

# *(Supply Chain Resilience)*

*(case study)*

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**Abstract**—The purpose of this paper is to explore the resilience that Al-Madina Logistics can provide to its customer's supply chain. Al-Madina plays the role of third party logistics & helps to facilitate the flow of goods & services within different supply chains that have different products such as Oasis bottle of water & Macdonald's boxes that used to wrap the food at the restaurant. The findings are based on interview with the supply chain manager at Al-Madina Logistics. The paper distinguishes between a proactive and reactive aspect of resilience & shows the relationship between Supply Chain Risk (SCR), supply chain resilience (SCRes) & supply chain vulnerability (SCV).

**Keywords**—Supply Chain Risk, Supply Chain Vulnerability, Supply Chain Resilience.

## I. Introduction

Supply chain resilience (SCRes) has been a very critical issue to organizations, especially when supply chains are becoming more and more complex. Many researchers wrote about supply chain risks and disruptions, and how these risks and disruptions should be managed going all the way till they reach resilient supply chains. This paper will shed some lights on some theoretical aspects & concepts such as the definition of Supply Chain Resilience SCRes, supply chain risks (SCR), achieving supply chain resilience (SCRes), assessment of supply chain resilience (SCRes) & the relationship between SCRes, SCV & SCR. Then a case study of a third party logistics will be discussed in order to view & examine the aspects that demonstrate at the theoretical review. Moreover, various relationships will be exposed to show the link & connection between the concepts that exhibited previously. At the end several recommendations will be suggested in order to achieve supply chain resilience.

## II. Theoretical Review:

### A. Definition of Supply Chain Resilience (SCRes):

Resilience is a word with a Latin root coming from the original word *resilio* & it means springing back. As Barroso et al mentioned a SCRes means "the ability to react to the negative effects caused by disturbance that occur at a given moment in order to maintain the supply chain's objectives" [1]. This means, when a disturbance happened within a supply chain, the ability of that supply chain to fight that disturbance

and prevent it from happening in the first place is known as Resilience of supply chain. At the outset, there are two types of a resilience as a way of responding within a supply chain which are proactive and reactive. The proactive is putting more efforts to standby for anything that will cause a disturbance at the supply chain. The reactive is putting the efforts after the disturbance has taken place & trying to put back on track everything within the supply chain. Second, there are two elements for resilience supply chain which are resistance capacity & recovery capacity. Looking in deep into the first element which is resistance capacity, we find that it is concerned about the ability to avoid the impact of disturbance or minimize the time between the beginning of disturbance and the beginning of recovery from that disturbance. The second element refers to the ability of a system to return to its functions and tasks once a disturbance takes place. Also, there are two things that may cause a difficulty in resisting a disturbance. The first one is the limited resources in which to invest in both reactive or proactive ways. The second thing is that limited control over the parties of a supply chain. In addition, there will be always a risk and an uncertainty at a supply chain. So, companies need to develop a system that deals with unavoidable events. As Christopher & Peck mentioned a SCRes means "the ability of a system to return to its original state or move to a new, more desirable state after being disturbed" [3].

### B. Supply chain Risks (SCR):

Supply chain risks is one of the issues which companies are suffering from nowadays. As supply chains become more complicated because of global sourcing and other factors, they are more likely to face risks. The core challenge for the companies is to work on managing the supply chains and making them resilient and flexible to face risks. This part discusses the possible supply risk in a global sourcing context. Since there is long distances between the supply locations and places of distribution which causes an uncertainty of stability of supply resulted from long lead times. There are some approaches to apply supply chain resilience to improve supply chains performance. The first approach to reach this aim is represented by the introduction of operational buffers along the supply chain such as "excess inventory or productive capacity, backup sourcing, multiple sourcing" [9]. These traditional buffering strategies could decrease operational performances and could negatively impact

competitive advantage" [9]. "The second risk management approach, called mitigation, is based on the analysis of the processes with the aim of reducing the likelihood of occurrence" [9]. "The last strategy is to confront the risk by introducing contingency plans that can be activated once a negative event occurs. Contingency plans can be defined as business continuity management plans" [9]. Organizations should adapt the three approaches to have a minimum amount of risks.

### C. *Achieving Supply Chain Resilience (SCRes):*

As the Businesses all over the world are expanding rapidly & people are exchanging goods & services worldwide, the complexity of supply chains increased & the risks also increased. There are three steps to make a supply chain more flexible. The first step is to mitigate a supplier risk. In most scenarios a disturbance in a supply chain may be caused by a failure in a supplier's supply chain. In this case the buyer has no control on that failure & this failure is caused by a lack of visibility at the supply chain. Despite the new strategies in supply chain management as horizontal collaboration, which is increase the flexibility of a supply chain, it may also increase the complexity and decrease the direct control. Therefore, it would be good to recognize the risk of disturbance from all levels of suppliers at supply chain. The second step is to manage global flows by involving the logistics service providers. At the outset, they need to know the incentive of the customer, So they can respond to any changes in demand & product flow. Second they should have smoothness in putting the needed plans to minimize the products & cash flows. This will help to minimalize the fright costs. The third step is to have a demand forecast to prevent stock outs & surplus. It's important to have accurate demand by having the right data, rules that consider some facts as peak times and a model that can answer what- if questions. In addition, businesses are establishing collaborative relationships with the parties of a supply chain in order to have competitive advantage without knowing that this relationships are contributes in having a SCRes. Considering the three types of relationships competencies which are communication, cooperation & integration can really give a supply chain flexibility & thus achieving a SCRes. As Paulraj mentioned "Relational competences influence the patterns supply chain management SCM practice & can improve the performance of a supply chain" [5].

### D. *Assessment of Supply Chain Resilience( SCRes):*

Traditional management is not effective anymore, so it build up a measurement tool called the Supply Chain Resilience Assessment and Management (SCRAM). For this tool data collected from several global manufacturing and service firms are used to confirm SCRAM, using qualitative methodology with 1,369 empirical items from focus groups reviewing 14 recent disruptions. At all businesses all around the world, they define their risks according to their aims & desired outcomes. Also, In all companies the concept of the

risk differ from one department to another again according to their desired outcomes. If we look deeply, we will find that a supply chain risk means to miss match between supply & demand and serving customer needs. So, any errors that can harm the information flow & material flow among the first level of supplier to the last consumer at the supply chain, considered as disruption at supply chain. In Engineers point of view, resilience is the ability of an objective to return to its original state after it bowed or squeezed, But in entrepreneurs point of view, resilience is the flexibility of a supply chain to resist disruption or to return or respond to changes which has not been predicted. In fact , dealing with disruption effectively & efficiently at a supply chain well increase the financial returns, As Pettit. Et. Al has mentioned " Effective managing operational risk directly improves finance performance" [7]. Also, There is discord between resilience & cost. In fact, it costs lots of money to have a flexible supply chain without disruption or with minimum disruption. On the other hand, it costs lots of money also if a disruption happened within a supply chain. Therefore, firms need to have a critical options regard their aim's & objectives., In addition There is the concept of robustness as Asbjornslett has mentioned " Supply chain is robust or resilience with respect to a threat, if the threat not able to produce any lethal effects on the system" [3]. This means that in order to avoid disruption at the supply chain or to react toward it when it happens we need both robustness & resilience. The difference between a robustness system & resilience system is that, a robustness system has the ability to fight a disruption and fix everything to its original state. On the other hand, a resilience system has the ability to have a new stable station. As Drof & Bishop mentioned "use a control engineering definition of robustness. A system is robust when the system has acceptable changes in performance due to model or parameter changes and moderate modeling errors." [3].

### E. *The relationship between SCRes & SCV & SCR:*

It sounds that a resilience should be create & build within a supply chain through certain features & thus improve the flexibility of that supply chain. Also, Due to the extended supply chains, there is a need for a visibility of information, high level of collaboration and risk management to minimize the risk associated with a supply chain. In addition, this will give a supply chain agility to be able to react to changes & disturbance. Moreover, a Supply Chain Vulnerability (SCV) is the tendency or sensitivity of a supply chain that may be effected by disturbance. Therefore, by knowing & identifying a supply chain vulnerability, a supply chain risk can be identified too. In fact, a supply chain risk (SCR) is anything that causes a disturbance in information, material and product flows within a supply chain & thus causes issues in delivering the final product to the end customer. As Juttner et al mentioned " supply chain risks refer to the possibility & effect of mismatch between supply & demand" [9]. Obviously by knowing the impact of a disturbance within a supply chain, the degree of vulnerability can be determined, & by reducing the disturbances or eliminating them within a supply chain, a SCRes can be achieved. In addition, by decreasing the

disturbance within a supply chain & achieving SCRes, it can eliminate & reduce the risks associated with the supply chain. Thus we can say that these three concepts are interrelated.

### III. Case Study:

This paper interest in how Al-Madina logistics can contribute to the resilience of a supply chain. It's considered as a significant element in the supply chain according to its role as a third party logistics. The evaluation will include these two concepts: supply chain Risk (SCR), supply chain vulnerability as it influences a supply chain resilience. The findings of this report based on interview & investigation on Al-Madina Logistics.

Al-Madina logistics company (AMLS) is located in the Sultanate of Oman. It is one of the leading companies which are operating in logistics and supply chain sector. They are competing to be the best 3PL provider in the region. AMLS provides supply chain services such as Freight Forwarding, Transportation, Warehousing, Open Yard/Container Yard & Professional Logistics Consultancy

#### A. Warehousing & Distribution Center:

AMLS' state-of-the-art Warehouses and distribution centers contain several multi-purpose established facilities which are more than 275000 square meter in size covering of more than 180000 pallet locations tactically distributed throughout Oman. The warehouse will be prepared by equipment and storing conditions of ambient, frozen, chilled. Handling system. Products which require special conditions will be managed based on international standards that temperature and humidity will all be standardized to certify accuracy. There are some value-added activities which are done within the facilities such as Inkjet coding using inkjet machines for product promotional activities, Heat wrapping labeling and stickering your products for promotional activities, Bar-coding as per retail requirement prior to distribution, Sorting for resale from product returns zone, Quarantine management & Damage products destruction.

#### B. Freight Forwarding:

AMLS is about to be one of the creative and capable freight forwarding services in the sultanate. Three types of transportation will be focused on, maritime, aviation, and land. The freight forwarding system technology is helping the organization to manage the major of all the activities of the business clearly. The system is united with e-Customs and it is able to process exports and imports easily.

#### C. Transportation:

It is one of the main logistic services which is considered to be consistent and affordable. They have some plus points like introducing new vehicles based on the task, a fleet management system to manage and control day to day operations, and provide GPS to monitor all vehicles and guarantee safeness. AMLS has a great fleet with different functionalities such as General cargo, Temperature control cargo, Container haulage, Heavy haulage & Specialized requirement.

#### D. Open yard /Container yard:

AMLS is in process of making a very big open yard for the items which need a big capacity to be stored and it is not affected by the temperature and weather. This yard will be equipped with some needed equipment. Types of items which can be stored in an open yard are, specialized cargo, bulky items, automobile/vehicles, Project materials, machinery, timber/wood, building materials, chemicals. The open yard system will be used to control the movements in the yard.

#### E. Quality service:

AMLS is keeping in mind that implementing international certified quality standards (CQS), and Health, Safety, and environment (HSE) elements in daily operations is important to ensure consistency, dependability, and flexibility. Some other plans are implemented such as Emergency Response plan (ERP), and Business Continuity and Contingency plan (BCCP), to guarantee that the business is assured continuously.

#### F. Professional service:

In order to make accurate decisions and reduce risks, AMLS is provided with a computer aided solutions, six sigma tools, and world class management expertise including also the global experience since years in the sector of supply chain. The process of decision making will be needed in outsource operations, warehouse and distribution center design, storage and handling automation solutions, and warehouse management system (WMS) selection and project management.

### IV. Supply chain Resilience Proactive & reactive:

As mentioned above in the tritcale review that there are two types regard to responding to an disturbance which are proactive actions & reactive actions. At Al-Madina Logistics they are using the two types for instance, each day at the morning the supply chain manager checks the available trucks with its order detailed. Then, he gives the detailed to customer service employee in order to check & update them in to the system which known as aware software, in case the information are not at the system, the customer service employee calls the customers in order to have the necessary information of the commodity that they supposed to bring in.

After that, the job created at the aware software system in order to know the goods & commodity that will come in either freezer (-18,-20), room temperature or chiller (+2,+5). Then store each commodity at the appropriate place & locations. All of this steps considered as proactive actions to prevent a mistake from happening. In addition, another proactive action is that when rain expected to fall, they distribute an e-mail with instructions within their division. Also, delivery drivers are informed in order to take their provision & to be more careful. Moreover, they be ready by flowing the procedures & steps for receiving the inbound containers that well be coming next day. On the other hand, they have three unplanned trucks or containers for delays orders & argent use (unexpected events) & this consider as reactive action because they using them after a change occurs. In fact they received an e-mail in the day of our visit says " please find attach a total of 3 pallet well come in 3 trips", this supposed to be received a week ahead but they receive it that day & the customer want the service that day. Due to the unplanned containers that they have, they were able to deliver their service to the customer. So, based on experience & based on standard operation producers SOPs they are able to reacts to the unexpected changes.

V. Achieving supply chain resilience (SCRes) through minimizing Supply Chain Risk (SCR) & supply chain vulnerability (SCV) :

As Christopher & Peck mentioned "supply chain Vulnerability is the susceptibility of supply chain to the likelihood & consequences of disruption" (2004). Also, As Peck said "something that is at risk, is vulnerable" (2006). Based on this by knowing the vulnerability the risk can be known. Also, by identifying the risks & minimizing it, SCRes can be achieved. Looking to Al –Madina Logistics it can be found that Al-Madina demand's increased during the rain due to the shares that The General Authority for charity owns at the company. So, whenever there is a need for reliefs they have to work to satisfy that need & that where the risk increased. The manager of supply chain at AL Madina logistics said that he always able to maintain the risk & manage the unexpected events due to his experience since he is working at this area from long time. Also, he said that the risks that they face are avoidable & expectable. But, they faced station when it take long time to solve it, they were having a new customer which was Muscat Cold Store who specialized in selling meet. Their product were coming from New Zealand ( cutting frozen goat meat), at the beginning it was difficult & hard for Al-Madina staff to do the inbound process in appropriate way. It took them 2-3 months to manage this process because it took them from 7-8 hours to offload one container. Figure 1 demonstrate this situation:

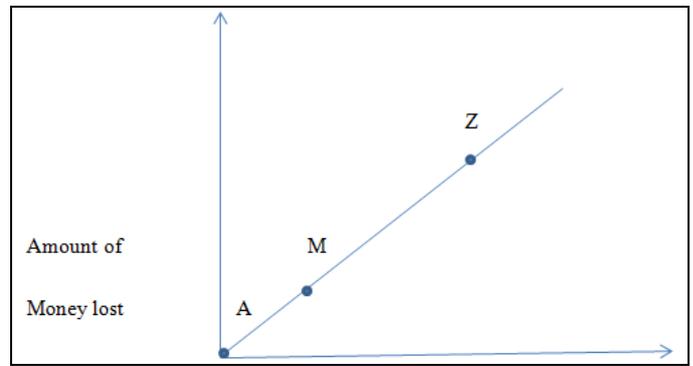


Figure 1: Time to solve issue/disturbance/unexpected change

point A shows the occurrence of an issue or change or disturbance & the amount of time spent to disturbance & money that lost. This point didn't affect the supply chain resilience because it solved quickly.( 3 unplanned trucks that used to react to the sudden email that was send to Al-Madina logistics)

Point M shows the time spent until they solve this issue & also the money lost (Muscat cold market). This issue defiantly affects the resilience of the supply chain of that product, but after they solve it the supply chain & flow of that product & what depends on return flexible.

As administrated below, there is an opposite relationship between Supply Chain Resilience SCRes (Dependent Variable) & Supply Chain Risk SCR ( Independent Variable) : whenever the risk of the flow of goods & services minimized the more the supply chain will have resilience ( the more the risk of flow of goods & service minimized between the parties that Al-Madina provides logistics service to them, the more flexible the supply chain between those parties & definitely a resilience will be achieved within this supply chain: figure 2 below shows the relationship.

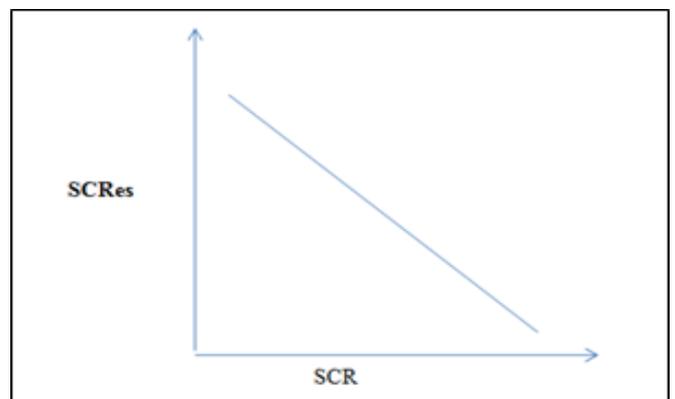


Figure 2: The relationship between Supply Chain Resilience & Supply Chain Risk

As exhibit below, a supply chain more risky if it has high level of sensitivity so there is a positive relationship between Supply Chain Risk (SCR) & Supply chain Vulnerability (SCV): figure 3 below shows this:

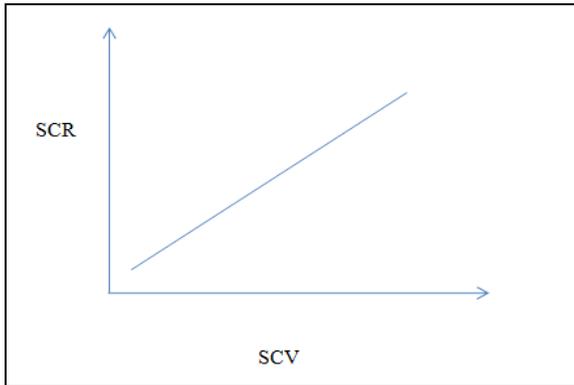


Figure 3: The relationship between Supply Chain Risk (SCR) & Supply chain Vulnerability (SCV).

The following matrix shows the reasons of having low or high response to changes & the consequences of that on SCR:

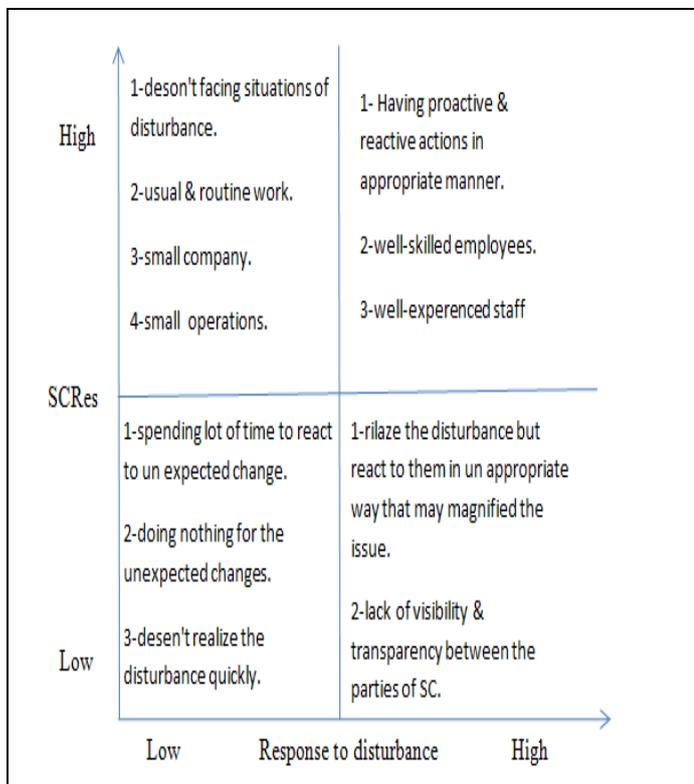


Figure 4: Reasons of having low or high response to changes & the consequences of that on SCR.

## VI. RISK MANAGEMENT TECHNIQUES:

### A. Five ways:

Q 1: What is the risk or change or disturbance that happened?

A1: Customer complained about late delivery/wrong amount of delivered items/ issues regard to the bill/ wrong goods delivered.

Q2: why?

A2: truck breakdown/new employee was the reason of the wrong amount of items delivered , types of goods delivered & issue at the bill.

Q3: why?

A3: need service at car agency/need to learn more to move along the learning curve & improve.

Q4: why?

A4: mistakes at the schedule need to reschedule it again.

Q5: why?

A5: due to new method of scheduling had applied.

### B. Fishbone:

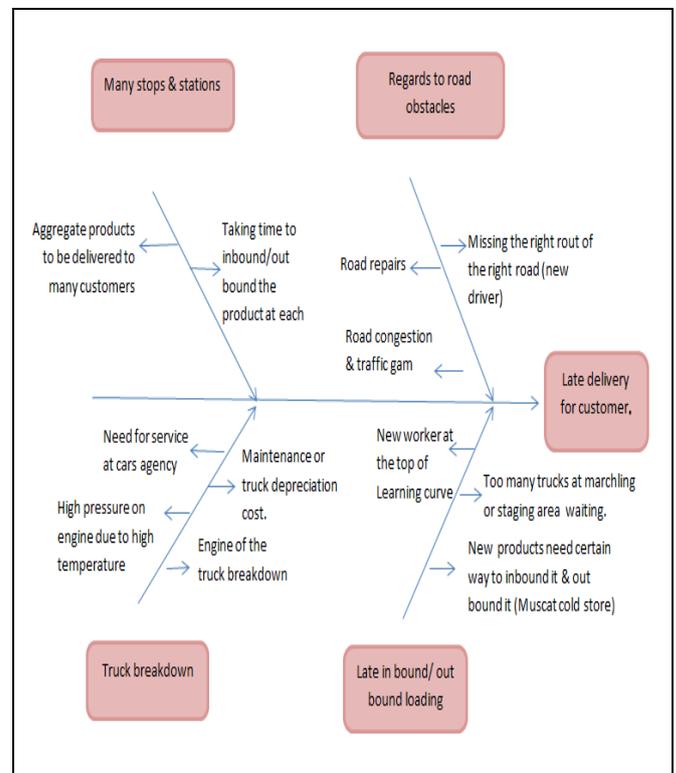


Figure 5: Fishbone of the late delivery for customer.

## VII. Conclusion:

To sum up, supply chain resilience is the ability to be flexible within a supply chain. Also, there are several ways contributes to the way to achieve supply chain resilience and how to minimize risks and mistakes. In addition, there is a relationship between supply chain resilience SCRes & supply chain risk SCR & supply chain vulnerability SCV. A case study were considered to study & evaluate the concept of Supply Chain Resilience within Al-Madina Logistics (3PL), as its important role in facilitating the flow of goods & services in other supply chains. As a result several recommendations applied to help companies achieve a supply chain Resilience.

## VIII. Recommendations:

1- Firms including AL-Madina Logistics should do the SWOT analysis to know how to avoid uncertainties, and to plan their operations more accurately.

2- Firms should have accurate demand forecast from the point of sale data to be able to know the amount of risk. Aggregate demand is advisable here especially for Al-Madina Logistics. Al-Madina Logistics should define their service level & define their risks in order to decide whether it well affect them or not. Also, to know how much they should put effort to solve such one.

3- It is better to have accurate data about the three unplanned trucks to see if they will need more in future.

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## REFERENCES

- [1] Steven A. Melnyk , David J. Closs , Stanley E. Griffis , Christopher W. Zoble , John R. Macdonald. (2014). Understanding supply chain resilience. *Supply chain management review*, 18 (1), 34-41. Retrieved from <http://web.a.ebscohost.com/ehost/detail/detail?vid=18&sid=ebf3c6ae-0a4f-49a4-ba43-bd9a15dee6e1%40sessionmgr4001&hid=4109&bdata=JnNpdGU9ZWVhY29wZT1zaXRl#db=bth&AN=93738476>
- [2] Uirike. Rowbottom, Clyde. Buntrock , Haukur. Hannesson. (2011). Three steps to supply chain resilience. *Logistics & transport focus*, 13 (7), 42-44. Retrieved from <http://web.a.ebscohost.com/ehost/detail/detail?vid=25&sid=ebf3c6ae-0a4f-49a4-ba43-bd9a15dee6e1%40sessionmgr4001&hid=4109&bdata=JnNpdGU9ZWVhY29wZT1zaXRl#db=bth&AN=64921546>
- [3] Virginia L . M . Spiegler, Mohamed M . Naim, Joakim .Wikner. (2012). A control engineering approach to the assessment of supply chain

resilience. *International Journal of production research*, 50 (21) , 6162-6187. Retrieved from <http://web.a.ebscohost.com/ehost/detail/detail?vid=6&sid=ebf3c6ae-0a4f-49a4-ba43-bd9a15dee6e1%40sessionmgr4001&hid=4109&bdata=JnNpdGU9ZWVhY29wZT1zaXRl#db=bth&AN=82703230>

- [4] Andreas. wieland, Carl Marcus. Wallenburg. (2013). The influence of relational competencies on supply chain resilience: a relational view. *International Journal of Physical Distribution & Logistics management*, 43(4), 300-320. Retrieved from <http://www.emeraldinsight.com/doi/full/10.1108/IJPDLM-08-2012-0243>
- [5] Juttenr. Uta, Maklan. Stan. (2011). Supply chain resilience in the global financial crisis: an empirical study. *Supply chain management*, 16(4), 246-259. Retrieved from <http://web.a.ebscohost.com/ehost/detail/detail?vid=14&sid=ebf3c6ae-0a4f-49a4-ba43-bd9a15dee6e1%40sessionmgr4001&hid=4109&bdata=JnNpdGU9ZWVhY29wZT1zaXRl#db=bth&AN=65550707>
- [6] Stavros T. Ponis. (2012). Supply Chain Resilience: Definition of Concept and Its Formative Elements. *The Journal of Applied Business Research*, 28(5). Retrieved from [http://www.academia.edu/2005537/Supply\\_Chain\\_Resilience\\_Definition\\_Of\\_Concept\\_And\\_Its\\_Formative\\_Elements](http://www.academia.edu/2005537/Supply_Chain_Resilience_Definition_Of_Concept_And_Its_Formative_Elements)
- [7] Timothy J. Pettit, Keely L. Croxton, and Joseph Fiksel. (2013). Ensuring Supply Chain Resilience: Development and Implementation of an Assessment Tool. *Journal of Business Logistics*, 34(1), 46-76. Retrieved from <http://onlinelibrary.wiley.com/doi/10.1111/jbl.12009/abstract>
- [8] CARVALHO, H., BARROSO, A, P., MACHADO, V, H., AZEVEDO, G.S,&MACHADO,V.C.(2011). Retrieved from <http://docentes.fct.unl.pt/hmlc/publications/supply-chain-resilience-simulation-study>
- [9] Colicchia C, Dallari F, and Melacini M. (2009, December). Production Planning & Control: The Management of Operations. Increasing supply chain resilience in a global sourcing context. Retrieved from <http://www.tandfonline.com/doi/abs/10.1080/09537280903551969>
- [10] Christopher M, Peck H. (2004). Building the Resilient Supply Chain. *International Journal of Logistics Management*, 15(2), Retrieved from <http://www.emeraldinsight.com/journals.htm?articleid=1527548>

## Biography:

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