European Journal of Logistics, Purchasing and Supply Chain Management
Vol.5 No.5, pp.1-25, December 2017
Published by European Centre for Research Training and Development UK (www.eajournals.org)

# EFFECT OF SUPPLY CHAIN ROBUSTNESS ON ITS PERFORMANCE

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**ABSTRACT:** *Although the research in supply chain robustness in its early stages, it is expanding rapidly this is due to Companies can mitigate and reduce the risk of unexpected and destructive events and be able to resume business quickly and The difficulty of predicting environmental factors surrounding companies has made it necessary to develop a disaster recovery plan as it is impossible for companies to resume business after a major crisis. In fact, about 80% of companies are suffering from their business interruption and do not have a clear disaster management plan coming out of the market and customers expect to receive information 24/7/365. This means that if the company has problems in the technological infrastructure and cannot resume its business as soon as it loses its customers and customers will turn to other competitors. Based on extant supply chain robustness, supply chain management and supply chain performance literature, a conceptual model was developed and validated. A questionnaire survey instrument was developed and administered among supply chain managers to collect data. Data was collected from 90 organizations belonging to different nodes of Egyptian automotive industry. Study employed exploratory and confirmatory factor analysis for data analysis. Further, to test the hypotheses and to fit the theoretical model, Structural equation modeling techniques were employed. Result of this study indicates that Supply chain robustness have a positive impact on supply chain performance. Where the explanatory power of supply chain performance of supply chain operations is 61.5%. Despite the importance and benefits of supply chain robustness (Business Continuity Management and Disaster Recovery Plan), Which can be explained as follow: (i) Confronting the errors caused by the human element, which are among the most difficult errors, which may result in the deletion of data owned by the company, whether by mistake or deliberately. (ii) The existence of disaster management that contributes to the development of an efficient team that can devise non-traditional means that increase efficiency and limit the negative effects to a minimum. (iii) Prevent disasters by removing their causes or reducing their effects by preparing the necessary measures and using appropriate techniques and precautions. (iv) Designing an effective organizational pattern in order to face the crisis when it occurs, reduce its effects and work to restore balance and activity to the organization after the crisis ends. (v) Reduce the physical and moral effects of the crisis. (vi) Save time, effort and cost in order to achieve the efficiency and effectiveness of the organization's performance and not waste these resources in dealing with crises. (vii) Secure equipment and property to help avoid crises. And minimize the chances of production interruption. (viii) Reduce problems of low morale of employees. (ix) Decrease losses and accelerate the return to the normal state of work. but business continuity management and disaster recovery plan were not among the interests of researchers in supply chain management. Research in this field is very deficient and in its early stages. It is necessary to study the effect of business continuity management and disaster recovery plan on supply chain performance. This study is one of the first attempts to support the theory of supply chain disaster management, pre-crisis preparedness, recovery and return to work normally after crises. The aim of this study is to develop a conceptual and practical framework to help supply chains be more prepared for emergencies.*



ISSN 2054-0930 (Print), ISSN 2054-0949 (Online)

**KEYWORDS:** Supply Chain Robustness, Business Continuity Management, Disaster Recovery Plan, Supply chain performance, Egyptian automotive industry.

## INTRODUCTION

Today, increasing and full dependence on ICTs and the emergence of virtual organizations that rely on the electronic exchange of information with supply chain partners and the lack of space and time constraints in exposing organizations to more breaches and electronic attacks which have affected the continuity of many organizations' caused:

- Exiting from competition.

- Influencing the organization's reputation and losing its customers.

- Organizations are subject to legal accountability.

- Its inability to function normally again and its return to competition.

Causing the supply chain to be characterized by Robustness and this is achieved through Business Continuity Management and Disaster Recovery Plan.

Supply chain management research is increasingly focusing on supply chains in times of crisis (Richey, 2009). Many companies face the risk of data loss, which is one of the most important assets owned by any company. The loss of such data is a real disaster if there is no plan to recover it. Organizations that can cope with and deal with the crisis is achieving a better competitive position than other organizations (Large, 2005). There are no disaster plans or programs that can be applied in all organizations in a typical way, but vary according to the situation of each organization (Rathbun, 2007). This is evidenced by the phenomenon of these institutions being exposed to successive disasters. Rather, it is necessary to prepare plans that correspond to the requirements and data of each organization (Richey, 2009).

Leaders and managers who implement disaster recovery plan, able to cope with the pressures of disaster, action and decision-making in the face of events and are abler to take responsibility for society and for workers. But many companies that do not start to care about disaster management only after they have experienced disaster that cause great loss and that it is necessary to take the initiative and prepare in advance to face disasters (Skipper and Hanna, 2009).

Martin, (2002) explained that the Disaster Management Plan is designed to maintain the continuity of critical and necessary operations in case of emergencies or crises. The Disaster Management Plan provides an effective way for management staff to proactively control all activities related to the disaster situation and mitigate the potential negative impact with the media, the public and the shareholders (Oloruntoba and Gray, 2006). This plan must be updated annually and made available to employees. This plan is designed as an accompanying document to the business appeal plan and consists of two main parts (Oloruntoba and Gray, 2006):

1. The first part is the disaster recovery plan in the event that in the event of a disaster attack the data processing centers.



ISSN 2054-0930 (Print), ISSN 2054-0949 (Online)

2. The second part is a business recovery plan that will address situation surrounding work and business units.

Recovery from such disasters requires a clear and clear plan to restore corporate activity and return to normal as soon as possible in the same state as before the disaster (Balcik and Beamon, 2008). The plan is called the Disaster Recovery Plan or the Business Continuity Plan (BCP) Data and information, allowing the company to allow it to return to normal activity again (Nijas, 2014). As a result, most international companies have begun to focus on disaster recovery planning and preparedness and have become an important non-negotiable necessity, yet many companies are not interested in developing such a plan (Oloruntoba and Gray, 2006).

The disaster recovery plan is designed to ensure continuity of critical processes in the event of a disaster by developing a framework that includes policies, processes and procedures to protect its Information Technology assets and ensure continuity of operations after disasters (Large, 2005). This plan provides an effective solution for the recovery of all vital and important operations within the time frame required by holding records and storing them outside the organization's site (Oloruntoba and Gray, 2006). The Crisis Recovery Plan is a plan within several plans that will provide procedures for dealing with emergencies (Richey, 2009).

## LITERATURE REVIEW

The following are the most important previous studies related to the subject of study. Studies related to Business Continuity Management, Disaster Recovery Plan, Supply chain performance and Egyptian automotive industry.

### Supply Chain Robustness:

Sindhuja, (2014) classified supply chain robustness into two categories: supply chain continuity planning and supply chain disaster recovery.

### Supply Chain Continuity Planning

Nijaz, (2014) showed that business continuity management is a term used to maintain business continuity and non-interruption that may result from operational, regulatory and environmental factors. Aberdeen Group found that the cost of every hour in which work was halted increased by an average of 65% between June 2010 and February 2012, with losses of approximately $ 100,000 per hour (Csaplar, 2012) and the average cost of the work stopped at the Emerson Network Power and the Ponemon Institute was about 505,500 dollars, and every minute the data center stops working represents a loss of about $ 5,600. Butler, (2013) found that the 49-minute stop at Amazon on January 31, 2013 resulted in a loss of about $ 5 million, and such losses were repeated when the services of Facebook, Microsoft, Google and Twitter in January-February - March 2013, which demonstrates the great importance of business continuity management and protection from downtime and interruption of work which costs large projects.

### Definition of Business Continuity Management:

Business Continuity Management (ISO 22301) is defined as: "an integrated management process that identifies potential threats to companies and the impact of those threats on business


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processes; Stakeholder interests, reputation and brand "Cruze, (2016). Nijaz, (2014) defines business continuity management as a term that emphasizes the ability of businesses to continue their operations and services if they experience disaster in their computer systems.

**Business Continuity Cycle Phases:**

Nijaz, (2014) showed that a business continuity lifecycle consists of six phases that the organization should follow in order to improve its level of readiness for continuity and survival. The following figure illustrates the components of the business continuity management lifecycle according to ISO 22313:

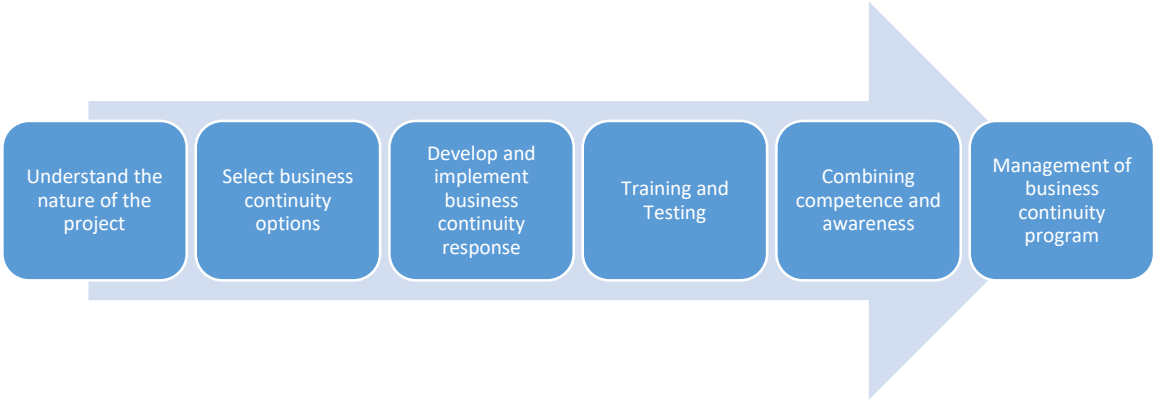


**Figure 1. Business Continuity Cycle Phases**

**Source: Nijaz, (2014)**

**Understand the nature of the project**

This first phase involves understanding and understanding the internal and external environment in which the company operates. This phase also refers to the surrounding circumstances and the realization of the company's core competencies and competencies. At this key stage, core institutional activities and surrounding threats are identified through business impact analysis and risk assessment (Nijaz, 2014).

**a. Business impact analysis:**

According to Rule 20/80, 80% of the output and project revenues originate from 20% of its activities. In the business impact analysis, these important activities and priorities of the organization are clearly identified, in addition to determining the degree of reliability among the various activities, and the minimum resources needed for disaster recovery and normal return to work before such disasters occur. The potential damage to the business as a result of the disruption as well as the maximum acceptable time periods for the cessation of activities is also assessed. Under catastrophic conditions, the time to think and react is limited, and organizations must understand this fact well (Nijaz, 2014).



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**b. Risk assessment:**

Organizations should undertake a formal risk assessment and study, systematically identifying, analyzing and assessing the risk of disruption of priority activities and the resources required for them based on the results of the business impact analysis (Nijaz, 2014).

**Select business continuity options:**

At this stage, organizations should identify business continuity alternatives based on business impact analysis and risk assessment outputs, with a view to reducing the overall impact of the disturbances that have occurred to the Organization's activities. Alternatives should focus primarily on reducing disturbances to priority activities, and then dealing with any disturbances that may occur. All alternatives should be studied, and then the most cost-effective alternative, which meets the target for the target time for recovery (Nijaz, 2014). Continuity options include the following:

- Move the place of doing business.
- Transfer or reallocation of resources.
- Alternative operations and backup capacity.
- Replacing resources and skills.
- Insurance.
- Asset recovery.

**Develop and implement business continuity response:**

At this stage, the Company must implement the pre-determined sustainability strategies through plans and procedures (Nijaz, 2014). The basic requirements for an appropriate and effective response include:

- Identify clear procedures for managing disasters and their obstacles.
- Communicate with the concerned authorities.
- Develop business continuity plans.

However, other specialized schemes could also be developed to address exceptional circumstances or procedures. These additional specialized plans may include a range of plans such as:

- Emergency response plan.
- An accident response plan.
- Plan to restore disaster activity that may infect information technology.

Each of the plans mentioned above serves specific objectives and conditions. The need to develop such plans should be determined according to the risks inherent in them and in accordance with the Company's own conditions and risk tolerance as well as the environment in which it operates. Such plans should be characterized by coherence and logical coherence among them, since any conflict or contradiction might adversely affect the overall program and


ISSN 2054-0930 (Print), ISSN 2054-0949 (Online)

thus the continuity of the Organization's work. In addition, roles and responsibilities must be clearly defined in the framework of plans and procedures developed (Nijaz, 2014).

**Training and Testing:**

Training in business continuity is one of the important steps in the program as a whole, as continuity plans are tested and validated during this phase. In addition, resources and teams involved in the implementation of these plans are being examined. It is essential for the Organization to ensure that existing plans meet business requirements and meet its sustainability objectives in the event of difficult circumstances. Regular training and appropriate testing create conditions for the organization to cope with unanticipated circumstances and lead to the improvement of its preparedness through reliable and appropriate plans (Nijaz, 2014).

**Combining competence and awareness:**

Business continuity management should become an integral part of the core values of the organization in order to ensure that the level of efficiency required for incident response is maintained. As noted above, business continuity management is an integrated process as it does not consist of unrelated phases and outputs. It represents a culture that must be integrated into the entity of regular processes and routines. Awareness should be raised among staff and relevant stakeholders, and there may be a need for orientation sessions to emphasize the importance of achieving business continuity management objectives. The greater the degree of awareness of the staff of an organization, the greater the chances of overcoming the Organization's harsh conditions (Nijaz, 2014).

**Management of business continuity program:**

Business Continuity Management (BCP) has an essential role in the business continuity management lifecycle and is a key focus of successful implementation; it defines implementation methodology, controls and manages controls to ensure that the objectives are achieved. The business continuity program management process includes elements such as: leadership, support, program planning, planning, operational control, performance assessment and continuous improvement (Nijaz, 2014).

A key aspect of program management is to keep the outputs related to the Business Continuity Management process updated to reflect the current situation, as the lack of regular updating will result in the failure to meet the objectives set in the event of disturbances. The modernization of business continuity management plans must be integrated with relevant business processes and should not be considered as a separate activity in this process (Richey, 2009).

**Supply Chain Disaster Recovery:**

Natarajarathinam et al., (2009) identified supply chain disaster recovery as "a crisis at an unexpected time that results in one or more supply chain activities being interrupted, resulting in a disruption of the flow of goods and services".

In light of the threats and security breaches facing organizations, it was necessary to work on disaster management. Disaster management is defined as a meaningful activity of the organization to identify the nature of the risks that can be experienced in order to determine



ISSN 2054-0930 (Print), ISSN 2054-0949 (Online)

what should be done and to take and implement the necessary measures to control these risks and mitigate the effects that they entail (Schulten et al., 2014).

Schulten et al., (2014) explained the concept of disaster recovery management includes:

- The ability to predict future events, and try to identify the size and nature of potential crises, and all the alternatives available to prevent crises or reduce the severity of the effects and prepare to address them when they occur.

- Flexibility and ability to change rapidly to cope with the successive events and rapid and sudden nature of the disaster.

- The use of an effective communications network that helps to provide adequate information as quickly as possible so as to determine the dimensions of dsasters and develop indicators for the consequences that may result.

- The ability to create an organizational climate characterized by understanding, cooperation and participation between all administrative levels and job centers to deal with crises.

- Ability to prioritize and direct the attention of individuals and groups to major problems and not to distract attention and potential in secondary problems.

Natarajarathinam et al. (2009) developed a comprehensive five-dimensional framework for classifying supply chain crises as follows:

**Disaster sources:**

Paulsson (2007) identifies the risks and crises facing organizations and divides them into two main parts:

- Operational risk: arises within the organization and relates to the performance of the activities necessary to sustain the flow of products and services.

- Changing dynamic risks: those risks that arise outside the boundaries of the organization and cannot be controlled or controlled, for example: inflation, new laws set by the state, exchange rates of some currencies and terrorist operations against countries.

Natarajarathinam, et al., (2009) classified internal crisis sources that affect supply chains into crises related to:

1. Workers: such as workers strike.
2. Infrastructure: such as (accidents related to the manufacturing process).
3. Information technology: such as (hacking computer network).
4. Financial aspects: such as supplier bankruptcy.

Some of the internal factors may also be considered external factors, where the source of the crisis may in some cases become a combination of internal and external factors. For example, if an employee within a supply chain is involved in destroying or removing data from the computer network, the source of the crisis can be considered an internal source, but if this destruction or security breach causes a person not belonging to any of the supply chain partners,


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in this case is an external source (Natarajarathinam, et al., 2009). The cause of the crisis (both internal and external) can be considered if:

- Lack of a tight security system (internal source).

- Breakthrough the security system and access to information through someone who does not follow the supply chain partners (external source).

**Supply chain disasters scope:**

Natarajarathinam, et al., (2009) classified the range of supply chain crises into three categories that will be presented as follows:

1. One company: or a member of the supply chain.

2. Supply chain partners: crises affecting the entire supply chain.

3. Regional or international scope: These are crises whose impact is beyond supply chain partners. Examples of such crises include earthquakes, hurricanes and terrorist attacks that extend to the regional and global levels and do not stop at the supply chain. It is clear that almost all natural disasters can be seen as large-scale events affecting the lives of thousands of individuals and all supply chains.

Helferich and Cook (2002) added that the same type of disaster does not produce the same results as it does, but differs from one organization to another according to its degree of predisposition to deal with crises. For example, Japan suffered a 7.2-magnitude earthquake in 2008, resulting in 12 deaths, while the 1999 earthquake in Turkey caused more than 25,000 deaths. Thus, the impact of the crisis can be greatly reduced through good planning.

While Martin, (2002) highlighted the need for a disaster management plan to provide information on proactive dealing with crises and the importance of the plan to include several detailed procedures for: executive managers, legal situation, Investor Relations, HR, sales and marketing and Technology Management.

The activities of the disaster management plan begin by alerting to a crisis. After an incident has been identified, the disaster management team conducts an assessment of the situation and determines whether a state of emergency is needed and the disaster management plan is activated. When the plan is activated, departmental staff will be alerted and directed to activate their actions (Martin, 2002).

**Supply chain disaster recovery management stages:**

Although there is a recent consensus on the classification of disaster management, there is still a difference between the approaches that classify disaster management activities. Several studies have agreed on four key stages in managing supply chain crises: (Waugh, 2000; Altay and Green, 2006; Natarajarathinam, et al., 2009; Schulten et al., 2014; Chowdhury and Quaddus, 2016).

**Mitigating disasters:**

This phase aims to assess potential sources of disasters and identify a range of activities aimed at reducing and mitigating these disasters (Richey, 2009).



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**Getting ready:**

This phase is based on developing a rapid disaster response plan, training all staff on how to deal effectively with disaster in case they occur, and how each person is aware of the role that is required.

Phase I and II help to mitigate the impact of disasters through proactive and proactive preparedness to deal with these disasters. For example, both Japan and Turkey suffered the earthquake, and more than 25,000 people lost their lives in Turkey, compared to just 12 in Japan, due to Japan's initiative and proactive decisions that helped reduce the impact of the disaster (Altay and Green, 2006).

**Rapid Response:**

Blecken, (2010) highlighted the need for supply chain partners to respond quickly to the changing changes in the ever-changing dynamic environment and that there is a great need for the collaboration of supply chain partners in disaster management in order to speed up business recovery after corporate failures and downtime.

The rapid response phase is concerned with immediate action after the disaster. The crisis is dealt with as planned in advance, helping to reduce its impact and reduce the problems that will be encountered during the last phase (Natarajarathinam et al., 2009).

**Recovery and return to work:**

The recovery phase of supply chain disaster is intended to support business continuity and resume operations and return to business normally.

The first and second phases are the pre-planning decisions to deal with supply chain crises effectively while the third and fourth phases represent the reaction decisions in crisis management.

Schulten et al., (2014) showed that the stages of disaster management of supply chain are periodic and not linear in the sense that they can all be carried out simultaneously. The following figure illustrates the application of a long-term strategic perspective to proactive decision-making processes to minimize the impact of unexpected events. Supply chain crisis management processes help to deal with changes and their absorption and the return of systems to balance after they have stopped working.



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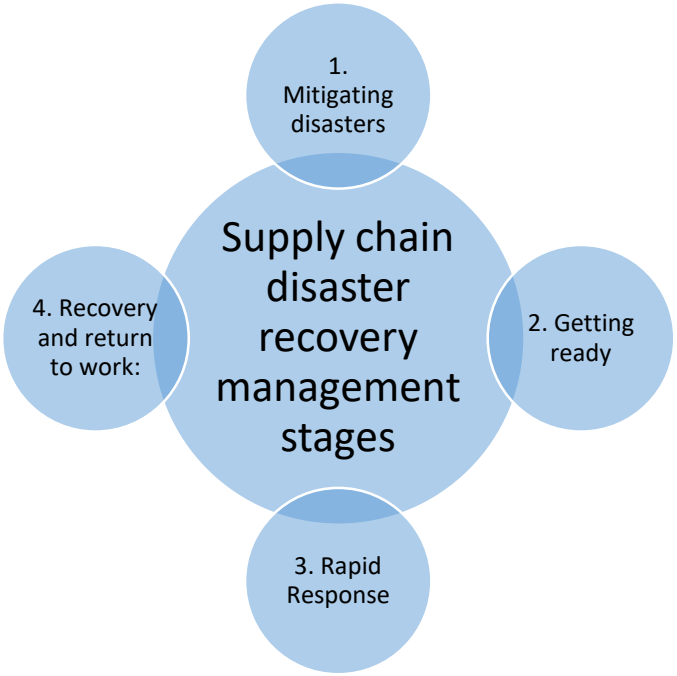


**Figure 2. Supply chain disaster recovery management stages**

**Source: Schulten et al., (2014)**

Richey, (2009) presented an integrated approach to dealing with disasters of the supply chain called the pyramid of disaster management.

**Cooperation: Theory of Relationship Management:**

Cooperation is an important issue to deal with supply chain crises. The study of Min et al., (2005) defines cooperation as "sharing information between two or more companies and sharing responsibility for planning, management, implementation and performance measurement". Richey (2009) considered relationship management to be important and necessary to deal with crisis supply chain crises. The study noted that relationship management theory encompasses several dimensions: commitment, trust, loyalty, and long-term relationships between partners.

**Communication: Communication theory:**

Supply chain crisis management needs to activate different communication channels. The communication process differs in terms of the degree of impact of societies on the political, economic, social, and cultural values and variables. Therefore, the effectiveness of the means of communication changes in the societies according to these variables. Thus, the visions and ideas of the two leaders differed in the communication process. Explained to this difference. Organizations need different communication channels, including internal communication between departments and departments of the organization, and external communication with supply chain partners (Richey, 2009).

Several studies (Large, 2005; Skipper et al., 2008; Richey, 2009) have highlighted the importance of supporting communication technology in facilitating the exchange of information among supply chain partners.



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**Competing Values Theory: the theory of competitive values:**

Introduction of competing values: The basic principle in this approach is that the criterion used to measure the effectiveness of organizations depends on the desires or values that you prefer. It is not surprising that the organization owner's perception of the effectiveness of the organization is different than that of the account manager, production manager, marketing manager, or human resources manager. This approach assumes that there is no single goal that is fully agreed upon, Thus, organizational effectiveness is a personal issue, that is, it is related to the individual values, preferences and wishes of the resident (Skipper et al., 2008).

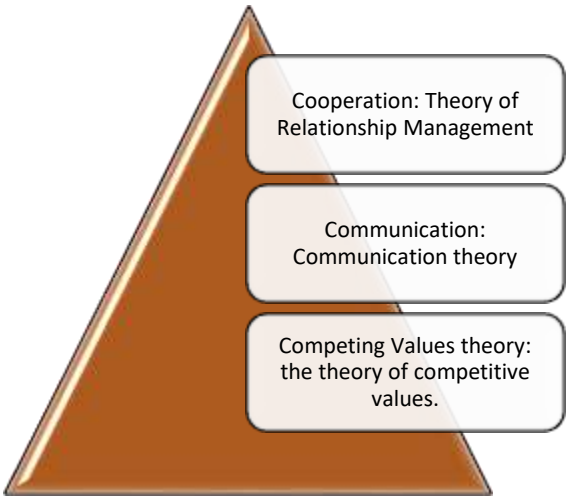


**Figure 3. An integrated approach to deal with disasters**

**Source: Richey, (2009)**

**Supply Chain Performance:**

Anand and Gvover (2015) defined supply chain performance as an organized and systematic process for measuring the effectiveness and efficiency of supply chain operations. Chia et al., (2009) considered the performance of the supply chain to be an integral part of any business strategy.

Kajuter, (2002) believes that the main objective of the supply chain is to improve the efficiency of supply chain members in order to support the competitive position.

**Importance of Measuring Supply Chain Performance:**

Measuring the performance of the supply chain helps:

- Improved integration and collaboration among supply chain partners (Garango and Bititci, 2007)

- Ensure that the supply chain partners are distinguished in providing a service that satisfies the customer (Whalen, 2002).

- Financial stability (Whalen, 2002).



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- Ensure continuous improvement of supply chain operations (Milliken, 2001)

- Successful Business and Projects (Cooke, 2003)

- The possibility of using performance measurement results to develop the appropriate organizational structure, and to bring about real change in organizations (Hervani, 2005).

- Performance measurement has many uses, including determining the efficiency and effectiveness of the current system or comparison with proposed alternative systems (Hervani, 2005).

- Performance measurement helps decision makers by providing information for decision making (Chen, 2002).

- Performance measurement provides a proactive approach that helps determine the success of existing strategies (Chen, 2002).

- Performance measurement helps improve supply chain management, achieve corporate goals, and improve the overall performance of the industry (Chen, 2002).

**Basic functions of performance measures:**

Melnyk et al., (2004) presented three basic functions for performance measures that can be illustrated as follows:

1. Oversight: means that performance measures enable managers to assess the current performance of the organization.

2. Communication: Achieving internal communication between the departments / departments of the functional organization, and external between the organization and its external partners.

3. Optimization and development: Performance measures help:

- Define the gap between actual performance and expected performance.

- Identify the causes of that gap.

- Take the correct measures necessary to reduce or prevent deviation from actual performance.

Several previous studies have addressed a variety of supply chain performance measures. Various researchers have attempted to measure the performance of the supply chain using a variety of methods and developed a variety of performance measurement models that will be illustrated as follows:

Lembert and Pohlen, (2001) presented a model to measure the performance of the supply chain called "Map Model-Framework" map measuring supply chain performance, this sample consists of the following steps:

1. Draw a map illustrating the key relationships between supply chain partners.



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2. Effective management of relationships with both suppliers and customers and clarifying ways of utilizing those relationships in creating value added to the supply chain in general.

3. Determine the impact of relationships with suppliers and customers on the profitability of the supply chain.

4. Reorganize the processes and activities of the supply chain to become more integrated (supply chain integration processes).

5. Balancing financial and non-financial performance measures.

Hale and Moberg, (2005) carried out in a case study on the supply chain in North America. It was applied in the form of a case study on Ford Motor Company which developed an integrated system for the implementation of the supply chain management and measuring its performance through the establishment of partial measures of chain activities and control through the following:

- Establishment of new systems for forecasting and inventory planning.

- Establish a system for selecting suppliers and contacting them.

- Reduce the stock size to one-third.

- Registration of customer service levels.

- Implement a system to monitor the performance of suppliers.

Prior to considering the proposed system to measure the performance of the supply chain, Ford faced major problems, including the lack of integration and integration of data and decision-making information in the areas of procurement, supply, distribution and termination of customer orders.

The results of the study were to reach specific measures in the fields of supply chain:

- Measures related to delivery performance.

- Inventory reduction measures.

- Delivery time standards.

- Measures related to productivity and cost of operations within the supply chain.

Thakkar et al., (2009) presented some of the characteristics of the performance measures used in measuring the performance of the supply chain, including:

- The measurement system should have the ability to allocate appropriate measures to the supply chain strategy.

- There should be no deviation between supply chain objectives and measurement objectives.

- Performance measures should reflect a sufficient balance between financial measures and non-financial measures.



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- Standards should reflect the relationship between different levels of strategic decision-making, tactical and operational.

Thakkar et al., (2009) described the process of measuring the performance of the supply chain as a difficult process, as it affected many aspects of the organization and the environment.

The study pointed to the importance of measurement clarity for supply chain partners. The study presented several measures to measure the performance of the supply chain, including:

1. Supply chain costs.

2. Level of services provided to customers.

3. Efficiency in asset management.

Bigliardi and Bottani, (2010**)** used the Balanced Score Card methodology in measuring supply chain performance. This study pointed out that:

- Balanced Scorecard is one of the modern administrative methods and techniques that contribute to performance control. It is an administrative system and a strategic plan to evaluate the activities and performance of organizations according to their vision and strategy.

- Balanced Scorecard aims at balancing financial and non-financial measures, short-term objectives, long-term goals, and internal and external perspectives

- Balanced Scorecard is a way to link performance indicators with the organization's strategy. Therefore, if there is no clear strategy, a balanced performance card will not work.

- This card is considered a means to set balanced goals only and therefore if not accompanied by the application of management policies for development will fail.

Leuschner et al., (2013) showed that there are three components of organizational performance:

1. Financial performance: includes the return on investment, return on assets and market share.

2. Non-financial performance: It relates to meeting customer needs and expectations.

3. Operational Performance: It focuses on discovering the evolution of the organization's capabilities in terms of quality, flexibility and delivery.

Several studies have addressed the measurement of supply chain performance. Many researchers have tried to measure supply chain performance in multiple ways and have developed a variety of performance measures. The Kurien and Qureshi (2011) study gave a detailed account of previous studies that measured the performance of the supply chain and presented performance measures used in supply chain models. The Supply Chain Operations Reference (SCOR) model developed by Supply Chain Council (1996) is among the most widely used supply chain performance metrics among all models developed to measure performance Supply chain, where: (Mentzer and Konrad, 1991; Ren, 2008; Theeranuphattana and Tang, 2008; Kurien and Qureshi, 2011; Sindhuja, 2014)

1. Provide a scientific framework that takes into consideration the performance requirements of the member organizations in the supply chain.


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2. The model considers supply chain activities as a set of joint and inter-organizational processes.

3. Interested in the integration and communication between the members of the supply chain.

4. The model provides management practices that produce the best performance.

5. The model is concerned with measuring the performance of the supply chain through the use of multiple dimensions including (Sindhuja, 2014):

a. Reliability on the supply chain SC reliability: produced by delivering the right product in place and at the right time, packaged and packaged in the right quantity and presented to the right customer.

b. Supply Chain Response SC Responsiveness: means the rapid delivery of products to customers.

c. Flexibility Supply Chain SC Flexibility: The supply chain response to market changes in order to achieve competitive advantage and maintain.

d. Cost of Supply Chain SC costs: Include the costs associated with the work of the supply chain.

e. Efficient Assets: Means the effectiveness of organizations in asset management to achieve customer satisfaction.

6. The model considers the performance of the supply chain as efficient in terms of optimal utilization of resources, and effective in terms of achieving supply chain objectives (Ren, 2008).

## THEORETICAL FRAMEWORK AND HYPOTHESES DEVELOPMENT

Depending on Russell and Saldanha, (2003), study has considered supply chain operations dimensions which include SC robustness. This study used the framework developed by SCOR (Stephan, 2001; Stewart, 1995) for measuring supply chain performance as it is found more relevant for study. The conceptual model is represented in Figure: 4**.**

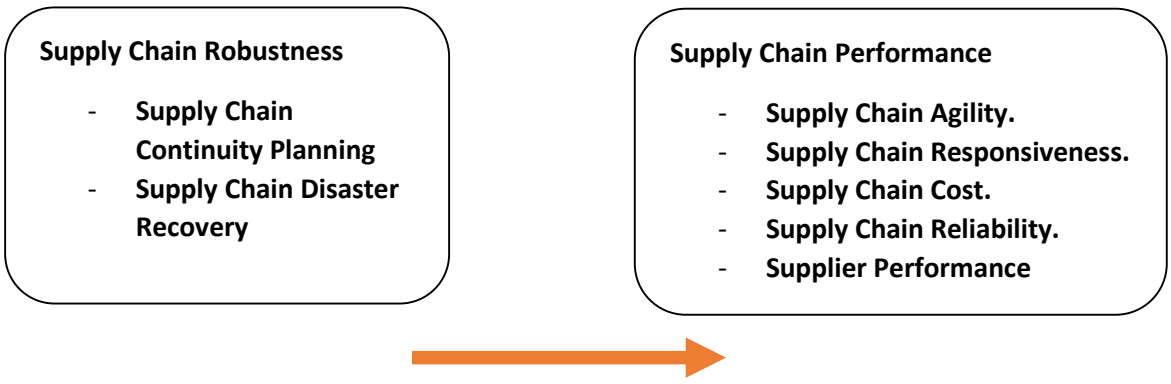


**Fig. 4. The conceptual model**



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**Hypothesis**:

In the light of study model described in Figure 4, we can identify relationship to be tested, which was formulated in the following hypothesis:

**The main hypothesis**: Supply Chain Robustness has a positive impact on supply chain performance.

## RESEARCH LIMITATIONS/ IMPLICATIONS

The limits of research include both the scientific boundaries "which are related to the methodology of research and its variants" and the practical limits "which are specific to the practical field of study," as can be seen in the following detail:

**Scientific Limits of research:**

b. Research focused on study the impact Supply chain robustness on supply chain performance Which includes supply chain agility - supply chain reliability - supply chain costs - supply chain responsiveness - supplier performance). As well as the impact of supply chain operations on their performance.

**Practical Limits of research**: research was limited to companies that are located in different nodes along the supply chain of the Egyptian automobile industry. These companies are represented in:

- Manufacturers and assemblers of automotive.
- First and second tier suppliers.
- Distributors (agents i.e.: sales - spare parts).

**The Egyptian Automobile Industry and its Supply Chain:**

The automotive industry is one of the pillars of industrial development as it is one of the largest assembly industries that rely on a wide range of feed industries belonging to several different types of industrial activities. The automotive industry is one of the most influential industries in supporting the economies of countries, especially the countries that export abroad, whether in the form of full-fledged cars or in the form of components, parts and spare parts. The last decades of the last century witnessed an unprecedented increase in the number of vehicles worldwide, Statistics indicate that the number of cars in all countries of the world reached the end of the last century (641) million cars and is expected to reach this number to about one billion cars by 2020 (Report of the Egyptian Association of Automotive Feeding Industries, 2014).

Success of the automobile industry in any country depends mainly on its success in providing the right environment for feed industries. Feeding industries are the backbone of the automotive industry and are a small industry that serves a large industry. Creating demand for both production and spare parts. The automotive industry as a manufacturing industry depends on a wide range of feeder industries that belong to all types of industries (metal, chemical, engineering, electrical, electronic, textile and leather). The industries that feed the automotive


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industry in Egypt include a wide industrial base and the state is keen to develop nutritious industries The creation of new jobs, the provision of foreign exchange and the formation of a strong industrial base that contributes to the increase of national output (Report of the Egyptian Association of Automotive Feeding Industries, 2014).

The number of companies producing cars of different types in Egypt (21) companies other than the processing of cars and the construction of the external structure, which produces different types of cars, including cars of various capacities, and buses and ordinary and tourist, minibuses and light, medium and heavy transport vehicles (Report of the Egyptian Association of industries feeder cars, 2014).

The automobile industry in Egypt began in the fifties of the last century through Al-Nasr Automotive Company, which was owned during that period of the state within the framework of the socialist system based on customs and legislative protection to protect the fledgling domestic industry that is to support the Egyptian national economy. (Industrial Modernization Program IMC, 2005)

Al-Nasr Automotive Company was established in 1957 by a ministerial committee which included the formation of a committee comprising the Ministry of War and the Ministry of Industry to establish the industry of lorries and buses in Egypt. International companies were invited to complete this project. Deutsche Bank, now known as Dietz AG, has successfully assembled Fiat in Egypt and produced several locally assembled models with a total of 19 models. (Industrial Modernization Program IMC, 2005)

With the transformation of the Egyptian economy into a free market and dependence on the private sector to build modern industry, the government shifted from a full protection system to a policy of privatization by relying on private companies and encouraging investment to advance and develop the Egyptian economy and local industry (IMC, 2005).

The new strategy for cars is to shift from assembly to full car manufacturing and to increase the local component ratio and reach the domestic manufacturing rate within cars from 45% to 60%. And the start of large factories and production units and the exploitation of large production savings for export, especially in the automotive component sector, which can compete strongly in many foreign markets. (Adel, 2015)

Egyptian engineering industries have the potential and capabilities to achieve successes at the local and global levels.

## RESEARCH METHODOLOGY

### Research Sampling

The target population of this research was: All organizations working in the automotive industry–throughout its three main sub-sectors – in Egypt (i.e., an example of a manufacturing industry); namely manufacturers/assemblers of the auto feeding and automotive industries and CBU importers and distributors. A total of 101 automotive firms were contacted of which 90 accepted to participate).


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**Unit of Analysis**

All the auto-feeding and automotive organizations which working in Egypt and implementing or partially implementing SCM practices– represented by individuals (e.g., leaders, managers and specialists) that are responsible in the area of study (e.g., SCM, ICT, and research and development (R&D) activities in these companies).

With respect to the first sector (i.e., automotive industry), probability simple random sampling technique was used as this study targeted the entire population (i.e., 101 automotive firms were contacted through email and/or phone) of which 84 accepted to participate through face-to-face depth interviews, resulting in a response rate of 89.16%. Despite being characterized by a small population size, the companies of this industry are physically dispersed at various governorates in Egypt and virtually located at different positions (i.e., multiple nodes/heterogeneous) across the same SC, which made the data collection process an extremely difficult yet value-adding one.

**Data Collection**

Primary data collected (using triangulation design) was mainly based in part on direct/personal semi-structured in-depth interviews (qualitative data) and in part on questionnaires (quantitative data). A mixed methods approach was used in the data-collection phase to understand, map out and investigate from different standpoints

(a) the research problem and proposed relationships.

(b) the nature of the Egyptian automotive industry.

Study combines qualitative and quantitative approaches:

First, the researcher began to follow the qualitative approach, which depends on study and reading of data and events in a non-quantitative manner, where the data is not converted to numbers as in the case of quantitative research, but the results are obtained from the observation and analysis of events and attitudes and documents and verbal and nonverbal communication in the search, The qualitative research depends on the use of the inductive method, which is based on starting or thinking of the finished part to the whole, where the researcher starts from the data collected or observations that he observed to reach certain results (Zikmund and William, 2000). This means that hypotheses and theories are derived from the data set Praised the process of data collection and after analysis, researcher examines the data here for the purpose of description and knowledge of virtual relationships between phenomena, and then returns to the community of study or place their application to collect data to test hypotheses. The qualitative research was carried out through five in-depth interviews, which helped the researcher to gain an in-depth understanding of the underlying causes of the research problem and to discover the nature of the automotive industry in the Arab Republic of Egypt.

Secondly, the quantitative part of the survey was conducted in order to measure the data collected through the questionnaire lists and then to perform quantitative statistical analysis in order to analyze and interpret quantitative data and prepare recommendations. Quantitative research aims to test the theories in a standard way, through the identification of the theory already existing in the previous literature, obtaining the necessary concepts and definitions, and then assuming the relationships between variables and data collection and analysis



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statistically, and in the light of the results reached by the researcher is accepted or Refusal or modification of the theory.

**Questionnaire Development**

The questionnaire list, which includes a set of terms that measure the variables of study based on the five-dimensional Likert scale, is designed to identify the impact of effective implementation of information security initiatives on both supply chain operations and performance. The required data have been translated into questions that help answer them in providing the necessary data for study

Measurement items used in this study were either developed from literature or adopted from previous studies. Identification and validation of newly generated items were done in two stages:

Item generation through literature review

Pilot testing using Q-sort methodology

In the first stage, potential items were generated through an extensive literature review which helped in identifying the content domain of the major constructs. This also helped in the generation of initial items and the definition of the constructs. The initial pool of items was reviewed by academic and industry experts.

During the second phase, the items were pilot tested using Q-sort methodology (Nahm et al., 2004). The pool of items was subjected to three sorting rounds to ensure that each item was placed under right constructs.

**Survey Administration and Sample Demographics**

Transactions of credibility and consistency: The Cronbach alpha coefficient was used to measure the stability coefficient (reliability score) at the level of all variables related to the impact of the effective implementation of information security initiatives on the performance of the supply chain. The internal consistency coefficient of the data was also measured.

**Results of stability and validity tests for the dimensions of effective implementation of information security initiatives:**

The results of the following table indicate the following:

The validity of all items at the level of the total dimensions where the internal consistency coefficients at the level of (0.01) These ranged between (0.52 to 0.91), which reflects the strength of the values of the transactions and their proximity to the correct one, the relationship between the different dimensions and the extent to which they represent the dimensions of the supply chain robustness, which greatly reflects the degree of credibility of these dimensions.

Based on 90 responses, all the constructs were tested for reliability, unidimensionality and validity.



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**Table 1: The validity and reliability results of the variables (supply chain robustness) as a dependent variable using the Cronbach alpha coefficient and Pearson correlation**

| sentences | Internal consistency coefficient | Cronbach alpha |
|---|---|---|
| Our organization documents actions to be taken in the event of emergencies or problems, which cover the communication crisis, business processes and recovery once again. | 0.70** | 0.881 |
| Our organization has a written plan for recovering systems, data and communications after security problems occur. | 0.57* | |
| Our organization has a regular schedule of periodic maintenance of all components of the business continuity plan. | 0.78** | |
| Our organization can return to operations in a short time, if a major security breach occurs for the supply chain information security system. | 0.86** | |
| Our organization takes action to ensure that the following core processes are quickly resumed following system failure / disruptions | 0.73** | |

**** Indicates a significant level of 0.01**

*** Indicates a significant level of 0.5**

**Table 2: The validity and reliability results of the variables (supply chain performance) as a dependent variable using the Cronbach alpha coefficient and Pearson correlation**

| sentences | Internal consistency coefficient | Cronbach alpha |
|---|---|---|
| supply chain responds to changes in market demand without a surplus or a shortage of inventory. | 0.88** | 0.860 |
| supply chain benefits from the various competencies of partners to quickly respond to market changes | 0.54* | |
| Supply chain is able to predict demand in the market | 0.60** | |
| Supply chain reduces supply periods. | 0.76** | |
| The supply chain ensures a reduction in time that does not create added value in production lines. | 0.75** | |
| The supply chain ensures coordinated flow of operations along the supply chain. | 0.69** | |
| Supply chain system increases the rate of saturation of applications. | 0.89** | |
| Supply chain system reduces the safety stock. | 0.69** | |
| Supply chain system reduces inventory obsolescence. | 0.92** | |
| Supply chain system increases inventory turnover rate. | 0.59* | |


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| | | |
|---|---|---|
| The supplier companies - our partners - deliver timely delivery of each of the materials / components / products. | 0.67** | |
| Our suppliers - our partners - deliver quickly. | 0.60** | |
| Our suppliers - our partners - deliver high quality. | 0.73** | |
| The supply chain system achieves a reduction in outbound and outbound costs. | 0.88** | |
| The supply chain system achieves a reduction in storage costs. | 0.87** | |
| The supply chain system achieves a reduction in inventory retention costs. | 0.60** | |
| Achieves supply chain system reduced product warranty use. | 0.61** | |
| The supply chain executes orders during a relatively short supply period. | 0.79** | |
| The supply chain shortens the delivery cycle of customer orders. (The difference between receiving the order from the customer and shipping it to him permanently). | 0.77** | |
| The supply chain is characterized by fast response to customers. | 0.80** | |

**** Indicates a significant level of 0.01**

*** Indicates a significant level of 0.5**

**Table. 3: Simple linear regression model to determine the significance of the impact of supply chain robustness on supply chain performance**

| **Independent variable** | **Estimated parameters** $\beta_i$ | **t. test** | | **F. test** | | **$R^2$** | **r** |
|---|---|---|---|---|---|---|---|
| | | **Value** | **significant** | Value | significant | | |
| **Constant part** | 0.765 | 3.252 | **0.01 | 45.800 | 0.001** | %61.5 | 0.784 |
| **Supply chain robustness** | 0.493 | 6.692 | **0.01 | | | | |

**** Indicates a significant level of 0.01**

**From the previous table it is clear:**

**1 - Factor (R2):**

We find that the independent variable total indicators (supply chain robustness) accounts for (61.5%) of the total change in the dependent variable (supply chain performance). The rest is due to random error in the equation or perhaps not to include other independent variables that should have been included in the model.

**2- Testing the significance of the independent variable:**

Using the choice of T. test, we find that the independent variable, the total supply chain indicators, has a significant effect on the performance of the supply chain, with a value of (6.692) at a level less than (0.01).



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**3 - Test quality of the regression model:**

To test the overall quality of conciliation of the model as a whole, the F-test was used. Since the value of the F-test is 45.800 and it is significant at a level less than 0.01, Supply.

**4- Test the modality of the dependent variable:**

From the regression assumptions, the errors are distributed by a standard normal distribution with an arithmetical mean (zero) and a deviation of 0.99 standard, as is evident when drawing the histogram for standard linear regression errors.

**- Hypothesis:**

The major hypothesis, which states that "supply chain robustness have a positive impact on supply chain performance" is accepted.

**Results of Hypothesis:**

Result of hypothesis was found to be positive and significant. This is because improved supply chain management practices improve supply chain performance. In addition, this finding confirms the fact that a well-secured supply chain directly leads to enhanced and improved supply chain performance.

## RECOMMENDATIONS

Based on the prior research literature and the conducted qualitative/quantitative data analysis for the current research, the findings of this thesis have different implications for the leaders of various Automotive supply chain nodes/stakeholders in Egypt:

a. It is possible for the managers of the Egyptian automotive supply chain to benefit from the proposed model by the researcher in trying to work on the supply chain robustness, which improves the performance of the supply chain in general.

b. Egyptian automotive supply chain managers can take care of implementing an integrated portal that combines physical and technical security to protect information assets from unauthorized access, disclosure, data modification or destruction by setting up the correct password mechanisms and keeping copies Additional and maintain network security.

c. The supply chain needs to benefit from the different competencies of partners in order to achieve rapid response to changes in the market.

d. The importance of supplying the automotive industry partners with high quality delivery.

e. The need to reduce the supply chain system for both incoming and outgoing costs.

## FUTURE SCOPE

Researcher proposes the following points to guide other researchers as areas for future research:



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1. The impact and interaction of several variables such as the size of the organization, the structure of the organization and the complexity of information technology in the application of supply chain operations between organizations.

2. The impact of the educational level and the age of supply chain managers on the extent to which they accept the application of supply chain robustness.

3. The impact of the supply chain robustness on supply chain performance to companies working in other industrial sectors and companies that have worked in the service sector and to know the impact on supply chain performance.

## REFERENCES

Adel, H., (2015), "The impact of information and communication technology (ICT) and Technology intelligence (TI) on the performance of the lean, agile and leagile supply chains: A comparative study", *Doctor of philosophy Thesis, Cairo University, Faculty of Commerce.*

Altay*, N. and Green, W.G. (2006), "OR/MS research in disaster operations management", European Journal of Operational Research, Vol. 175 No. 1, pp. 475-93.*

Anand*, N. and Grover, N. (2015), "Measuring retail supply chain performance", Benchmarking: An International Journal, Vol. 22 No. 1, pp. 135-166.*

Balcik, B. and Beamon, B.M. (2008), "Facility location in humanitarian relief", International Journal of Logistics: Research & Applications, Vol. 11 No. 2, pp. 101-21.

Bigliardi, B. and Bottani, E. (2010), "Performance measurement in the food supply chain: A balanced scorecard approach". *Facilities*, Vol. 28 No 5, pp. 249-260.

Blecken, A. (2010) "Supply chain process modelling for humanitarian organizations", *International Journal of Physical Distribution & Logistics Management*, Vol. 40 Issue: 8/9, pp.675-692

Butler, S. (2013), "Analysis: horse meat scandal delivers supply chain lessons", Retail Week, 21 February, available at: www.retail-week.com/analysis-horse-meat-scandal-deliverssupply-chain-lessons/5046419.article (accessed 29 April 2013).

Capsplar, D. (2012), The cost of downtime is rising, available at: http://blogs.abardeen.com/it-infrastructure/the-cost-of-downtime-is-rising./accessed on September 2017.

Chen, F. (2002), "Information sharing and supply chain coordination". Working paper. Graduate School of Business, Columbia University, New York, NY.

Chia, A, Goh, M. and Hum, S. (2009), "Performance measurement in supply chain entities: Balanced scorecard perspective". *Benchmarking*, Vol.16 No.5, pp. 605–620.

Chowdhury, M. and Quaddus, M. (2016) "Supply chain readiness, response and recovery for resilience", *Supply Chain Management: An International Journal*, Vol. 21 Issue: 6, pp.709-731

Cooke, J.A. (2003), "Want real collaboration? Change your measures", *Logistics Management Highland Ranch*, Vol. 42 No. 1, pp. 37-41.

Cruz, G. (2016) "Project risk planning in high-tech new product development", Academia Revista Latinoamericana de Administración, Vol. 29 Issue: 2, pp.110-124.

Dhillon, G. (2007), *Principles of Information Systems Security: Text and Cases*, John Wiley and Sons, New York, NY.



ISSN 2054-0930 (Print), ISSN 2054-0949 (Online)

Garango, P. and Bititci, U. (2007), "Towards a contingency approach to performance measurement: an empirical study in Scottish SMEs", *International Journal of Operations and Production Management*, Vol. 27 No. 8, pp. 802-825.

Hair, J.F. and Anderson, R.E. (1995), *Multivariate Data Analysis*, Prentice Hall, Upper Saddle River, NJ.

Hale, T. and Moberg, C.R. (2005), "Improving supply chain disaster preparedness – a decision process for secure site location", International Journal of Physical Distribution & Logistics Management, Vol. 35 No. 3, pp. 195-207.

Helferich, O.K. and Cook, R.L. (2002), Securing the Supply Chain: *Management Report*, CLM Publications, Oak Brook, IL.

Hervani A.A., Helms, M.M. and Sarkis, J. (2005)," Performance measurement for green supply chain management". *Benchmarking*, Vol.12 No.4, pp. 330–353.

Industrial Modernisation Programme (2005), ―Strategic study to upgrade Egypt's automotive sector‖, Industrial Modernisation Centre, Cairo.

Kajüter P. (2002) Proactive Cost Management in Supply Chains: Cost Management in Supply Chains. Physica, Heidelberg © Springer-Verlag Berlin Heidelberg 2002.

Kurien, G.P. and Qureshi, M.N. (2011), "Study of performance measurement practices in supply chain management", *International Journal of Business, Management and Social Sciences*, Vol.2 No.4, pp. 19-34.

Lambert, D.M. and Pohlen, T.L. (2001), "Supply chain metrics". *The International Journal of Logistics Management*, Vol.12 No.1, pp. 1-19.

Large, R.O. (2005), "Communication capability and attitudes toward external communication of purchasing managers in Germany", *International Journal of Physical Distribution & Logistics Management*, Vol. 35 No. 6, pp. 426-44.

Leuschner, R., Rogers, D.S. and Charvet, F.F. (2013), "A meta-analysis of supply chain integration and firm performance*", Journal of Supply Chain Management*, Vol. 49 No. 2, pp. 34-57.

Martin, B. (2002), "Disaster Recovery Plan Strategies and Processes, SANS Institute InfoSec Reading Room.

Melnyk, S.A., Stewart, D.M. and Swink, M. (2004), "Metrics and performance measurement in operations management: dealing with the metrics maze". *Journal of Operations Management*, Vol.22 No.3, pp. 209-218.

Mentzer, J.T. and Konrad, B.P. (1999), "An efficiency/effectiveness approach to logistics performance analysis", *Journal of Business Logistics*, Vol. 12 No. 1, pp. 33-61.

Milliken, A.L. (2001), "Key ingredients of successful performance metrics in the supply chain", *The Journal of Business Forecasting Methods and Systems*, Vol. 20 No. 2, pp. 23-28.

Min, S., Roath, A.S., Daugherty, P.J., Genchev, S.E., Chen, H., Arndt, A.D. and Richey, R.G. (2005), "Supply chain collaboration: what's really happening", *International Journal of Logistic* Management, Vol. 16 No. 2, pp. 237-56.

Nahm, A., Vonderembse, M., & Koufteros, X. (2004). The impact of organizational culture on time-based manufacturing and performance. Decision Sciences, Vol.35 No. 4, pp. 579–608.

Natarajarathinam, M., Capar, I. and Narayanan, A. (2009). "Managing supply chains in times of crisis: Review of literature and insights." *International Journal of Physical Distribution and Logistics Management*, Vol. 39 No. 2, pp. 535-73.

Nijaz, B. (2014), "Business continuity management: a systemic framework for implementation", *Kybernetes*, Vol. 43No. 2, pp.156-177.



ISSN 2054-0930 (Print), ISSN 2054-0949 (Online)

Oloruntoba, R. and Gray, R. (2006), "Humanitarian aid: an agile supply chain?", Supply Chain Management, Vol. 11 No. 2, pp. 115-20.
Paulsson, U. (2007), "On managing disruption risks in the supply chain – the DRISC model", PhD dissertation, Lund University, Lund.
Rathbun, B.C. (2007), "Hierarchy and community at home and abroad", Journal of Conflict Resolution, Vol. 51 No. 3, pp. 379-407.
Ren, T. (2008), "Application of supply chain performance measurement based on SCOR model" International Conference on Wireless Communications, Networking and Mobile Computing, WiCOM 2008, 12 October 2008 through 14 October 2008.
Repoert of the Egyptian Association of Automotive Feeding Industries, 2014.
Richey, R.G. Jr. (2009), "The supply chain crisis and disaster pyramid: A theoretical framework for understanding preparedness and recovery", *International Journal of Physical Distribution & Logistics Management*, Vol.39 Issue: 7, pp. 619-628.
Russell, D.M. and Saldanha, J.P. (2003), "Five tenets of security-aware logistics and supply chain operation", *Transportation Journal*, Vol. 42 No. 4, pp. 44-54.
Scholten, K., Scott, P. and Fynes, B. (2014) "Mitigation processes – antecedents for building supply chain resilience", *Supply Chain Management: An International Journal*, Vol. 19 Issue: 2, pp.211-228,
Sindhuja P.N, (2014), "Impact of information security initiatives on supply chain performance". *Information Management & Computer Security*, Vol.22 No5, pp. 450-473.
Skipper, J.B. and Hanna, J.B. (2009), "Minimizing supply chain disruption risk through enhanced flexibility", *International Journal of Physical Distribution & Logistics Management*, Vol. 39 No. 5, pp. 404-427.
Stephens, S. (2001), "The supply chain council and the supply chain operations reference (SCOR) model: integrating processes, performance measurements, technology and best practice", *Annals of the Logistic Spectrum*, Vol. 34, pp. 16-18.
Stewart, G. (1995), "Supply chain performance benchmarking study reveals keys to supply chain excellence", *Logistics Information Management*, Vol. 8 No. 2, pp. 38-44.
Thakkar J, Kanda A and Deshmukh S.G. (2009), "Supply chain performance measurement framework for small and medium scale enterprises". *Benchmarking*, Vol. 16 No.5, pp.702–723.
Theeranuphattana, A. and Tang, J.C.S. (2008), "A conceptual model of performance measurement for supply chains: Alternate considerations". *Journal of Manufacturing Technology Management*, Vol.19 No.1, pp. 125–148.
Waugh, W.L. Jr (2000), Living with Hazards, Dealing with Disasters: An Introduction to Emergency Management, M.E. Sharpe, Armonk, NY.
Whalen, J. (2002), "Weighing in on performance measurements", *Logistics Management and Distribution Report*, Vol. 41 No. 5, pp. 33-37.
Zikmund and William G. (2000), *Business Research Methods*, Fort Worth: The Dryden Press.


ISSN 2054-0930 (Print), ISSN 2054-0949 (Online)