

An integrated approach for corporate risk evaluation using AHP (Analytic Hierarchy Process): case based analysis

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Abstract:

Risks are inherent in every aspect of business, and the ability to manage risk is one of the important aspects that distinguish successful business leaders from others. Risk management systems developed after 11 September 2001 American attacks, and the bombings of the Spanish and British transportation systems. Risk management is a systematic activity that is used to direct organization to take advantage of opportunities and avoid threats. To build an effective risk management corporate top management must support this direction through encourage rigorous and forward thinking, accountability and authority for decision making, effective communication system, balanced thinking. The successful risk management framework facilitates effective decision making. Risk management must be one of the organization processes.

Risk ISO standard defines risk as “the effect on uncertainty on objectives” this definition is divided into 3 parts first each corporate needs to define objectives at all levels “strategic- tactical - operation”, second define uncertainty and measure uncertainty which is equal to multiplying probability of occurrence and the effect of uncertainty on achieving objectives, third part of definition is this effect may be positive at opportunity or negative at threats. There are many types of risk sources but we can classify them generally into external and internal sources of risk. The current paper introduces a general framework for ERM using six-sigma process. The six-sigma methodology relies mainly on two processes. The first is the DMAIC process that signifies five steps (Define, Measure, Analyze, Improve and Control). The DMAIC process can be adopted for any service or manufacturing process. The second methodology is the DMADV that signifies five steps (Define, Measure, Analyze, Design and Validate). This process concerns with the design of new processes or products. The DMAIC process was validated by massive number of applications e.g. product quality improvement, production waste reduction, etc. Here, it is adopted as a conceptual framework for managing enterprises risk problem. Moreover, the proposed framework was used to guide a large organization located in Egypt to adapt and apply the ISO 31000:2018 ERM framework successfully. Besides, the risk matrix used to assess risks at each department and the associated targets for each risk type (risk appetite) are developed successfully.

The case study will be applied at El Araby Group one of the important corporates in Egypt to build risk framework on supply chain process to manage risks in a proactive, professional and

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effective manner this will be done by a team and the results of this team will be presented at this paper

Keywords: *corporate, supply chain, risk management, response plan – risk matrix - multi criteria risk assessment - risk appetite).*

1.INTRODUCTION

Risk ISO standard define risk as “the effect on uncertainty on objectives” which means that each corporate need to define objectives at all level “strategic- tactic - operation” then define uncertainty then measure uncertainty by probability of occurrence and the effect of uncertainty on achieving objectives, this effect may be positive at opportunity or negative at threats. There are many types of risk sources but we can classify them generally to external and internal sources of risk.

Risk management is a systematic activities that used to direct organization to take advantage of opportunities and avoid threats .Managing risk requires rigorous and forward thinking, accountability and authority for decision making, communication, balanced thinking. The successful risk management process facilitate effective decision making. Risk management must be one of the organization process. It is an important issue to determine the risk appetite for each type of risk before establish response plan to deal with. To build an effective risk management process corporate need top management commitment.

Risk management process is different from standard to other but the main process of risk management is:-

- 1-Study the internal and external issue that have an effect on organization objectives.
- 2-Risk identification to identify uncertainty cases, risk sources, an event which cause risks, describe likelihood and consequence.
- 3-Risk analysis is a process to comprehend the nature of risk and to determine the level of risk, provides the basis for risk evaluation and decisions about risk treatment.
- 4-Risk evaluation involves comparing estimated levels of Risks to determine the significance of the level and type of risk and rearrange risks according to risk level.
- 5-Risk treatment for threats there is four strategy (avoid – mitigate – transfer – accept) and for opportunity risk manager can use one or more type of this strategy (Exploit – Enhance – Share – accept).
- 6-Monitoring and review to likelihood and consequence because it changes by time and to repeat risk management cycle.
- 7-Communication and consultation with Internal and External Stakeholders to Improve Understanding of risks and risk management Process and ensure all participants are aware of their roles and responsibilities.

Formerly, risk has been managed for a while in a random manner regardless of its importance. But recently, the importance of risk management was recognized and many international organizations are started to develop a standardized process for risk management. As example: ISO 31000: 2009 and it’s new release ISO 31000:2018, which outlines the process of implementation of risk management. In this standard a conceptual approach to develop comprehensive enterprises risk management (ERM) practices in an organization is provided (Gjerdrum and Salen, 2010). Practitioners were expected to “adapt and not adopt” the ISO 31000 ERM process according to their organizations’ risk management needs (Frigo and Anderson, 2014). However, the ISO 31000 ERM process has been criticized as being overly

abstract and is confusing in many of its terms and definitions in ERM by both practitioners and researchers (Gorzen-Mitka, 2013; Leitch, 2010). The industry's drive toward ERM is also being "viewed as a still developing process" (Frigo and Anderson, 2014). This makes adaptation of the ISO 31000 ERM process a challenge for most organizations.

Afterwards, the ISO 9001: 2015 and 14001: 2015 and ISO 45001:2018, which stated in clause 6.1 "To conform to the requirements of this International Standard, an organization needs to plan and implement actions to address risks and opportunities. Addressing both risks and opportunities establishes a basis for increasing the effectiveness of the quality environmental, health and safety management system, achieving improved results and preventing negative effects". All this standard recommend ISO 31000 to build risk frame wok

Lambert et al. define SCM as "the integration of key business processes from end user through original suppliers that provides products, services, and information that add value for customers and other stakeholders". These processes include not only traditional logistics activities such as warehousing, inventory management and inventory, and transportation, but also non-traditional activities such as procurement, production support, packaging, sales management, and customer sales order processing so Risk management in supply chains is a vital aspect for the enterprise survival and market gain.

In reasons of the highlighted issues in the previous standards, the current paper introduces a general process for ERM. The proposed approach relies on the integration between six-sigma process and ISO 31000 standard. The six-sigma methodology relies mainly on two processes. The first is the DMAIC process that signifies five steps (Define, Measure, Analyze, Improve and Control). The DMAIC process can be adopted for any service or manufacturing process. The second methodology is the DMADV that signifies five steps (Define, Measure, Analyze, Design and Validate). This process concerns with the design of new processes or products. The DMAIC process was validated by massive number of applications e.g. product quality improvement, production waste reduction, etc. Here, it is adopted as a conceptual process for managing enterprises risk problem. Moreover, the proposed process was used to guide an organization to adapt and apply the ISO 31000ERM process successfully. Besides, the risk matrix for each department and the associate targets for each risk type (risk appetite) are developed successfully.

2.LITERATURE REVIEW

Due to the importance of the subject many researchers attempt to provide risk management road maps that provide solution to how organizations can adapt and customize the ISO 31000enterprise risk management process to suits its needs and requirements (Bennie Seck-Yong Choo Jenson Chong-Leng Goh 2016).

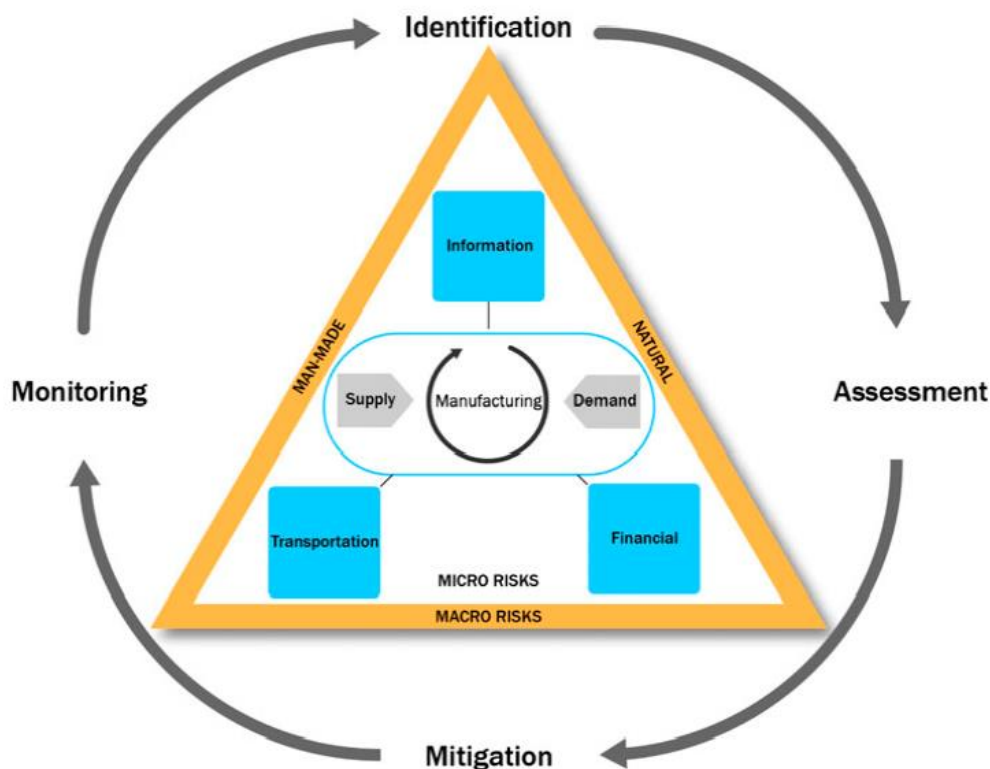
Another research introduce systematic process incorporates a wide range of evaluation criteria and still demonstrates clarity in risk level estimation, aggregation and prioritization in a manner that ensures repeatability. Precision of ranking is enhanced through a combination of actions; firstly, an updatable database is developed for failure modes, risk variables and parameters (Uzoma Okoro a, Athanasios Kolios a, Lin Cui 2016). Another research develop a risk management process, combined with Six Sigma tool and techniques, to help handle the undesired effects that can occur during the project Execution (Muhammad Usman Tariq 2013).

Proposed process for risk management depends on using DMAIC methodology. We first Define the external and internal issue that have an effect on corporate objective and goals. We then establish the suitable metrics to provide Measurement on the process. Next, we analyze the collected data to identify risks and its effect on objectives the output of analyzing process is causes and sources of risk, positive and negative consequences, the likelihood particular consequences will occur, factors affecting likelihood and consequence and the existing controls and description if it suitable to deal with risk or not. at Improve stage we consider the options for risk treatment, to increase process resilience to any variables. Finally, we continuously monitor the process deviation and institute corrective mechanisms to eliminate the deviations. This provides for mitigating the risk and delivering the product on time, achieving corporate objectives.

SCRM can be operationalized by a business continuity plan, or by a supply chain continuity planning process with four stages: awareness, prevention, remediation and knowledge management. Kleindorfer and Saad created a specific, three-step model. The three steps are denoted as SAM: Specifying sources of risk and vulnerabilities, Assessment, and Mitigation O. Lavastre et al. / Decision Support Systems 52 (2012)

Supply chain risks can be divided into two categories – macro-risks and micro-risks disruption and operational. Macro-risks refer to adverse and relatively rare external events or situations which might have negative impact on companies. Macro-risks consist of natural risks (e.g. earthquakes and weather-related disasters) and man-made risks (e.g. war and terrorism and political instability). On the other hand, micro-risks refer to relatively recurrent events originated directly from internal activities of companies and/or relationships within partners in the entire supply chain. Generally, macro-risks have much greater negative impact on companies in relation to micro-risks.

Furthermore, micro-risks can be divided into four subcategories: demand risk, manufacturing risk, supply risk and infrastructural risk. Manufacturing risk refers to adverse events or situations within the firms that affect their internal ability to produce goods and services, quality and timeliness of production, and profitability. Demand and supply risks refer to adverse events at the downstream and upstream partners of a firm, respectively. In order to ensure the healthy functioning of a supply chain, information technology, transportation and financial systems, are also of critical importance. Any disruptions in these systems can also lead to serious problems in a supply chain. Therefore, we classify the risks relating to these three systems as infrastructural risk as shown in figure () (William Ho, Tian Zheng, Hakan Yildiz & Srinivas Talluri 2015).



Risk management process in supply chains The risk management process can be performed in several ways. In general, it is split at least into three stages (identification, assessment, and mitigation). It usually starts with the risk identification and ends with risk mitigation. This indicates a proactive way of execution and an implementation of recovery plans. For instance, supply chain risk management approaches in this manner are illustrated by Hallikas et al (2004), Sodhi and Tang (2009), and Ziegenbein (2007).

- Risk management with Six-sigma process

Another distinctive characteristic of the approach of Christopher (2003) is that it relies on the six sigma process DMAIC (Define, Measure, Analyze, Improve, and Control). The DMAIC cycle is adjusted by changing the “Define” to “Identify” and “Improve” to “Reduce”. Relating the research areas risk management and quality management programs like total quality management (TQM) and six sigma is already supported by some researchers such as Lee and Whang (2005) and Tang (2006b). For instance, quality planning being a part of quality management is often connected to risk management. Quality planning relies on preventive thinking which is a proactive perspective in the research area of risk management.

Another innovative approach developed by integrating time horizons and all business views, i.e. strategic (long-term), tactical (mid-term), and operational (short-term), and thus providing a better responsiveness by adding additional reversal possibilities (feedback loops) Monika Weishaupt and Werner Jammerneegg (2010).

A. Chappell and H. Peck (2011) aimed to contribute to practice and theory by exploring whether six sigma methodologies could be applied usefully to reduce risk—in terms of process variability—in a military supply chain context.

3. The proposed integrated process

The proposed approaches relies on the integration between ISO 31000 and DMAIC process of six-sigma methodology.

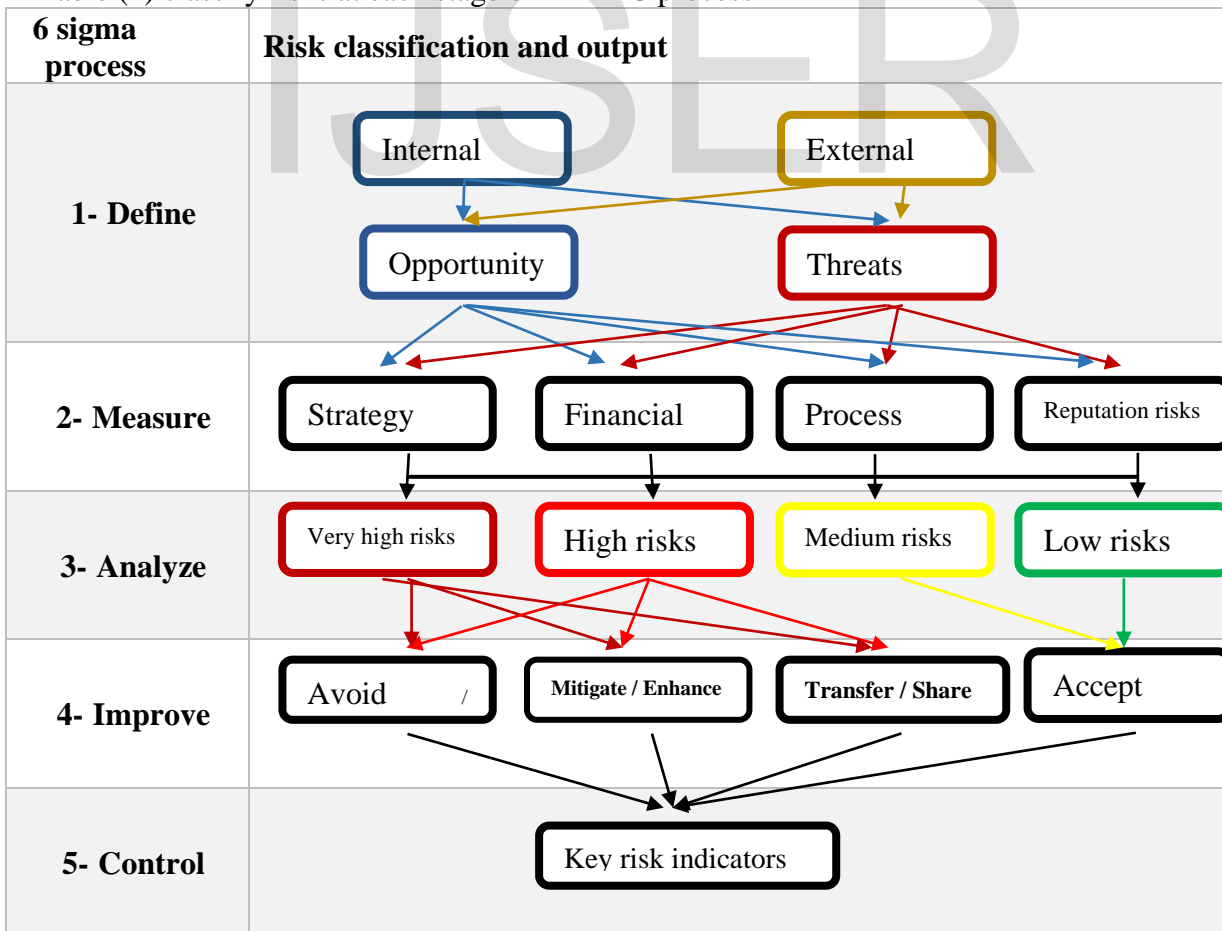
The following table shows how to merge between ISO 31000 and 6 sigma

Table 1: the proposed integration between ISO31000: 2009, DMAIC and MCDM

ISO 31000:2009	Equivalent process at DMAIC Process	Statistical tools used
• Establishing the context	1- Define	PESTEL Analysis – SWOT analysis- SIPOC - Voice Of the Customer
• Risk identification	2- Measure	Risk Matrix – multi criteria decision analysis
• Risk analysis • Risk evaluation	3- Analyze	Pareto, histogram, run chart, bar chart - Root Cause analysis.
• Risk treatment	4- Improve	Problems solution and the proposed action plan.
• Monitoring & review	5- Control	Key risk indicators, monitoring the implementation of action plan.
Communication & consultation		

We can classify risks at each stage of DAMIC process as the table below to clearly traceable risk from define process to put suitable response plan and at Improve process then put key risk indicator to predict the risk Occurrence probability. It is important to get feedback after the end of the improvement process from 3 to 6 months because risks changes with time so we must repeat this process dynamically.

Table (2) classify risks at each stage of DMAIC process



4. Real case study

4.1 Case background

The case we select for our case study is EL ARABY GROUP, it is one of the largest companies in the field of manufacturing electrical and home appliances in Egypt, and it was established in 1964. The company has been exposed to many risks such as the interruption of factories due to its dependence on import components from East Asia. When floods occur at East Asia, the raw materials and components supplier factories stopped, which led EL ARABY to diversify suppliers from different parts of the world. Another risk occur to EL ARABY, the company's operations stopped when the Egyptian government is exposed to the crisis of unavailability of dollar in 2016, forcing the company to change its strategy of depending on the sale of its products in the local market to export to provide the foreign currency.

Therefore it was necessary to develop a range of work within the company to manage risks in a proactive, professional and effective manner this will be done by a team and the results of this team will be presented below.

We will focus on supply chain management which include the major risks which lead to disruption.

Purpose of the Study

By the end of this study we can manage supply chain risks to achieve the result below:-

1. Reduce custom clearance lead time
2. Deliver goods to customer within suitable time
3. Collect return goods from customer within suitable time
4. Manage warehouse spaces efficiency
5. Develop a risk management frame wok
6. Develop action plan for each risk type, key risk indicators and monitoring methodology

5. Applying DMAIC process to manage risks

5.1 define

To define risks, we can separate risks to external and internal risks.

A.External risks

By using PESTEL analysis we can summarize company external environment as below.

A.1 Political condition key points:-

1-after presidential elections in 2018, which cause stability at the internal situation of the country and improve the economic conditions which seen at the decline in the foreign exchange rate, decrease in inflation rates, attracting foreign investment to Egypt after the issuance of the new investment law and the government's attempts to reduce the unemployment rate High rates of growth.

2. The improvement of Egypt's external relations with most countries of the world, especially the African countries, East Asia, the Brix States and the United States of America, contributes to attracting more foreign direct investments.

3- Combat terrorism in all its forms through Egypt's participation in the UN Security Council, to try to fight the financing of terrorists, to strike places of training and to try to change the minds of young people by changing religious discourse.

4- The IMF said that the floating of the pound, which took place in November 2016, had a negative effect on fuel subsidies. The IMF said that the government must raise subsidies before the start of the new fiscal year 2018/2019.

A.2 Economic conditions

The most important economic performance indicators which reflect how the economy is improving

1. GNP for 2018-2018: \$ 251 billion (positive indicator)
2. Exchange Rate Pound vs. Dollar in the Official Market: EGP 16.19 (Nov, 2019) (positive indicator)
3. Exports of goods reached 25.8 billion dollars (FY2018) (positive indicator)
4. Imports of goods: \$ 63.5 billion (FY2018) (**negative indicator**)
5. Direct Investments: US \$ 39 billion (2018) (positive indicator)
6. Net cash reserve of US \$ 45.2 billion (end of Oct. 2019) (positive indicator)
7. Inflation: 4.8% Sep. 2019 (positive indicator)
8. Credit Rating: Fitch B2 (Stable) (positive indicator)
9. Total external debt: 108.6 (June 2019) (**negative indicator**)
10. Egypt at global competitiveness report (93/141) (2019) (positive indicator)

A.3 Social factors

- The population of Egypt in the latest statistics in October 2019 was 99.4 million.
- The increase of annual population rate is 2 million /year in Egypt.
- Number of Egyptians living abroad is 9.5 million.
- No. of population of Egypt less than 15 years 34.2%.
- number of households is 23.5 million households at 2017 compared with 9.7 million households in 1986

A.4 Environmental factors

Decree of the Council of Ministers No. 1963 issued on 6 September 2017, which provided for some amendments to the Regulations of the law of the environment to reduce the high pollution rates in Egypt and

A.5 Legal Factors

It is the Laws and legislations that have been issued and have an impact on the scope of the company's business such as: -

- Investment Guarantees and Incentives Law (Law No. 72 of 2017).
- The Law of Facilitating Procedures for Granting Licenses to Industrial Establishments (Law No. 15 of 2017) and it's Implementing Regulations.
- Regulations of the Importers Registry Act.
- Amend the rules of implementing the provisions of the Import and Export Law No. 118 of 1975
- the protection of competition and the prevention of monopolistic practices (2019)
- Executive Regulations of the Consumer Protection Law (2019).
- The new investment law (2019).
- African Union Agreement (2019).
- Law regulating the use of non - cash payment (2019).
- Law on the organization of industry associations and chambers of industry (2019).

B. Internal process

To define the internal process, we can use the following tools

B.1 draw SIPOC analysis as below for each process

supplier	Input	process	output	customer
1-market research 2- sales	1- market share 2- market size	marketing	1- sales plan 2- production plan	1- planning
1- marketing	1- production plan	planning	1- production plans 2- material requirement plan	1- manufacturing 2-procurement
1- planning	1- material requirement plan	procurement	1- purchase order	1-supplier
1- procurement	1- purchase order	SUPPLIER	1- component delivery at suitable time	1-logistics
supplier	1- component delivery at suitable time	logistic	1- translate product from supplier to company warehouse	warehouse
logistic	translate product from supplier to company warehouse	warehouse	receive component and store it and provide it to product line at suitable manner	manufacturing
warehouse planning	component production plan	manufacturing	final product	final product warehouse
manufacturing	final product	warehouse	store product and transfer it to dealers	dealers sales man
marketing warehouse dealers	sales plan inventory dealer requirement	sales	sales order	dealers

B.2 Voice of customer to as below

Process	Business Related Parties		KPI's	Target
	Service Provider	Customer		
Product Supply Chain	Purchases	Production Planning	Raw Material & Component Delivery Lead Time	30 ~120
			% Of accuracy for Raw Material & Component Quantity	100%
			% of commitment for Standard Packing QTY	100%
			% of commitment for Minimum order QTY	100%
	International Logistics	Purchases	Demurrage & Storage Fees	Zero
			Factory Arrival Date	5 days before montly production
Storing Goods	FG Warehouse	Marketing	% of storage space utilization	100%
			Product damage inside warehouse (PPM)	50 PPM
	Transportation	Factories	No. of Factory lines' stops due to delay of transferring FG to Warehouse	Zero
Deliver Goods to Customer	Transportation	Sales	Delivery Orders Lead Time	3 days
	Transportation	Sales	Product damage during delivery (PPM)	50 PPM

5.2 measure

Risk assessment

Risk evaluation involves comparing estimated levels of risks to determine the significance of the level and type of risk to make decisions about future actions.

- Whether a risk needs treatment
- Priorities for treatment
- Which option to choose
- Whether an activity should be undertaken
- Which of a number of paths should be followed

Consequence Likelihood matrix

The consequence likelihood matrix is a means of combining qualitative or semi-quantitative ratings of consequence and likelihood to produce a level of risk or risk rating. A consequence likelihood matrix is used to rank risks, sources of risk or risk treatments on the basis of the level of risk. It is commonly used as a screening tool to define which risks need further more detailed analysis or which risks need treatment first, or which risks need not be considered further at this time. Points to remember:

- The consequence scale should cover the range of different types of consequence to be considered (for example financial loss, safety, environment or other parameters depending on context).
- The lowest likelihood must be acceptable for the highest defined consequence otherwise all activities with the highest consequence are defined as intolerable.

- Many risk events may have a range of outcomes with different associated likelihood. It is appropriate to focus on the most serious outcome, or to rank both common problems and unlikely catastrophes as separate risks.

Consequences Ranking

Level	Description	Description/Impact				
		Injures	Financial	Product / service quality	Market share	Legal
1	Insignificant	<ul style="list-style-type: none"> No injures 	<ul style="list-style-type: none"> 1.5 % Loss in net profit 	<ul style="list-style-type: none"> Some of products / services out of specification 	<ul style="list-style-type: none"> >2% loss of market share 	<ul style="list-style-type: none"> A fine of 10,000 pounds
2	Minor	<ul style="list-style-type: none"> First aid treatment 	<ul style="list-style-type: none"> 3% Loss in net profit 	<ul style="list-style-type: none"> complaint from customers orally 	<ul style="list-style-type: none"> >5% loss of market share 	<ul style="list-style-type: none"> A fine of 100,000 pounds
3	Moderate	<ul style="list-style-type: none"> Medical treatment 	<ul style="list-style-type: none"> 4.5% Loss in net profit 	<ul style="list-style-type: none"> Written complaint from customers 	<ul style="list-style-type: none"> >10% loss of market share 	<ul style="list-style-type: none"> A fine of 1000,000 pounds
4	Major	<ul style="list-style-type: none"> Extensive injuries 	<ul style="list-style-type: none"> 6% Loss in net profit 	<ul style="list-style-type: none"> Customer cancel orders 	<ul style="list-style-type: none"> >15% loss of market share 	<ul style="list-style-type: none"> Imprisonment due to legal conditions
5	Catastrophic	<ul style="list-style-type: none"> Death, toxic release off-site with detrimental effect 	<ul style="list-style-type: none"> 7.5% Loss in net profit 	<ul style="list-style-type: none"> large loss of market share 	<ul style="list-style-type: none"> <15% loss of market share 	<ul style="list-style-type: none"> A fine of 1000,000 pounds and Imprisonment due to legal conditions

Likelihood Ranking

Level	Probability	Description
1	Rare	<ul style="list-style-type: none"> May occur only in exceptional circumstances (e.g. once in 10 years)
2	Unlikely	<ul style="list-style-type: none"> Could occur at some time (e.g. once in 5 years)
3	Possible	<ul style="list-style-type: none"> Might occur at some time (e.g. once a year)
4	Possible	<ul style="list-style-type: none"> Will probably occur in most circumstances (e.g. monthly)
5	Almost Certain	<ul style="list-style-type: none"> Is expected to occur in most circumstances (e.g. daily)

5	10	15	20	25	5	LIKELIHOOD RANKING
4	8	12	16	20	4	
3	6	9	12	15	3	
2	4	6	8	10	2	
1	2	3	4	5	1	
1	2	3	4	5		CONSEQUENCES RANKING

Risk level	Risk color (key)
Very high	From 15 to 25
High risk	From 10 to 12
Medium risk	From 5 to 9
Low risk	From 1 to 5

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3. Analysis

Risk register

Step 1: Risk Identification				Step 2: Risk Assessment				
No.	Risk Description	Risk cause	Current control	Probability description	Probability (1 - 5)	Consequence description	Consequence (1-5)	Risk degree
1	Increase competition with international companies which lead to sales decrease	The increase the foreign direct investment of foreign companies in Egypt and the increase of investments of local companies, which leads to competition increase in the domestic market also in export, especially which most company's target African and European market.	1-Increase product quality 2-Increase after sales services level.	Market share loss	4	Possible	3	12
2	Market contraction and sales decrease	1- Inflation rate rising from 13.3% at 2016 to 30.7% at 2017. 2 - The recommendation of the International Monetary Fund to raise the value of subsidies on fuel before the beginning of the next fiscal year, leading to high inflation and low purchasing power. 3- The reduction of the pound against the dollar at 3/11/2016 from 8.88 to 17.7 at 3/ 2018.	1-Strategy direction to increase export 2-Reduce production cost	Market share loss	4	Possible	4	16
3	inability of export to some Arab countries	The unstable security situation for The largest markets are exported as Libya, Iraq and Syria	Strategy direction to increase export at Africa	Loss of export opportunity	2	Possible	4	8
4	Customs Clearance delay	The issuance of surprising decisions by government agencies are delayed related to inspection of shipments	submit complaints to government agencies	Penalties of custom clearance delay	3	Almost Certain	5	15

5	Sole supplier for some products	Accept new supplier procedure take a long time (one year) from the brand owner.	Submit the purchase order for these materials early	Production stop and increase product cost.	4	Almost Certain	5	20
6	Arrival delay of materials and components	The concentration of suppliers in one geographical area / presence of suppliers in the area of natural disasters such as floods, storms, earthquakes and external political turmoil	No control	Increase product cost.	4	Possible	4	16
7	Arrival delay of materials and components	Congestion in the arrival ports of, which leads to the non-laying of the navigational line at the arrival port.	Monitoring arrival ports	Production stop and increase product cost.	4	Possible	4	16
8	increase shipping cost	1- The international requirements for shipping conditions have changed 2- Inclusion of a hazardous substance	Set shipping forecast target	Increase product cost.	3	Possible	3	9
9	increase shipping cost	due to loading efficiency decrease	Set loading efficiency target and improve it	Increase shipping cost.	3	Possible	3	9
10	Increase after sales service cost. (New Consumer Protection Bill)	Because the warranty includes the expenses of transporting product when for repair from customer to the maintenance center and return it back to consumer after the completion of maintenance	No control	Increase after sales service	3	Possible	3	9
11	The company is subject to fraud by an impersonator	Impersonation of suppliers	Continuous communication with suppliers and updating of their data	Money loss	4	Unlikely	2	8
12	Arrival Late of some raw materials	For sudden requests (change purchase plan)	Modify the purchase order	Money loss	2	Possible	3	6
13	Exposure to fines and legal irregularities	Failure to comply with the terms of the new laws that are issued due to there is no responsible for make	Assigning a department to study the laws to	Legal sanctions	5	Possible	3	15

		announcement to each employee by the new lows.	be issued and specifying the points of compliance and responsible for implementation					
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3. Improve

To build a suitable response plan the participant team use the brain storming technique and develop the below response plan to use it to decrease risks to the suitable degree.

Step 3: Risk Response				
No.	Risk Description	Risk cause	Risk degree	Response plan
1	Increase competition with international companies which lead to sales decrease	The increase the foreign direct investment of foreign companies in Egypt and the increase of investments of local companies, which leads to competition increase in the domestic market also in export, especially which most company's target African and European market.	12	1- Develop Product to be more ability to compete in terms of price, technology and after-sales service.
2	Market contraction and sales decrease	2- Inflation rate rising to 16% October 2018. 2 - The recommendation of the International Monetary Fund to raise the value of subsidies on fuel before the beginning of the next fiscal year, leading to high inflation and low purchasing power. 4- The reduction of the pound against the dollar at 3/11/2016 from 8.88 to 17.9 at 10/ 2018.	16	1- Search about alternatives to cost reduction (local supplier – new cheap technology - Work with suppliers to build factories inside Egypt
3	inability of export to some Arab countries	The unstable security situation for The largest markets are exported as Libya, Iraq and Syria	8	1- Export to Africa as promising markets while exploiting Egypt's strategic location
4	Customs Clearance delay	The issuance of surprising decisions by government agencies are delayed related to inspection of shipments	15	1- Increase stocks 2- Completion of customs clearance procedures before the arrival of

				components and materials
5	Sole supplier for some products	Accept new supplier procedure take a long time (one year) from the brand owner.	20	1- multiply suppliers from different regions of the world
6	Arrival delay of materials and components	The concentration of suppliers in one geographical area / presence of suppliers in the area of natural disasters such as floods, storms, earthquakes and external political turmoil	16	1- multiply suppliers from different regions of the world
7	Arrival delay of materials and components	Congestion in the arrival ports of, which leads to the non-laying of the navigational line at the arrival port.	16	1-Pre-release of raw materials and components by preparing the necessary papers before the arrival of raw materials and components to the ports of scarcity
8	increase shipping cost	3- The international requirements for shipping conditions have changed 4- Inclusion of a hazardous substance	9	1- Negotiate with different shipping companies to minimize shipping cost
9	increase shipping cost	due to loading efficiency decrease	9	1- Plan for Increase shipping efficiency
10	Increase after sales service cost. (New Consumer Protection Bill)	Because the warranty includes the expenses of transporting product when for repair from customer to the maintenance center and return it back to consumer after the completion of maintenance	9	1-Increase quality level of product 2-Increase process sigma level 3-Increase returns sigma level
11	The company is subject to fraud by an impersonator	Impersonation of suppliers	8	1- Implement information security system with supplier 2- Confirm with supplier by several ways
12	Arrival Late of some raw materials	For sudden requests (change purchase plan)	6	Develop Purchasing forecast plans for four months and review it every month
13	Exposure to fines and legal irregularities	Failure to comply with the terms of the new laws that are issued due to there is no responsible for make announcement to each employee by the new lows.	15	1- Determine the responsible of studying the new laws and identify points of commitment and develop plans to implement compliance with the laws

5. Control

To control risks the study team put suitable Key Risk Indicator for each Risk to Monitor Risk as Below

Gap assessment table

We suggest each risk indicator for Each RISK and assess it according to the table below and take

score	Dimension	Assessment Question	Low Values (rating 1)	Medium Values (rating 3)	High Values (rating 5)
1	Frequency	Is the frequency of measurement adequate to flag a risk event prior to occurrence?	-Frequency is not clear - Frequency is monthly or less frequent.	-Frequency is clearly defined. - Frequency is at least weekly. -It is not clear whether the frequency is sufficient to prevent the risk event.	-Frequency is clearly defined. -Frequency is at least daily or lowest required for the specific metric. -Frequency is low enough to identify and prevent potential risk events.
2	Trigger Levels	Do trigger levels exist and if so are they analytically sound?	Trigger levels have not been identified.	Trigger levels have been identified but are not analytically sound.	Trigger levels exist and they are sound.
3	Escalation Criteria	Are there clear escalation criteria tied to the trigger levels?	No clear escalation criteria.	Escalation criteria exist but no clear owner or documentation.	Clear escalation criteria with responsible owner with documentation.
4	Leading /Lagging	Is the metric a leading or a indicator?	Is the metric tied to the risk event occurrence?	The metric is tied to a control or root cause, but not leading enough to prevent a risk event.	The metric is tied to one of the major root causes and has sufficient lead to prevent the risk event from occurring.
5	Ownership	Is there a clear owner for the creation and analysis of the metric?	No clear owner. Metric is more ad hoc in nature.	Some ownership, but changes from time to time or is not a clearly established job function.	Clear ownership for creation and analysis of the metric as part of an established job function.

6	Historical Data	Does historical data exist on the metric?	New or recently created metric with no past data.	Past data available but has not been tracked. It can be retrieved with some effort.	Historical data available and has been tracked as a metric for significant period of time.
7	Data Accuracy	How accurate and reliable is the data?	Data reliability and accuracy cannot be ascertained (or are unknown) Process/procedure for data collection is subjective in nature.	Reliable data collection process is in place and is not subjective. Measurement error is high (inadequate) or unknown.	Reliable, repeatable data collection procedures. Measurement error is low (adequate) and it is well known.

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No.	Risk Description	Risk indicators		
1	Increase competition with international companies which lead to sales decrease	Sales value	Market share	No. of competitors
2	Market contraction and sales decrease	Sales value	Market share	Inflation Ratio
3	inability of export to some Arab countries	Export sales value	Arab countries at global competitiveness report	Corruption Perceptions Index
4	Customs Clearance delay	Stopping time due to custom clearance	Custom clearance average time	
5	Sole supplier for some products	Stopping time due to Sole supplier	Percentage of sole supplier to all suppliers	
6	Arrival delay of materials and components	Stopping time due to material arrival	Nature disaster at supplier countries	Arrival time monitoring report
7	increase shipping cost	Shipping cost	loading efficiency	
8	Increase after sales service cost. (New Consumer Protection Bill)	After sales service cost	No. of returns at the first year of warrantee	Customer PPM (part per million)
9	The company is subject to fraud by an impersonator	No. of fraud risks		
10	Exposure to fines and legal irregularities	No. of legal risks	Legal compliance cost	

Future work and conclusion

The research show the impact of external environment on corporate working in Egypt at importing raw materials or exporting final products and company cannot avoid external risks so managing external risk impact is great challenge. This research focus only on supply chain risks so the future risks can apply this methodology on various industrial process as production process, sales, after sales, inventory management, information technology, Administrative Affairs and human resource process.

The risk matrix developed by the team is designed to EL ARABY company and the probability of occurrence and expected consequences may be changed by the scope of the work or company that implements this methodology depending on the size of the work of each organization and the nature of the risks to which this organization is exposed.

The nature of the risks identified in this research varies from one organization to another depending on the nature of the industry, suppliers, the country in which the organization is established, and the nature of the employees in this country which has a severe impact on the effectiveness of the response plans.

The risk impact and probability of occurrence are not constant but change from time to time. Therefore, the risk assessment process should be repeated periodically to ensure that risks are at acceptable levels and to add new risks to risk portfolio and the appropriate response plan. This study can be beneficial to the industrial business whether technical or non-technical to improve their

Processes and manage the risks in order to provide the continual improvement in the whole Organization with a major reduction in cost and increase in the organization revenues and achieving corporate objectives at strategy, tactical and operational levels.

The commitment of risk team members and top management at all risk management stages is very important impact on business (increase opportunity and decrease threats effects).

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