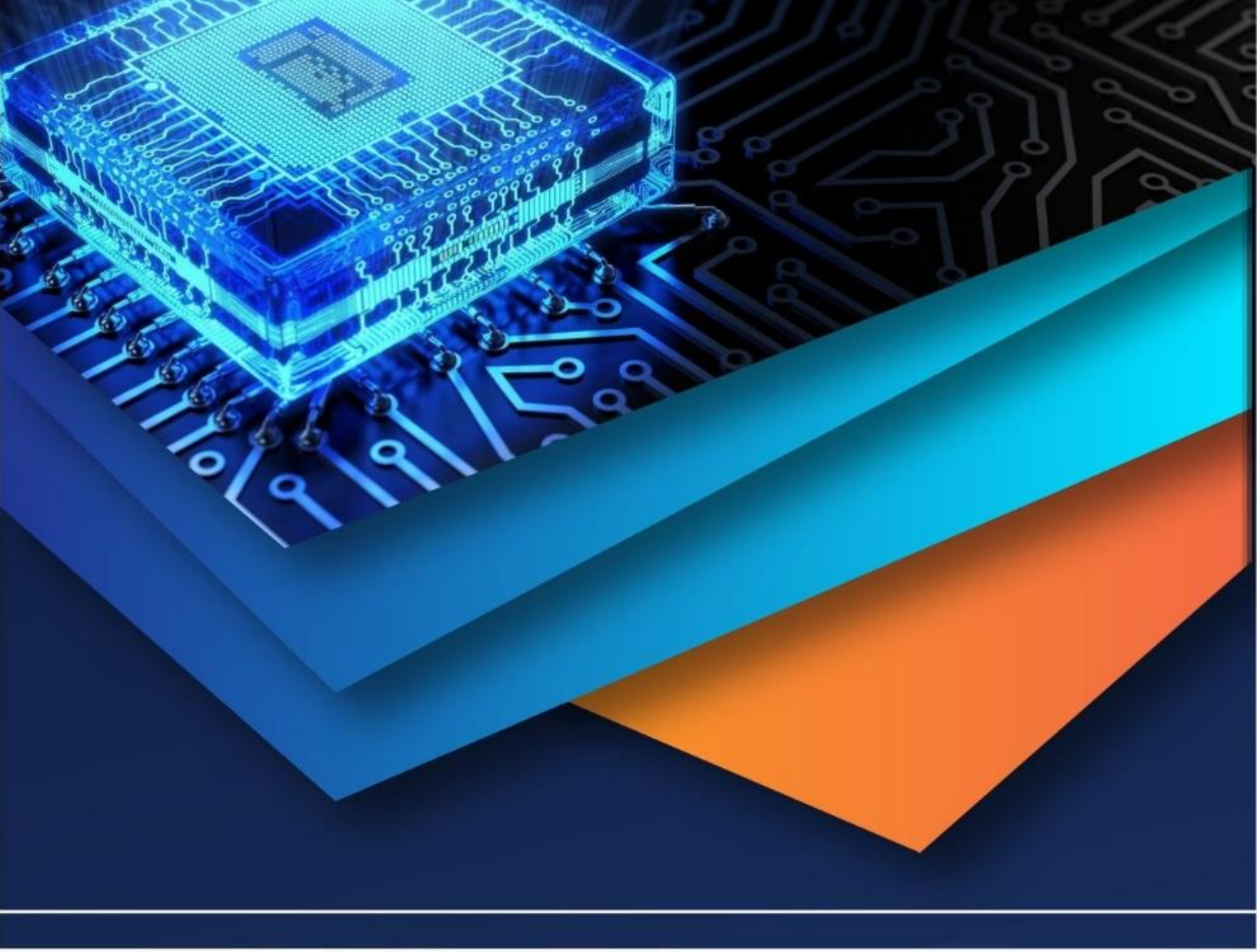

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