

# **INVESTIGATION OF THE SUPPLY CHAIN RISKS IN TILE MANUFACTURING COMPANIES IN SRI LANKA**

Report on Supply Chain Management

by

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## **ABSTRACT**

This study aims to figure out potential Supply Chain risk facing by the local tile manufacture in Sri Lanka against the Global well known high quality branded tiles and low cost tiles imported from China and India. And also this study will further analyze quality of the tiles of the above three categories, affordability for consumers and customers perceptions .Another objective of this study is to understand the market share of these categories and the customer perception. Finally providing recommendations to local tile manufactures to mitigate the potential risk associate to face against global players with necessary government interventions.

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## 1. INTRODUCTION

This study mainly focuses on the potential Supply chain risk associate of the local tile manufactures against global players. When it comes to global players there are two types of tiles manufactures those who produce mass productions especially in china, Europe and India. Due to mass productions and availability of the raw materials and latest technology, manufactures in China and India were able to produce tiles at a cheaper price compared with prices of the locally manufacturing tiles or reputed brands produced in Europe. When it comes to the quality and the designs there are limitations with this mass productions. As a result Sri Lankan consumers will not be able to buy customized uncommon tiles design from these global suppliers. Therefore advantages and the disadvantages to the customers those who willing to buy china and Indian tiles also need to be carefully studied within this research.

There are well known European branded tiles also in the market to purchase to Sri Lankan tiles consumers. These tiles are in high standard and of uncommon designs which satisfy the customer's esteem needs.

When Sri Lankan free trade policy allow Global players to sell their tiles in Sri Lanka, there is a potential risk associate with local manufacture to compete in the market with their limited resources .Amid the global players competition Sri Lankan tile manufacture were able to sustain in their business for a long period. This study will aim to analyze the evolution of the market share over the period.

And also this study will focus on potential supply chain risk associates by local tiles manufacture and risk mitigation strategies that can be adopted. Hence to reduce the risk and improve the entire supply chain profitability, productivity and efficiency while reducing the cost.

## 2. LITERATURE REVIEW

Manufacturing firms anywhere in the world are facing a huge risk of business sustainability resulting from mass customization, shortening product life cycles and entry of international competitors in to their markets. The market for product and service is becoming increasingly international as witnessed in the Tile and Sanitary ware products market in Sri Lanka. In responding to the international markets or globalization, firms realize that they need to adopt more international manufacturing/operational strategies while at the same time ensuring that the organizational culture is appropriately adapted at the local level to ensure that expected benefits from implementing those strategies are achieved. Globalization has had a major impact on manufacturing, both locally and internationally. With globalization broadening the marketplace and increasing competition, customers are placing greater demands on manufacturers to increase quality, serviceability, and flexibility while maintaining competitive costs (Dangayach and Deshmukh, 2003; Laosirihongthong and Dangayach, 2005b),( Daniel I. Prajogo, Tritos Laosirihongthong, Amrik Sohal, Sakun Boon-itt, (2007))

### 2.1 Supply Chain Risk in Global Context

As per the Survey done on Global Supply Chain and Risk Management by The MIT/PricewaterhouseCoopers for 209 companies with global foot prints it was found that globally operating organizations are exposed to high-risk scenarios ranging from controllable risks-such as raw material price fluctuations, market changes, or fuel price volatility-to uncontrollable ones such as natural disasters.

The findings validate **five key principles** that companies can learn from to better manage today's risk challenges to their supply chains and prepare for future opportunities.

1. Supply chain disruptions have a significant impact on company business and financial performance.



2. Companies with mature supply chain and risk management capabilities are more resilient to supply chain disruptions. They are impacted less and they recover faster than companies with immature capabilities.
3. Mature companies investing in supply chain flexibility are more resilient to disruptions than mature companies that do not invest in supply chain flexibility.
4. Mature companies investing in risk segmentation are more resilient to disruptions than mature companies that do not invest in risk segmentation.
5. Companies with mature capabilities in supply chain and risk management do better along all surveyed dimensions of operational and financial performance than immature companies.

In this study mature supply chain refers to companies adopting enablers of most effective risk mitigations (e.g., flexibility, risk governance, alignment, integration, information sharing, data, models and analytics, and rationalization)

Above mentioned study further emphasis on linking the customer value proposition, sound supply chain operations, and robust risk management is key to success. Moreover, there are supply chain and risk management principles,

most sensitive supply chain

In the above study respondents from 209 companies were asked about the more sensitive supply chain operations. Their responses was supply chain operations were most sensitive to skill set and expertise (31%), price of commodities (29%), and energy and oil (28%).

### **2.1.1 The Seven Supply Chain and Risk Enablers of Maturity**

1. Risk governance - the presence of appropriate risk management structures, processes, and culture.

2. Flexibility and redundancy in product, network, and process architectures - having the right levels of flexibility and redundancy across the value chain to be able to absorb disruptions and adapt to change.
3. Alignment between partners in the supply chain - strategic alignment on key value dimensions, identification of emerging patterns, and advancement toward higher value propositions.
4. Upstream and downstream supply chain integration - information sharing, visibility, and collaboration with upstream and downstream supply chain partners.
5. Alignment between internal business functions - alignment and the integration of activities between company value chain functions on a strategic, tactical, and operational level.
6. Complexity management/rationalization - ability to standardize and simplify networks and processes, interfaces, product architectures, and product portfolios and operating models.
7. Data, models, and analytics - development and use of intelligence and analytical capabilities to support supply chain and risk management functions.

According to survey done by The MIT/PricewaterhouseCoopers for 209 companies in 2013, companies consider alignment between partners in the supply chain as the most important factor in enabling risk reduction (60%). Internal and external process integration is also very important (49%) and (47%). Risk governance (44%) and network flexibility and redundancy (37%) are also being included in the mix. Finally, despite recent advances, data, models and analytics (28%), and complexity management/ rationalization (26%) are low on the priority list.

In the same survey they have defined four level of maturity for organization as follows.

**Level I: Functional supply chain management and ad hoc management of risk.**

Under this model organizations supply chains functions are operated as individual units characterized by low degree integrations among departments, high duplications of activities, and low level of coordination with suppliers and partners and product developments also being done independently. Inventory and capacity levels are not matches result in poor customer service and increase of total cost. Very limited vulnerability or threat analysis is done. When a risk or threat happens adhoc methods will be applied. (i.e. No forecast of analysis is done, when incident happen only they involve to solve it through external party).

**Level II: Internal supply chain integration and positioning of planned buffers to absorb disruptions.**

Under this level organization supply chain is well connected and information is shared throught the supply chain. Resources are jointly managed. Planning and implementation of strategies are done through integration among members of the supply chain. Basic threats and vulnerabilities are analysed. Scenarios concerning the base integrated plan are conducted to position targeted buffers of capacity and inventory to absorb disruptions. In order to response the change in demand postponement of delay differentiations are used. However visibility is very low for emerging changes and pattern outside the organization.

**Level III: External supply chain collaboration and proactive risk response.**

Main feature of this category is collaboration across extended enterprises. Information sharing and supply chain visibility is very high. Product designs or inventory management are integrated among internal external partners in the supply chain. External input is incorporated into internal planning activities. Interfaces are standardized, and products and processes are

rationalized to reduce complexity. Information sharing and visibility is used to analyse risk arise from internal and external sources. Accordingly sensors and predictors for changes is set up. Suppliers and partners are monitored for resilience levels and business continuity plans are created.

#### **Level IV: Dynamic supply chain adaptation and fully flexible response to risk.**

Companies in this category are fully integrated with all the key partners in the extended supply chains. Individual objectives are fully linked with the overall objectives of the company all the processes and strategies are well equipped (flexible) to cater sudden changes of the environments.

Emerging value chain patterns resulting from this interaction are probed and identified and higher value equilibrium points are achieved. Supply chain is diversified to cater multiple customer value propositions is different segments. Risk sensors and predictors are supported by real-time monitoring and analytics. Supplier segmentations also executed based on their profiles and risk strategies is determined accordingly.

#### **2.1.2 Reactions of the companies against Impact versus Likelihood**

Chopra and Sodhi(2004) identified that most of the companies target to mitigate low impact recurrent risk rather than high impact low likelihood risks. Hauser (2003) suggest that risk adjusted supply chain pays off in term of improved financial performance and competitive advantage. It is noted that companies not only focus on high recurrent risk but high impact low likelihood risk as well.

#### **2.1.3 Classification of Supply Chain Risks**

The literature suggests four categories of risks: supply, demand, operational, and security risks (Christopher and Peck, 2004; Manuj and Mentzer, 2008)

1. **Supply Risk:** Out comes arises from adverse event in the inbound supply that lead to affect to meet customer demand.
2. **Operational Risk:** the distribution of outcomes related to adverse events within the firm that affect a firm's internal ability to produce goods and services, quality and timeliness of production, and/or profitability.
3. **Demand risk** is the event that impact the likelihood of customer placing orders and variance of the information in customer demand
4. **Security risk** is the distribution of outcomes related to adverse events that threaten human resources, operations integrity, and information systems; and may lead to outcomes such as freight breaches, stolen data or proprietary knowledge, vandalism, crime, and sabotage.

#### **Ghoshal (1987) classification of supply chain risks**

1. **Macroeconomic risk** that arise from economics changes impact to shift in wage rates, interest rates, exchange rates, and prices.
2. **Policy risk** is the event of unexpected actions of national governments
3. **Competitive risk** associated with uncertainty of the competitor activities in foreign markets
4. **Resource risk** is the event that impact to resource requirement and variance of the quality of the resources in foreign or local markets.

#### **2.2. Risk Drivers**

According to the study conducted by Uta Jüttner , Helen Peck & Martin Christopher (2003) There are few risk drivers resulting supply chain risks such as 1) Focus on efficiency rather than cost 2)Supply chain globalization 3)Centralization 4) trend of outsourcing 5) reduction of suppliers

## **2.3 Competitive Priorities**

With regards to competitive priorities, Hill (2000) identified various order qualifiers and order winners. Order qualifiers are those criteria a company must meet to be considered as supplier. Order winners are those criteria that win the order over the competition. In other words, to provide order qualifiers, firms need only to be as good as competitors but to provide order winners they must be superior to. When developing order winners and order qualifiers, firms must distinguish each market place by their level of their importance. As market conditions have changed, so has the basis of competition. For example, quality is now being considered more as an order qualifier whereas other competitive dimensions such as flexibility, responsiveness, and particularly innovation, are now being considered as order winners (Bolwijn and Kumpe, 1990; Hamel and Prahalad, 1994), ( Daniel I. Prajogo, Tritos Laosirihongthong, Amrik Sohal, Sakun Boon-itt, (2007)).

### **2.3.1 Variety of imported goods**

The variety of imported goods available for sale in developed countries is considerable. With ongoing trade liberalization, the globalisation of markets, advances in communications and transportation technologies, and other facilitating factors, consumers are increasingly exposed to a wide array of imported goods (Business Week, 1993; Chuushoo Kigyoo Cho, 1995; Craig and Douglas, 1996). Previous studies have suggested that consumers tend to stereotype products manufactured in foreign countries, and that, owing to negative stereotypes about some foreign goods and patriotic feelings about goods made in the home country, consumers are more likely to prefer domestically-made goods (Han, 1988; Maheswaran, 1994). While the importance of marketing mix variables such as price and product quality has been firmly established, the national origin of the product and the role of the image of the product's country of origin are the subject of ongoing research.

### **2.3.2 Consumer's perceptions**

Kaynak and Cavusgil (1983) studied consumers' perceptions of different classes of products from 25 countries. They found that respondents held positive attitudes towards products made in their own country but the same respondents could be swayed to choose foreign products if quality and

Price considerations were sufficiently favorable. Specifically, they observed that consumers may not accept inferior-quality domestic products when superior foreign products are available. They concluded that consumer attitudes toward products of foreign origin vary significantly across product classes.

Han (1988) concluded that the emotion of patriotism played a significant role in consumers' choice of televisions and automobiles. However, "the cognitive attitude toward products made in different countries (country image) played a limited role". The study found that "patriotic" consumers tend to be older, white, and from blue collar occupations. Hong and Wyer (1989) found that a product's country of origin stimulates subjects' interest in the product and consequently leads them to think more extensively about product information and its evaluative implications.

### **2.3.3 Country-of-origin phenomenon**

One of the first conceptualizations of the country-of-origin phenomenon was that of Nagashima (1970, p. 68). He defined the image that consumers associate with a given country-of-origin as "the picture, the reputation, the stereotype that businessmen and consumers attach to products of a specific country. This image is created by such variables as representative products, national characteristics, economic and political background, history, and traditions". Others view this country image as reflecting consumers' general perceptions about the quality of products made in a particular country and the nature of people from that country (Han, 1989; Parameswaran and Yaprak, 1987). Scholars have noted that country-of-origin perceptions

entail cognitions, emphasizing specific product and marketing attributes, and affect, regarding the country's people (Han, 1988; Papadopoulos et al., 1990). More broadly, Samiee (1994) regards the country-of-origin effect as any influence or bias that consumers may hold, resulting from the country of origin of the associated product or service. The source of the effect ``may be varied, some based on experience with a product(s) from the country in question, others from personal experience (e.g. study and travel), knowledge regarding the country, political beliefs, ethnocentric tendencies, (or) fear of the unknown" (Samiee, 1994, p. 583).

#### **2.3.4 Consumer and industrial products**

In a meta-analysis of 25 studies through 1990, Liefeld (1993) noted that country-of-origin effects are real and occur over a wide range of consumer and industrial products. Other scholars have generated similar results (Baughn and Yaprak, 1993; Samiee, 1994). The magnitude of COI effects hinges in part on the nature of the product and tends to diminish in the presence of other product cues. In addition, prior product knowledge, product beliefs, and purchasing experience can have a moderating effect on the influence of COI (Liefeld, 1993; Samiee, 1994). Bilkey and Nes (1982) in their review of literature suggested that there is a tendency for consumers to evaluate their own country's products more favorably than do foreigners. But the authors found that, for many consumers, the effect of product evaluation bias can be offset by price concessions. Bilkey and Nes (1982) found that attitudes toward products from a particular country vary by product. Hence, electronic goods from Italy might be perceived poorly but Italian shoes would receive high marks from consumers.

#### **2.3.5 Consumers**

The increased exposure of consumers to global media, and depictions of Western lifestyles in local media, have increased their desire for quality branded goods and services. Technology

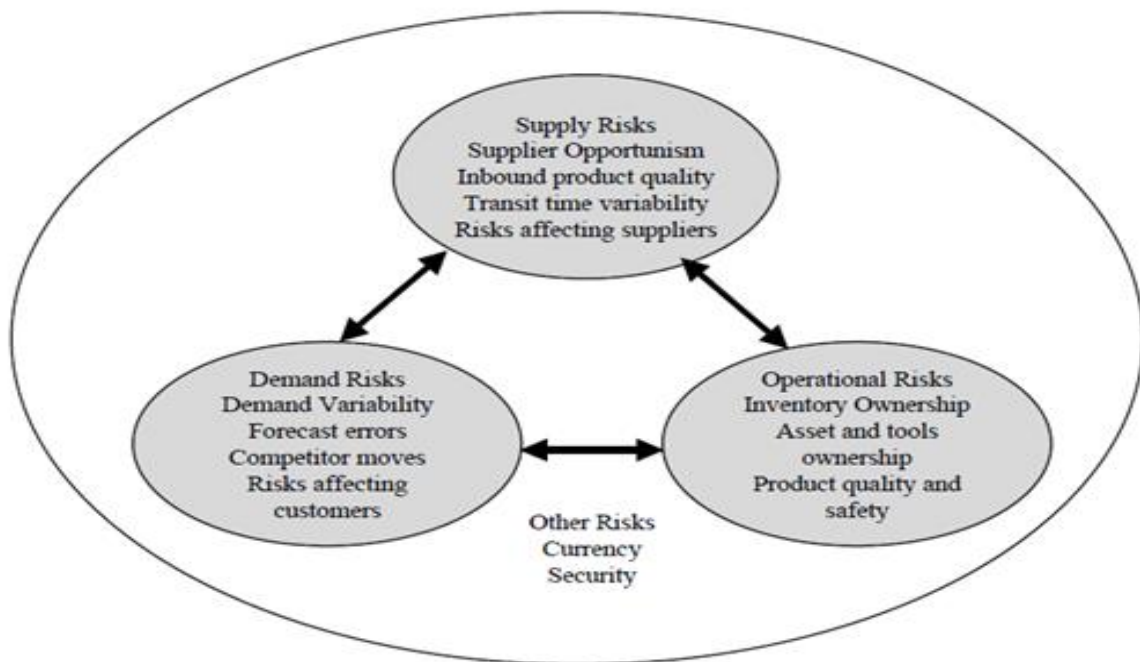


and feature/functionality expectations are rising. In Whirlpool's experience, Chinese consumers buying washing machines tend to prefer not the old twin-tub technology but the newer fully automatic machines. Similarly, consumers in most TEs buying refrigerators have shown a willingness to pay for more expensive no-frost refrigerators instead of the older technology (Whirlpool Tatramat/Whirlpool Polska Team Reports 1995) . There are signs that many TEs are evolving from a situation where one, low-priced, basic brand was all that was necessary, to situations where two, and even three, levels of quality and price might be warranted.

Consumers are also at a formative stage regarding the formation of brand loyalty, as many of the old traditional local brands are dying out, and many new brands are being launched in the marketplace. In addition, many of the product categories that consumers are buying are new to them, and their low levels of knowledge about these product categories lead them to rely on brand name cues. Many consumers in TEs associate new foreign products with superior quality (Shama 1992). However, consumers in many cases also appear to have discovered that not all brands with Western brand names have high quality, and there have in some cases been reports of a backlash return to local-branded goods. Finally, there are reports of resurgent economic nationalism or chauvinism in some countries, such as Poland (Whirlpool Polska Team Report, 1995).

#### **2.4 Supply Chain Risk Mitigations strategies and plans**

(Ila Manuj, John T. Mentzer, 2008) developed a risk management strategy and suggest that there are three categories of supply chain risks and each type risk need to be addressed separately. And also there are some risk external to supply chain such as Oil price fluctuation, currency and security risks as mentioned below in the Figure 1.

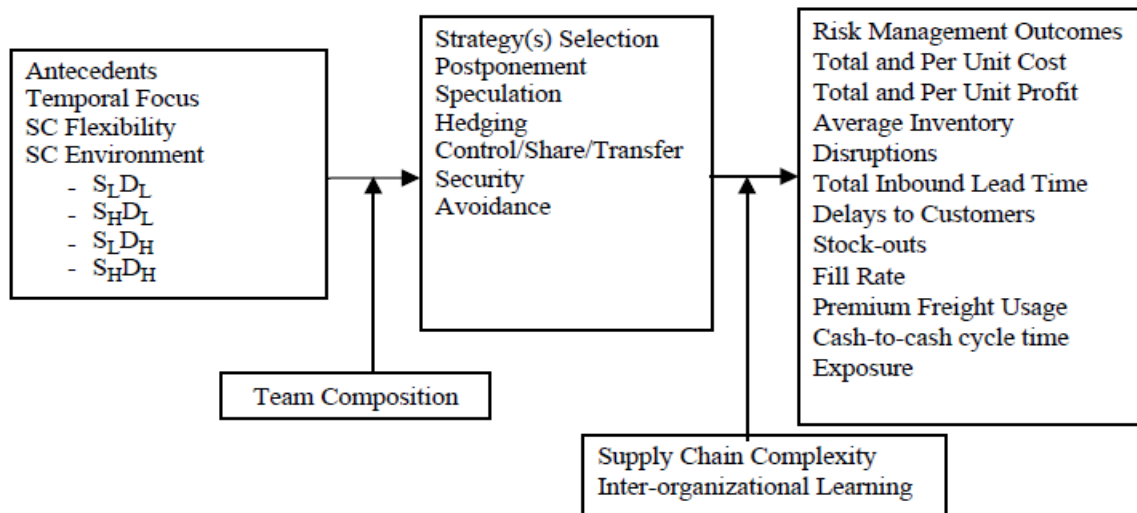


**Figure I. – Supply chain risk model**

As per the developed model those risk can be mitigated depend on the nature of those three major risk types. When the company supply risk is low( $S_L$ ) and demand risk is high( $D_H$ ) risk management strategy to be used different from when those types of risk are vary from low to high.

In this model it is suggested that strategy to be selected is depend upon the company focus on the risk such as temporal focus or long term, supply chain flexibility and supply chain environment.

### 2.4.1 Model for supply chain risk mitigation



**Figure II. – Model for risk mitigation**

**2.4.1.1 Temporal Focus** refers to strategies use to mitigate risk short term basis which involve lower investment. Risk management is a continual process that involves long-term dedication of supply chain members (Giunipero and Eltantawy, 2004).

(Ila Manuj, John T. Mentzer, 2008) suggest based on the finding of the study that short term focus is not referred as absence of risk mitigation but law importance to risk management.

(Mentzer and Firman, 1994) suggest that performance metrics lead to disregard the risk associates due to temporal perspective of the managers. If the reward system rewards only those who achieve their objectives irrespective of due attention to risks, then managers will strive to objectives at the cost of disproportionate risks.

**2.4.1.2 SC Flexibility** Upton (1994) defines flexibility as “the ability to change or react with little penalty in time, effort, cost or performance.” It means that in a highly uncertain market organizations who are flexible enough to sudden changes is benefitted faster than the competitors. Firms that achieve higher levels of flexibility significantly outperform their less flexible counterparts (Fawcett et al., 1996). In sum, supply chain flexibility provides an

inherent capacity to respond to emerging circumstances that cannot be fully anticipated in the planning cycle (Welch and Welch, 1996)

**2.4.1.3 Supply chain environment** refer to risk of supply, demand and operations. But (Ila Manuj, John T. Mentzer, 2008) suggest based on qualitative study that managers focus only on supply and demand risks as there is separate department to handle operational risks in terms of insurance cover and hedging foreign exchange exposure. The same study further revealed that even though managers are aware of the best strategies to be used most of the time it compromise due to following reasons. Performance metrics, supply chain flexibility, and team composition. However it is concluded that supply chain that adopt and invest in risk mitigation perform better than who don't do.

The same study further revealed that supply chain environment is the most critical factor for an organization to focus on risk mitigations. Strategies based on supply chain flexibility and temporal focus are depend within the supply chain activities. But supply and demand risk are outside the supply chain which require supply chain wide attention to properly analyze the risk and adaptation of risk mitigation strategies.

## **2.4.2 Supply Chain Risk mitigation strategies**

(Ila Manuj, John T. Mentzer, 2008) suggest that in order to select appropriate supply chain risk strategies expected cost savings and targeted profit need to be considered. Total supply chain cost and profit that account for both benefits and costs of risk management strategies are important outcomes that need to be measured to ascertain the effectiveness of a risk management strategy (Beamon,1998).

On the supply side, two outcomes of interest in global supply chains emphasized in the literature as well as by participants in the qualitative study(Ila Manuj, John T. Mentzer, 2008) include supply disruptions (Chopra and Sodhi, 2004), and total inbound lead time (Fagan,

1991). On the demand side, the outcomes most emphasized include stock-outs (Chopra and Sodhi, 2004; Fisher, 1997), fill rates (Beamon, 1998; Chang and Makatsoris, 2001), lead times, and delays to customers (Chopra and Sodhi, 2004).

#### 2.4.2.1 Matrix to adopt supply chain risk mitigation strategy

Based on the qualitative study done by (Ila Manuj, John T. Mentzer, 2008) and adaptation of the classification developed by Lee (2002) to develop a 2 by 2 matrix of supply chain environment, based upon supply and demand risks there are four types of environment exist such as low demand and low supply, low demand and high supply, high demand and low supply and high demand and high supply. Depend upon the supply chain expose to those environment strategies need to be changed in for mitigations of the supply chain risk arise from the environment. Table III cells denote the environments facing supply chains in terms of the levels of supply and demand risks. “SLDL” denotes low supply and low demand

Demand risks	Supply risks	
	Low	High
Low	$S_L D_L$	$S_H D_L$
High	$S_L D_H$	$S_H D_H$

Source: Lee (2002)

**Figure III. –Supply and demand risk matrix**

#### 2.4.2.2 Postponement strategy

Based on the study(Ila Manuj, John T. Mentzer, 2008) it is concluded that supply chains with low supply-high demand and high supply-high demand uncertainties are more likely to apply product postponement strategy than the low supply-low demand and high supply-low demand environments. However it is further emphasize that investment for changing plants and training program as per postponement strategy may provide advantages to competitors due to high initial. The existence of common or overlapping suppliers and customers in different supply

chains may affect a firm's ability to invest in the postponement related facilities and training programs (Yang et al., 2004).

Literature revealed that there is an increase trend in off-shoring, mass customizations, agile operations and e-business strategies in the global supply chains. (Yang et al. (2004).It is believed that as the proportion of off-shore components in the final product increases, the likelihood of a supply chain considering investment in

Form postponement will increase.

#### **2.4.2.3 Speculation strategy**

Speculation (also called selective risk taking) is a demand-side risk management strategy that is the opposite of postponement (Bucklin, 1965).it is based on the prediction of the future market demand good will be produced in advance. Buying of all the raw materials, productions of finished goods, marketing campaigns and hiring and recruitment will be decided based on forecasted demand.

The resources in the supply chain need to be directed to those specific products and customers that provide the firm with a competitive advantage (Perry, 1991). (Ila Manuj, John T. Mentzer, 2008) suggest that by producing finished at earliest point lead to gain financial benefits of economies of scales in production, procurement and transportations costs. Literature further emphasizes that it is needed to have high quality estimate of future demand. In case of absence of research of the product demand it is advised to continue the same product in to new market having similar consumer behavior pattern rather than new product in to the existing market under this strategy. (Ila Manuj, John T. Mentzer, 2008) conclude based on the study on this strategy companies with low supply –low demand uncertainty and high supply-low demand uncertainty are more likely to adopt this strategy and it further suggest speculations strategy is the most common strategy use by the companies participated in this study.

#### **2.4.2.4 Hedging strategy**

Hedging is an expensive strategy because it involves creating multiple options for decision variables. Therefore hedging is used only when there is perceived risk of high uncertainty of supply side risks in term of quality, quantity, disruption, price, variability in performance, and opportunism(Berger et al., 2004)

Another consideration in hedging is the requirement of similar levels of output in terms of quality and service across multiple facilities or supply chain partners. Hence, hedging yields maximum benefits where strong quality and process controls are in place. (Ila Manuj, John T. Mentzer, 2008) conclude that based on the qualitative study that hedging is more likely to use a s risk mitigations strategy when there is high supply-low demand and high supply-high demand uncertainty in the supply chain.

#### **2.4.2.5 Control/share/transfer strategy**

Refers to increase the ability of members to control supply chain processes, systems and decisions within the supply chain through integration. There are two types of integration as to forwards and backward. The literature suggests that integration may also be used to create entry or mobility barriers (Bucklin, 1965). (Ila Manuj, John T. Mentzer, 2008) suggest that Desirability of control and hence the level of integration also depend on the commitment of the focal firm to the target market. Vertical integration may increase control and reduce risks in a supply chain, but it changes variable costs into fixed costs.

Need for greater control leads to higher demand side integration (Anderson andGatignon, 1986). Innovative products, such as proprietary products and high service requirement products, are more likely to be sold through forward integrated supply chains (Boedecker and Morgan, 1980).

However, vertical integration ties up capital and reduces the flexibility of the supply chain to react to environmental changes. There is a growing trend toward supply and demand side

disintegration, with firms focusing more on core competencies, and outsourcing non-critical activities. (Ila Manuj, John T. Mentzer, 2008)

Sharing or transferring risks takes place through outsourcing and/or writing flexible contracts with clauses that account for possible changes in the environment and associated risks (Macneil, 1978).

(Ila Manuj, John T. Mentzer, 2008) study conclude that Supply chains facing SHDL environment are more likely to adopt backward integration, supply chains facing SLDH environments are more likely to adopt forward integration, and supply chains facing SHDH environments are more likely to adopt both backward and forward integration.

#### **2.4.2.6 Security**

Global supply chain security encompasses information systems security, freight breaches, terrorism, vandalism, crime, and sabotage. Study suggest that all types of supply chains will increase the use of security strategies.

#### **2.4.2.7 Avoidance**

(Ila Manuj, John T. Mentzer, 2008) study suggest that there are two types of avoidance strategies .Type 1: If the benefits can be gained is less than risk associate with the venture, it is advised to avoid that market if the company still meet their targets.

Type 2: even though benefits is less than the risk but supply chain can't meet the target then supply chain doesn't have any option to avoid that type of high risk market or supply. Under that type of situation strategy to be used under avoidance is to take initiative to reduce the impact of the risk or probability of risk by adaptation of appropriate actions.

### **2.5 Summary of supply chain risk mitigations in the literature**

According to the literature it is noted that even though managers of any organizations aware of the possible risk, they are reluctant to take actions against risk mitigation



Managers' attitude towards risks: Sharpira(1986) and March and Sharpira (1987) study Zsidisin et al. (2001) and (2004), they concluded that:

Even though most companies understand the risk of supply chain and natural disasters, they tend to pay less attention on risk mitigation strategies as likelihood of risk occurrence is difficult to analyze and organizations tend to utilize their financial capabilities on product developments, capacity and market share improvement activities according to the literature.

Another reason is lack of available data to analyze the possible risks and analytical models to quantify return on investment or benefits that can be obtained by investing in risk mitigation strategies. As articulated in Repenning and Sterman (2001), firms rarely invest in improvement programs in a proactive manner because “nobody gets credit for fixing problems that never happened.”

### **3. RESEARCH APPROACH AND METHODOLOGY**

According to the literature there are several models have been developed to analyze global supply chain risk and risk mitigation strategies. However all the models developed could not be applied in general as the studies were conducted only for specific supply chains. It is noted that the strategies to be implemented is depend upon the nature of the supply chain.

Therefore this study focus on local tile manufacturing risk and mitigations. Based on the existing literature could not find any research being conducted on the subject matter. Main areas to focus are specific supply chain risk associate with local tile manufactures and to suggest risk mitigation strategies based on the findings and literature.

#### **3.1 Research Methodology**

The purpose of this chapter is to explain in detail the research methods and the methodology to be implemented for this study. The chapter will explain first of all the choice of research approach, then the research design, as well as the advantages and disadvantages of the research tools to be chosen. This will be followed by a discussion on their ability to produce valid results, meeting the aims and objectives set by this dissertation. The chapter then will goes on to discuss the sample size and the sampling strategy to be applied by the author, and the data analysis methods which have to be used. It will concludes with a brief discussion on the ethical considerations and limitations posed by the research methodology, as well as problems could be encountered during the research.

#### **3.2 Research Approach**

Similar to chosen topic academic research have been done in the Global context with respect to other countries with different industries. The proposed research will be more focused in to Risk associate with ceramics tiles manufactures in Sri Lanka against globalizations which is form of a new research but on an existing subject.

The research approach that is to be used in this topic is inductive one. According to this approach researcher will begin with specific observations which are to be used to form generalized theories and conclusion to be derived from the research. The reasons to use inductive approach is it focus on the areas of the research where research is active and it is most appropriate for small samples that produces qualitative data. However, the main weakness of the inductive approach is that it produces generalized theories and conclusions based only on a small number of observations, thereby the reliability of research results being under question (Denzin & Lincoln, 2005).

### **3.3 Research Methods-Qualitative versus quantitative techniques**

In order to satisfy the objective of the research qualitative techniques to be used since the samples size related to the topic is very small.so that qualitative methods will be adopted which enable complete description and detailed analysis of the research topic.

However, the effectiveness of qualitative research is heavily based on the skills and abilities of researchers, while the outcomes may not be perceived as reliable, because they mostly come from researcher's personal judgments and interpretations. Because it is more appropriate for small samples, it is also risky for the results of qualitative research to be perceived as reflecting the opinions of a wider population (Bell, 2005).

### **3.4 Data collection method and tools**

Main data collection method to be adopted in this research topic is from existing literatures and in depth interviews. Mainly these interviews will be personal and unstructured interviews with the intention to identify participant's feelings and opinions on the subject topic. The main advantage of personal interviews is that they involve personal and direct contact between interviewers and interviewees, as well as eliminate non-response rates, but interviewers need to have developed the necessary skills to successfully carry an interview (Fisher, 2005, Wilson,

2003). What is more, unstructured interviews offer flexibility in terms of the flow of the interview, thereby leaving room for the generation of conclusions that were not initially meant to be derived regarding a research subject. However, there is the risk that the interview may deviate from the pre-specified research aims and objectives (Gill & Johnson, 2002).

Interview were conducted among three companies of local tile manufactures. Interview were based on the below mentioned frame work,

- Supply related risk of the companies & mitigations
- Operational related risk & mitigation
- Demand related risk and Risk of competitions & mitigations
- Information sharing risk and mitigations & mitigations
- Financial flow related risk and mitigation & mitigations
- Procurement related risk
- Natural disaster risk
- Supply chain Network Risk

### **3.5 Sample selection**

The method of purposive sampling will be used to develop the sample of the research under discussion. According to this method, which belongs to the category of non-probability sampling techniques, sample members are selected on the basis of their knowledge, relationships and expertise regarding a research subject (Freedman *et al.*, 2007). In the current study sample members which are to be selected based on their experience, expertise, relevance to this topic from the local tile manufacturing organization in Sri Lanka. Within this context, sample members of this study will be executives from 2 of local ceramics tiles manufactures out of 3 nos. And also random sampling techniques to be used to interview consumers of the

ceramic products. Namely two organizations are to be selected to choose for sample members are,

- 1.) Royal Ceramics Lanka PLC
- 2.) Lanka tiles PLC
- 3.) Mac tiles

### **3.6 Research process**

Meetings were held during February of 2019 with executives of above mentioned organizations. More specifically, the researchers should explain the nature and scope of the research and hence to ask them to participate in the research. Discussions to be limited to 20-25 minutes. During the interviews it is advised to the researchers to keep notes in order to help to analyse the gathered data.

During the interview, respondent were free to express their views on the subject matter which are not included in the discussed area. And those details should be separately noted.

### **3.7 Data analysis**

Content analyze to be used to analyze data gathered through the personal interviews. According to Moore & McCabe (2005), this is the type of research whereby data gathered is categorized in themes and sub-themes, so as to be able to be comparable. This method help to simplify data to gather in to themes and sub themes and to identify the relationships between those themes. And also it help to produce results that can be measured using quantitative techniques. Another advantage of content analyze is it enable researcher to summarized gathered information through interviews in line with the research objectives. However, human error is highly involved in content analysis, since there is the risk for researchers to misinterpret the data gathered, thereby generating false and unreliable conclusions (Krippendorff & Bock, 2008).

### **3.8 Ethical considerations**

This study to be conducted to subject to certain ethical issues. Signed consent and Briefing letter to be obtained from the all the participants. At the same time, sample members to be asked to sign a Debriefing and Withdrawal Letter. The aim of both letters are to confirm participants that their participations are voluntary and they are free to withdraw at any point and for any reasons.

### **3.9 Research Limitation**

As it for every research, this research had following limitations.

- Size of the population was much small – Bigger population would lead to select a random sample which lead to enhance the reliability of the data.
- In some case, participant did not reveal some important information which could have an impact on their business objectives and strategies by disclosing.

#### 4. DATA COLLECTION AND ANALYSIS

Based on the in-depth interview I have conducted with managers in local tile manufactures in Sri Lanka who are directly involving in development and implementation of strategies and making decisions in the supply chain in different activities such as supply, planning, product and process designing ,marketing, inventory controlling ,and finally logistics. following information were revealed subject to supply chain risk faces by local tile manufacturing and risk mitigation strategies being used to mitigate those risk.in the end of the this chapter I have compared world class practice being used based on the literature and applicability of those strategies in to selected local tile manufacturing company in order to optimize supply chain capabilities while minimizing risk currently being exposed.

Supply chain risk can be categorized in to different types. (Ou Tang a,c, S.NurmayaMusa a,b,n, 2010) suggest in their study risk can be grouped in to three stages such as source, make and deliver. In another study done by (Christopher S. Tang\_ 2005) suggest that supply chain risk can be categorized in to two types such as operational risk and disruption risks. Operational risk referred to inherent uncertainties arise in supply, demand or delivery. Disruptions risk referred to the major disruptions caused by natural and man-made disasters such as earthquakes, floods, hurricanes, terrorist attacks, etc., or economic crises such as currency evaluation or strikes.

In order to investigate the supply chain risk in local tile manufacturing I have developed a frame work as guide line for the interviews

## **4.1 Risk identification of the local tile manufacturing supply chains**

### **4.1.1 Supply related risk**

Supply related risk referred to risk arise in the inbound supply chain due to various conditions and issues. Main supply related risk identified in literature is as follows. Typical risk issues suggest by the literature survey done by (Ou Tang a,c, S.NurmayaMusa a,b,n ,2006) are single sourcing risk, sourcing flexibility risk, supplier selection/outsourcing, supply product monitoring/quality and supply capacity.

#### **4.1.1.1 Single sourcing risks**

When an organizations use single sourcing as sourcing strategy there are inherent risk associate with this strategy. If any disruption happens to the supplier entire supply chain will be affected under this method. Ericsson's inability of reacting to a supplier's fire accident is the consequence of single sourcing risk (Peck et al., 2003). There are advantages also when organization use single source supplier as supplier management cost can be reduced. Quality of the material can be maintained at the required level. Price advantages also can be taken as per the interview conducted with one of the manger in the company. Ericsson lost 400 million Euros after their supplier's semiconductor plant caught on fire in 2000, and Apple lost many customer orders during a supply shortage of DRAM chips after an earthquake hit Taiwan in 1999.

This risk can be mitigated adopting dual sourcing strategy as mentioned in the literature. Under this model there is always back up suppliers maintained and available in case of disruption or sudden increase of supply due to demand changes. When Indonesia Rupiah devalued by more than 50% in 1997, many Indonesian suppliers were unable to pay for the imported components or materials, and, hence, were unable to produce the finished items for their US customers. However, with a network of 4000 suppliers throughout Asia, Li and Fung ([www.lifung.com](http://www.lifung.com)), the largest trading company in Hong Kong for durable goods such as textiles and toys, shifted



some production from Indonesia to suppliers in other Asian countries. Even though dual supplier strategy minimize the risk of supply risk on the other hand it cause to increase supplier management cost and to increase the complexity of the supply chain causing huge investment to manage the suppliers. Another advantage can be obtained through dual sourcing strategy is to gain advantages of currency fluctuation impact. Considering the benefits and the cost the manager I interview related to this topic confirmed that their organization adopting dual sourcing supply strategy as their object is resilience and efficiency in the supply chain rather focus on cost advantage by compromising resilience in the face of uncertainty.

#### **4.1.1.2 Sourcing flexibility risk**

As discussed in previous chapter it is always better to have a backup suppliers in case of supplier disruption, capacity constraint, quality problem or any incident happen to change the supplier. But on the other hand it is very difficult to manage multiple suppliers for same raw materials or component as per the literature. As Kamrad and Siddique (2004) and LaLonde (2000) sourcing flexibility incur a hidden cost and managerial difficulties when switching suppliers in case of disruptions. Accordingly even a supply chain consist multiple suppliers, it makes another risk interim of management and additional costs. As per the one of the manager said “we are dealing with multiple suppliers except one or two raw materials, but there is a difference in the quality between suppliers. We buy the raw materials from the best quality supplier but in case of emergency we buy from the next available supplier. Since we have selected the best out of all, there may be quality and additional cost incurred if we shift the suppliers “Accordingly having multiple supply doesn’t completely remove the risk of supply since there are more additional concerns are arisen as a result.

#### **4.1.1.3 Supplier selection/outsourcing risk**

Supplier selection/outsourcing risk referred to risk associates with supplier selections or outsourcing.

Boer et al. (2001) suggested model of 3 stages of supply selection process with comprehensive details under each stages. Accordingly formation of selection criteria, determination of approved suppliers, and final supplier selection are the three stages to be concerned.

##### **4.1.1.3.1 Formation of selection criteria**

There are many criteria and models that has been developed to criteria for supplier selections in literature. Choi and Hartley (1996) investigate 26 supplier selection criteria used by different partners (automotive assemblers, first-tier suppliers, second tier suppliers) across the supply chain in the auto industry. Cost reduction capability, quality improvement capabilities and capacity improvement capabilities are among them. (Christopher S. Tang\_,2005) suggest based on the literature survey that there are few major points that have been considered by most of the organization to form supplier selection criteria .As per the survey cooperative long term relationship , quality ,delivery ,technological capability and financial stability are of the greatest important while price is one of least important criteria.

##### **4.1.1.3.2 Supplier approval/selection**

Under this stage main concern is to reduce the no of the selected suppliers in to small no of potential suppliers for final selection. Boer et al.(2001) report the following methods for determining a set of approved suppliers: clustering analysis, data envelopment analysis, and an Artificial Intelligence Approach called case-based-reasoning method.

#### 4.1.1.3.3 Final selections

This referred to selecting required suppliers out short listed candidates. In the literature there many model have been developed to select final suppliers. Linear weighting model (Assigning scores for parameters to be considered), Total cost of ownership (total cost incurred to purchase items, least cost supplier to be selected. This model developed by Boeret al. (2001) , Mathematical programming models() , simulation model are among the model can be used as per the literature survey done by Boeret al. (2001)

As per the interview conducted on the subject matter one manager responded that quality, reliability, delivery and price are the most important point they consider to select suppliers. And also he further stated that even though they wanted to consider supplier's technologic capabilities and financial stability, due to unavailability or difficulties to find those information made them to give up those criteria even though they have understood the importance of them. Another concern raised by them was finding enough suppliers for them for selections criteria also has become a problem. Therefore they are dealing with best out of few suppliers based on the criteria mentioned above. (Levary, 2007). Suggest that country risk and suppliers' supplier reliability also need to be considered in the supplier selection process. The same manger further stated that they have no idea about who their supplier's supplier are because of lack of visibility in the upstream supply chain. Another concern suggested by the manager I interviewed. Another manager interviewed informed that they have supplier selections criteria. Accordingly if a new supplier need to supply any raw materials, first of all they need to bring samples and those samples will be undergone thorough quality check. If the sample quality is up to the required level, customer will be registered as a supplier. After that particular supplier can supply the materials according to the manager interviewed.

#### **4.1.1.4 Outsourcing**

When a company outsourced some of the area in the supply as a result they can get more benefits as literature suggests reduced lead times, increase product quality, reduce inventory level, being able to focus on core competency of the company are among them as one of the manager stated as benefits they have realized. He further stated that there are some risk also associates with outsourcing such as increased transport cost, increase handling and management cost, risk of exploring company information, increase of bargaining power and mismatch among supply chain objectives and quality issues.

#### **4.1.1.5 Supply product monitoring/quality and capacity**

One of the main challenge we have in supply side is supply product monitoring and maintaining quality consistency said one of the manager I interviewed. He further stated that even though quality is maintained by the supplier's features of the raw materials being mined from the different mines are changing from geographic locations. Therefore for the option available for them is getting the best raw materials from the existing ones rather wait for the required quality. When inquired about the supply capacity monitoring, one manager informed that they do periodical audit on the local suppliers, hence they are being informed in advance about the supplier capacity. But when it comes to foreign supplier same manger informed that they don't have any traceability for supplier capacity. But quality is maintained to the required level. As in the literature suggest that long term relationship with suppliers lead to reduce cost, reduce product development cycle time, increase product quality at the same time (Helper,1991). [Cohen and Agrawal \(1999\)](#) is the first to develop an analytical model for evaluating the tradeoff between the flexibility offered by short-term contracts and the improvement opportunities and price certainty associated with long-term contracts. Accordingly it's not always the long term relationship offer optimal benefits.

#### **4.1.2. Operational risk**

Operational risk also can be grouped in few areas such as manufacturing, reward system, functional optimization.

##### **4.1.2.1 Manufacturing Risk**

Based on the interview I conducted related to the manufacturing risk most of the managers highlighted yield variation , yield percentage ,production processes capabilities , variance in production planning and demand, limitation of the production capacities, investment on new technology .etc.

Yield variation refer to the variation of the final products (Tiles) in shades, size, and evenness (Warps). This lead to categorize final products in to different grades resulting yield percentage reductions. They further said this particular incident is happened due to use of local raw material which have not been processed and receive in raw form. As a result of that required properties is not contained in the raw materials. So that factories need to process those materials before use them, it takes time and lot of effort. Even though factory processed those materials they are not being processed to 100% level due to lack of the technology and capacity as revealed by one of the Manager. All the tile being made is need to fire in a kiln at a temperature around 1100 Celsius and gradually need to be reduced the temperature as it go through the kiln. This process is happened in a kiln and even a slight change of the properties of raw materials result in shade and caliber variation. Same reasons lead to variation of the evenness of the tiles as confirmed by a manager.

As he further explained even though raw materials contain 100% properties due to inherent issues in the tile manufacturing industry final product variation is possible. He further said when they identified a defect in the final product, there are adjustment to be made in the kiln's

settings to rectify that defect which lead to increase the variations in shades and sizes. This issue is inherent to tile manufacturing industry all over the world.

#### **4.1.2.1.1 Limitation of the production capabilities**

As per the interview they revealed that there are capacity limitation for manufacturing process such as minimum square meters to be produced in order to get the cost benefits from the tiles being manufactured, otherwise manufacturing cost of a square meter will rise. According to them when the when the square meter quantity to be produced is reduced, they need to do frequent change overs and also wastages also increase per square meter another capacity constraint is changing the setup of the production lines for different sizes are very difficult in the tile manufacturing industry. According to the managers I interviewed they refer that when they set up the production line for a particular size until minimum no of square meters of tiles being produced, change in initial set up for different size is not feasible in terms of cost and could lead to increase the defects.

Another inherent risk or issue in the local tile manufactures are facing is producing the same shade tiles that matches to what they produced some times back. There are few parameters affect to variation as per the managers I interview. Change in quality of the raw materials, technology issue to trace the all the features of the mixture of previously produced lots. As a result there are changes in the shades as expressed by the managers.

One of the other issues associate with tile manufacturing industry they can't keep work in progress inventory once they dry pressed a tile it has to be fired in a kiln within an hour according to the manager I interviewed. Reason he mentioned for that is properties especially the moisture level must be maintained before fire, otherwise tile deformation will happen

resulting defect products. Therefore product postponement strategies can't be used in the tile industry.

#### **4.1.2.1.2 Investment on new technology for manufacturing**

Even though there are technological advancement available, investment cost of those advancement makes it difficult to adopt in the first place as revealed by the managers I interviewed. Especially when it comes to product design and development there are many changes to be done and but existing technologies being used are not flexible enough to cope with required changes and most of the times resulting investment cost for additional technologies. According to the managers I interviewed when they set up particular production line for dedicated sizes, those production lines are not feasible to cater different sizes making production capacities are fixed.

#### **4.1.2.1.3 Reward system**

As expressed by most of the managers I interviewed accepted that their reward system doesn't align with the smoothen flow of supply chain. Accordingly they said most of the departments are trying to achieve their departmental goals rather than considering entire supply chain objectives. Procurement department main objective is to cut down the cost of purchase, so that they always consider the cost of the purchase as top priority by compromising other important feature such as reliability, compliance to product features of the users, supplier capabilities, etc. Another good example is rather than increase of supply chain visibility based on the investment to be done for IT infrastructure they increase the production capacity investing on manufacturing technologies and equipment. Since no of pieces to be produced increased as a result, KPI for manufacturing will not compromise with the investment. But instead of investment in IT infrastructure for effectiveness of the supply chain will not be reflected in their KPIs as the benefits are long term and difficulties in measuring the exact benefit in short

term basis. And the other point is lack of top management attention on those type of long term benefited of the investment such as IT, warehousing, distribution since the benefits are long term said by one of the managers I interviewed. As discussed with the managers lack of attention on long term benefits could be obtained by prudent investments has great impact on supply chain effectiveness and the profitability.

Another vital fact revealed by another manager is even though they understood some of the consequences could be arisen with departmental wise focus they don't have taken any actions to mitigate those possible risks, due to the existing reward system which is based on achieving set goals.

#### **4.1.3 Demand related risk**

Demand risk is the possibility of an event associated with outbound flows that may affect the likelihood of customers placing orders with the focal firm, and/or variance in the volume and assortment desired by the customer. (Ila Manuj and John T.Mentzer, 2008).

According to the literature demand related risk anything that affect the buying decision of the customers of focal company due to any reason. One of the manager I interviewed said that main risk that affected mostly of all the supply chain related is demand related risk. They are planning everything based on the existing demand and goal is to increase the current share of the demand through various strategies. Accordingly new products being introduced by the importers affect the consumers demand. Low Price of the competitors also another fact that affect the demand for the focal company. Time taken for new product developments by the focal company also affect the demand when competitors introduce earlier. Technology difference being adopted for manufacturing between local companies and the competitors (China and Europe) affect the demand as expressed by the managers I interviewed due to advanced technology lead to low cost and reductions of the defects.



TOP MANUFACTURING COUNTRIES								
COUNTRY	2012 (Sq.m Mill.)	2013 (Sq.m Mill.)	2014 (Sq.m Mill.)	2015 (Sq.m Mill.)	2016 (Sq.m Mill.)	% on 2016 world production	% var. 16/15	
1. CHINA	5,200	5,700	6,000	5,970	6,495	49.7%	8.8%	
2. INDIA	691	750	825	850	955	7.3%	12.4%	
3. BRAZIL	866	871	903	899	792	6.1%	-11.9%	
4. SPAIN	404	420	425	440	492	3.8%	11.8%	
5. VIETNAM	290	300	360	440	485	3.7%	10.2%	
6. ITALY	367	363	382	395	416	3.2%	5.3%	
7. INDONESIA	360	390	420	370	360	2.8%	-2.7%	
8. IRAN	500	500	410	300	340	2.6%	13.3%	
9. TURKEY	280	340	315	320	330	2.5%	3.1%	
10. MEXICO	231	230	230	245	267	2.0%	9.0%	
<b>TOTAL</b>	<b>9,189</b>	<b>9,864</b>	<b>10,270</b>	<b>10,229</b>	<b>10,932</b>	<b>83.7%</b>	<b>6.9%</b>	
<b>TOTAL WORLD</b>	<b>11,226</b>	<b>11,961</b>	<b>12,377</b>	<b>12,357</b>	<b>13,056</b>	<b>100.0%</b>	<b>5.7%</b>	

Source: MECS, MECS, Acimac Research dept. "World production and consumption of ceramic tiles", 5th edition 2017

**Table I. – Top Manufacturing Countries**

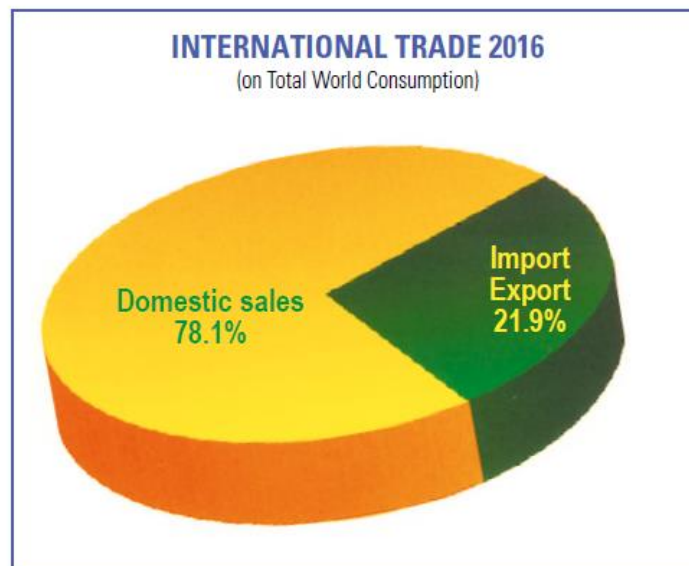
TOP EXPORTING COUNTRIES									
COUNTRY	2013 (Sq.m Mill.)	2014 (Sq.m Mill.)	2015 (Sq.m Mill.)	2016 (Sq.m Mill.)	% on 2016 national production	% on 2016 world exports	% var 16/15	value 2016 (million €)	average export price (€/sq.m)
1. CHINA	1,148	1,110	1,089	1,025	15.8%	36.7%	-5.9%	4,979	4.9
2. SPAIN	318	339	378	395	80.3%	14.1%	4.5%	2,570	6.5
3. ITALY	303	314	316	332	79.8%	11.9%	4.8%	4,588	13.8
4. INDIA	55	102	134	186	19.5%	6.7%	38.8%	598	3.2
5. IRAN	114	109	112	126	37.1%	4.5%	12.5%	328	2.6
6. BRAZIL	63	69	77	94	11.9%	3.4%	22.1%	293	3.1
7. TURKEY	88	85	77	81	24.5%	2.9%	4.8%	463	5.7
8. MEXICO	64	62	61	56	21.0%	2.0%	-8.2%	289	5.2
9. UAE	58	55	54	48	66.7%	1.7%	-11.1%	278	5.8
10. POLAND	48	42	42	46	32.4%	1.6%	9.5%	246	5.3
<b>TOTAL</b>	<b>2,259</b>	<b>2,287</b>	<b>2,340</b>	<b>2,389</b>	<b>23.2%</b>	<b>85.5%</b>	<b>2.1%</b>		
<b>TOTAL WORLD</b>	<b>2,670</b>	<b>2,705</b>	<b>2,746</b>	<b>2,794</b>	<b>21.4%</b>	<b>100.0%</b>	<b>1.7%</b>		

Source: MECS, Acimac Research dept. "World production and consumption of ceramic tiles", 5th edition 2017

**Table II. – Top Exporting Countries**

#### 4.1.3.1 Consumer Perception on local products

Consumer perception on the local products also affect to demand. As another manager said price of their product is the main turning point to change the mind from their products to imported products. One of the marketing manager I interviewed said that marketing is one of the main factors that change the demand for their products. Even though consumers are aware of the advanced quality of the locally manufactured tiles they tend to buy inferior tiles mainly due to price difference as revealed in the interviews. Main features of the local manufactures are quality, unmatched designs and the product range that can be used on any application according to the managers I interviewed. After sales service also one of the reason customers to buy locally manufactured tiles according the finding os the interviews. Kaynak and Cavusgil (1983) studied consumers' perceptions of different classes of products from 25 countries. They found that respondents held positive attitudes towards products made in their own country but the same respondents could be swayed to choose foreign products if quality and Price considerations were sufficiently favourable.



Source: MECS, MECS, Acimac Research dept. "World production and consumption of ceramic tiles", 5th edition 2017

**Figure IV. – International Trade 2016 on total world consumption**

#### **4.1.3.2 Inflation**

Another factors external to market but directly impact to consumer demand are inflation of the country, intervention of the government, policy changes of the government that affect to demand changes. According to the managers I interviewed revealed that country inflation is directly affect to the sales volumes of each year. Even though consumers are willing to buy locally manufactured tiles, their affordability is not matched due to the economic downturns as revealed in the interviews. If the country inflation is low, and economy is booming their sales volumes also going to be impacted positively.

#### **4.1.3.3 Operational Factors**

There are some internal factors also affect to demand change such as flexibility of the supply chain, innovation, cost of the products, product features ,consumer trust on the focal company, product defects ,complaint handling , customer care and after sales service are among others affect to demand as explained by the majority of the mangers I interviewed. Price also another risk for demand when it comes to local tile manufacturing as there are low price tiles available in the market. As per the literature balancing of unmet demand and excess inventory also a one of the main risk face by lot of supply chains. Evolvement of rapid technological changes also affect to change consumer demand as consumers are awaiting for latest and innovative products resulting from excess inventory being turned to obsolete stocks as per literature.

#### **4.1.3.4 Competition**

Main competitor for local tile manufactures is imported tiles manufactured in china. According to the study conducted by Margherita Russo, (2004) after four decades of undisputed leadership on the world market for tiles, Italy has now sunk to fourth place, behind China, Spain and Brazil.

Whereas in 1990 Italy was producing 450 million square meters of tiles, largely for exports, China was producing scarcely forty million square meters of tiles, mostly destined for domestic consumption. By 2001 China had exceeded one billion sq. mts., though still substantially intended for the domestic market, while Italy grew up to almost 640 million sq. mts. The enormous and rapid growth of China's tile production, driven by a domestic demand in strong expansion, was made possible by adopting cutting edge machinery produced in the ceramic district of Sassuolo in Italy, world leader in the production of machines for ceramic tile making as well as in the production of tiles themselves. Encouraged by strong intersectorial flows of knowledge in the field of machinery manufacturing and by a sharp increase of domestic demand, China is also beginning to produce machines for tile making, copying those developed in the Sassuolo district in Italy.

Accordingly it's is very clear that china has gained the lead global of tile manufacturing from 2001 to day. Main advantages china had is huge domestic consumption and low production cost due to low labor cost and other factors. Another factor is china was not depending on the tile manufacturing machines produced in Italy. What they have done they bought advanced machine from Italy and they replicate those machines. So that they were able to not only manufacture tiles but also tile manufacturing machines. Since machines manufactures in china were less expensive that enabled china tile manufactures to produce low cost tiles. Due to the mass production capabilities china tile manufactures can get the advantages of economic order quantity (EOQ). EOQ is the quantity to be produced in order to optimize the production capacity hence to reduce the unit cost of production. In the annexures I have attached how the global tile manufacturing capabilities have shifted from Europe to china and other Asian regions.

#### **4.1.3.4.1 Competitive priorities**

Hill (2000) identified various order qualifiers and order winners. Order qualifier refers to in order to survive in the market basic requirement to be satisfied by the particular organization with their product or service. Order winner refer to how the products are being differentiated from the similar product in the market to be chosen by a consumer. According to the literature quality has become order qualifier now days as it is the basic requirement to be satisfied in order to enter in to the market. As suggested by (Bolwijn and Kumpe, 1990; Hamel and Prahalad, 1994), ),( Daniel I. Prajogo, Tritos Laosirihongthong, Amrik Sohal, Sakun Boon-itt, (2007)) competitive dimensions such as flexibility, responsiveness, and particularly innovation, are now being considered as order winners

#### **4.1.4 Network Risk**

Refer to the risk arise from not understanding responsibilities of the members in the supply chain leading to suboptimal integration causing damages to the supply chain.( Uta Jüttner , Helen Peck & Martin Christopher,2010).Accordingly there are 3 types of network related risk has been identified in the literature as to lack of ownership, chaos and inertia (Christopher & Lee, 2001).

##### **4.1.4.1 Lack of Ownership**

This refer to risk resulting from blurring boundaries of service or product offering companies and receiving companies of those products in a supply chain according to the literature. As a result there could be damages to entire supply chain. The risks often result in inventory costs due to product obsolescence, markdowns or stock-outs, which are passed on among the organizations in the supply chain. .( Uta Jüttner , Helen Peck & Martin Christopher,2010).

According to one of the manager I interviewed revealed that even though their supply chain doesn't involve many organizations, functional boundaries exists and as a result lack of ownership for critical risks have been arisen such as not taking actions against obsolete items, not providing required information to take actions to prevent possible losses, not taking right decisions at the right time, management main focus only on sales related activities rather than support services, etc. Another good example for lack of ownership is goods are being stored outside the factories till they transfer to main warehouses. These pallets are being kept without a shelter as a result they get wet and dry from sunshine and rains. As a result packing get damaged and straps used to tight the boxes get loosen. And the pallets on which tiles were staked made out of wood get termite attacked resulting strength reduction explained by a manager. Even though this incident is known and aware by the factory and the warehouse no one is taking full responsibility for finding a solutions. According to the manager they are spending huge sum of money for repackaging caused by these issues.

Another practical example at the local tile company regarding lack of ownership is transport capacity utilization. Company utilize hired fleet of vehicle for their distribution from the main warehouses to island wide company own showrooms. Distribution is handled by transport department and loading is handled by warehouse staff. Since WH staff doesn't have any KPI set for capacity utilization they are not considering the capacity utilization of each vehicle being loaded on the other hand transport department is located away from the WHs they don't have a control over the capacity utilization as explained by one manger.

#### **4.1.4.2 Chaos**

Refers to risk arise from a supply chain due to complexities resulting over react, mistrust and distorted information among organization of a supply chain. According to the literature bullwhip effect also one outcome of supply chain chaos. (Lee et al.,1997).According to the

managers interviewed accepted that one of the main reasons lead to risks are chaos among inter departments trying to achieve departmental wise objectives ignoring other departments consequences. One example revealed by the manager is at the factory in order to reduce the cost and product complexities some of the SKUs being produced have been stopped. But that decision was not communicated to sales department so that sales division has continued to display the particular item and to raise customer orders. But when customer comes to collect goods, they were not available causing dissatisfaction of the customer and disappointments towards company brand image.

#### **4.1.4.3 Inertia**

Refer to the lack of responsiveness for changes within supply chain and external environment and market signals resulting inability to react competitor moves and changing consumer demand etc. According to the literature most organizations sacrifices flexibility against cost reductions. One of the good example as one of the managers explained company doesn't take actions against increased inventories, obsolesce of inventory And other problem explained is lack of required recruitment from the expected competency required to carry out particular job functions as explained by managers I interviewed.

#### **4.1.5 Information flow risk**

When it comes to information risk it can be categorized in to segments such as information accuracy, information system security and disruption, intellectual property and information outsourcing risk of Information accuracy as per the literature there two streams as to upstream and downstream. Risk of information may cause by information accessibility, information efficiency and data accuracy (Lee, 2002, 2004; Geary et al., 2002; Raman et al., 2001; Giermanski, 2000; Bradley, 2001; Faisal et al., 2007).

Distorted information or inaccurate information lead to wrong decision in the supply chain according to the literature. Most of the managers suggested that even though they are using reputed ERP system in the downstream that is not linked with upstream members in the supply chain. So that visibility of the information not available in their system resulting many causes in to the supply chain.

One of the main consequences of the organization I interviewed was Bull whip effect in the demand planning as a result of lack of the visibility of information said by one of the manager I interviewed. Another manager said decisions are made in the functional level in order to optimization of the objectives of their departments rather than focus on the entire supply chain resulting excess inventory , inventory of obsolete products , stock out of fast moving products. All the department working for their assigned target compromising objective of the supply chain. This will lead the supply chain more difficult to agile with the emerging trend or changes coming from demand side or by the environment jeopardizing entire organization in to a bad situation. Main issues identified by one of the manager interviewed said that they had to increase production capacities because of lack of information visibility for actual demand. Instead of investing on information visibility company has gone for investing in capacity increase resulting many obsolete inventories being idled inside the warehouse adding organization extra cost to maintain those inventories.

#### **4.1.6 Financial flow related risk**

Refer to risks that are resulting from poor decisions based on limited information about the return on the investment as suggested in the literature.( Ou Tang a,c, S.NurmayaMusa,2010)Suggest financial flow risk financial flow risk involves the inability to settle payments and improper investment. The common risks are exchange rate risk, price and cost risk, financial strength of supply chain partners and financial handling/practice. As per the



interview conducted with financial manager said that main financial risk associate with their organization are currency fluctuation, price of raw materials, energy price increase ,changes in government tax policies and recovery of credit based customers such as whole sellers, distributors, and other credit customers within the line of credit period granted. Increase of prices due to scarcity of raw materials lead to Risk as suggested by him. And also he further said financial related misconduct happened at the company own retails also another type of risk coming under this category. And also he further explained that cost involve in new products introductions to the market also a risk as some of them have been failed.

#### **4.1.7 External risk to the supply chain**

Referred to risks that are out of the supply chain is considered as external risks ranging according to the literature.

1. Natural disasters
2. Terrorist attacks
3. Environmental risk
4. Geopolitical issues

These risk are uncontrollable but have a great impact to supply chain if they occur in any part of the supply chain. Best example of natural disaster risk is based on the literature mature companies are more resilient against supply chain external risk than the immature companies. Parameters for categorized any supply chain as mature or immature is mentioned below.

One of the best example to explain impact of natural disaster to supply chain is earth quark of magnitude of 9.0 happened in Japan in March 11, 2011 followed by Tsunami waives travelled 10km towards inland. The impact of this disaster was devastating: 25,000 people died, went missing, or were injured; 125,000 buildings were damaged; and economic losses were estimated at \$200 billion as per the study conducted by Ioannis Kyrtzoglou, 2013. In the weeks

following the catastrophic earthquake, 80 percent of the automotive plants in Japan suspended production.

According to the study Nissan motor company is the most affected automobile supply chain at that time. Six production facilities and 5 critical suppliers had a severe damage. Loss of the production capacity was estimated to equivalent of 270,000. Despite this devastation Nissan recovery was remarkable compared with other automobile companies in Japan. During next six months Nissan's production capacity decrease was 3.8% while automobile industry suffered 24.8% decrease. At the end of the year Nissan's production increased by 9.8% while entire industry had a 9.8% reduction.

It is noteworthy to analyse how Nissan was able to recover rapidly while others suffered in a highly impacted natural disaster.

Main threat to their supply chain from flood is difficulties of finding local raw materials during the flood seasons as most of the sites are being flooded. Therefore as the risk mitigation plan they are keeping 6 months of buffer stocks in raw materials in order to face that type of devastation.

Below are key points in Nissan's mature risk mitigation plan included.

1. They have developed the supply chain to identify the risk as early as possible, and to determine counter measures by analyzing the risks affected then implementing them rapidly to mitigate the risks
2. Nissan had developed a readiness for possible natural disasters throughout the supply chain encompassing suppliers so that they know what to do when that type of disaster happened early in advance. And also they have trained their employees in the supply chain with simulation training so that they have experience of that type of incident. More importantly they have developed a business continuity plan which guide them how to operate or continue their business under this type of catastrophe.

3. Management was given authority in a devastating situation to take necessary action rather lengthy analysis.
4. Their supply chain model was flexible to adopt or absorb any kind of shock. They adopted decentralization with strong central control as and when required.
5. They maintained supply chain visibility to monitor each and every function throughout the supply chain and coordination among members.

#### **4.1.7.1 Possible Natural disasters for local tile manufactures**

According to the study they found that Nissan supply chain has adopted mature risk mitigation throughout the supply chain which paid off after the devastation.

According to recorded history possible natural disasters are flood and hurricane. Flood is the most recurrence disaster has happened in thought the history and there is a pattern also can be recognized it can happen. According to the manager I interviewed they have taken risk mitigation strategies for possible flood occurrence.

## **4.2 Risk mitigation**

### **4.2.1 Strategies**

According to the literature there are different types of risk mitigation strategies have been developed.

Accordingly there are 6 strategies being discussed such as postponement (Bucklin, 1965; Chiou et al., 2002; Zinn and Bowersox, 1988), speculation (Bucklin, 1965), hedging, control/share/transfer (Achrolet al., 1983; Agrawal and Seshadri, 2000; Cachon, 2004), security (Downey, 2004), and avoidance (Miller, 1992).

As per the study conducted by (Ila Manuj and John T. Mentzer, 2008) these six strategies has to be applied under different condition of risk associate with Supply and Demand.

#### **4.2.1.1 Postponement strategy**

This to be applied when demand is uncertain and change suddenly. However in order to adopt this strategy, any supply chain has to incur extra investments. Because of changing the processes to produce modular products involve huge investments as suggested by (Van Hoek, 2001). Effort to be used to design modular product is much more advanced compared with interconnected systems. (Baldwin and Clark, 1997).

#### **4.2.1.2 Speculation strategy**

This is to be used when demand uncertainty risk is low while supply related is high in a supply chain as suggested by (Ila Manuj and John T. Mentzer, 2008). Speculation strategy need high accuracy of the demand it can be done in a supply chain when demand uncertainty is low. Therefore proper analysis of demand with high accuracy can speculate requirement of supply for future and hence they can protect their supply chain supply uncertainty by planning in advance for future requirements.

#### **4.2.1.3 Hedging**

Hedging is another strategy that can be implemented against supply chain risk as suggested in the literature .Hedging is a strategy involve back up plans or options against possible risks. Accordingly dual sourcing can be used as a hedge against risks of quality, quantity, disruption, price, variability in performance, and opportunism (Berger et al., 2004), but dual sourcing requires more investment than single sourcing as keeping anything as back require additional effort and cost.in order to get the currency fluctuations or price fluctuation of the raw materials additional inventory has to be maintained for future requirements. When demand fluctuation or uncertainty is very high, producing more goods than average also can be considered as hedge according to the literature. As (Ila Manuj and John T. Mentzer, 2008 ) concluded hedging is a strategy to be used when Supply risk, Demand uncertainty risk , or both demand and supply risk are high in the supply chains.

#### **4.2.1.4 Control/share/transfer**

This is another risk mitigation strategy to be used according to the literature integration can be used to increase the ability of supply chain members to control the decision, share the risk, and to transfer the risk. Integration can be happened upstream or down stream.it is more like to use up ward integration when supply risk (Uncertainty) is high while downstream integration happed and when demand uncertainty is high to mitigate the associate risk throughout the supply chain. When both demand and supply side risks are high complete integration thought the supply chain can be used. However, vertical integration ties up capital and reduces the flexibility of the supply Chain to react to environmental changes as suggested by (Ila Manuj and John T. Mentzer, 2008 ). In the literature it is found that companies need to focus on their core competencies are more likely to have disintegrated supply chains. Therefore it is difficult to conclude that under what circumstance integration can be used as risk mitigation strategy to a particular supply chain since it need more parameters to be considered than what we discussed under supply chain risk according to the literature.

#### **4.2.1.5 Security**

When it comes to supply chain literature and recent studies confirm that almost all the companies working towards to increase the security of the supply chain from information systems security, Freight breaches, terrorism, vandalism, crime, and sabotage. According to literature RFID and GPS technologies are being used by supply chains commonly.

#### **4.2.1.6 Avoidance strategy**

This is another strategy being used to mitigate supply chain risks. Accordingly there are two types of avoidance strategy can be adopted according to literature. Type 1 is When company identify potential risk of a particular event in the supply chain they can avoid that event if the company goals are still met without it. Type 2 is even though company identify potential risk

associate with particular even, they can't avoid it since their goals can't be achieved without that. In that type of a situation what a supply chain can do is to control the possible risk impact by adopting necessary actions to mitigate the possible risk, they can venture that event.

#### **4.2.1.7 Team formations or Supply Chain Risk operations**

According to the study conducted by (Ila Manuj and John T.Mentzer, 2008) it is revealed that having a team to analyze to supply chain risk associate with any type of cost reduction or sales revenue increase project will help firm to make better decision at the lowest risk. In the same study it is further revealed that team composition is very important factor. Accordingly having a team with members as mentioned below will help in reducing risk and increasing the benefits.

1. Members with stakes for and against the decision in question
2. Members with risk-averse versus risk-taking attitudes
3. Trade-offs between inclusion of members outside the organization, and the time and cost of such an effort. For example, involving supply chain members may pay off in the long run but may involve significant investment by the focal firm
4. And getting the most functionally proficient managers versus managers with long-term vision

It is emphasized that rather taking individual decision, getting jointly involved in decision making pay offs at the end.

## **5. DISCUSSION AND CONCLUSION**

### **5.1 Local tile manufacturing supply chain risks**

#### **5.1.1 Risk of competition**

According to the interview based study I conducted and literature there are major risk drivers for local tile manufactures are facing. One of the main risks is competition mainly against low cost china based tiles. China has been able to produce low cost tiles mainly due to following reasons,

1. Machine used to produce tiles is manufactured in China resulting low manufacturing cost
2. China tile manufacturing is backed by huge local consumption making them to optimize their manufacturing cost
3. Availability of raw materials

I have attached in the annexures the figures how china based tile manufacturing increased their global market share gradually. Accordingly risk for local tile manufacture from this world giant is very high. And it is being increased continuously.

In order to mitigate the threat of global manufactures, local tile manufactures need to optimize their supply chain. And also according to the literature customer value proposition must be embedded in the supply chain in order to increase market share or retain the existing customer base.

Based on the interview conducted some of the value proposition are being embedded in to their supply chain strategies while some are being ignored. One good example is one of the local tile manufacture focus on innovation but ignore cost and responsiveness. Another manufacture consider cost and responsiveness but innovation is ignored. As a result their market share being paled or reduced while global products increase their market share.

Accordingly in order to increase the market share against global competition, local tile manufacture to embed customer value propositions in their supply chain.

According to the survey conducted by MIT/PricewaterhouseCoopers Global Supply Chain and Risk Management Survey 209 companies with global footprints in 2013

Their value propositions that lead to success. High customer service level (34 percent) and flexibility (27 percent) were cited as the top two drivers followed by cost minimization (22 percent) and efficient use of inventory (14 percent).

### **5.1.2 Risk of functional optimization**

According to the interview conducted among manger of local tile manufactures revealed that their supply chains are not optimized as an integrated system. Instead functional optimization are being done based on the set KPIs for each departments. They accepted that some of the decisions are directly impact to increase the risk of supply chain risks. One of the best example is in order to optimize manufacturing cost, factories tend to produce bulk orders rather than repeated orders resulting increase of inventory levels.

Sales departments tend to sell discounted products for their sales targets which lead to inaccurate information for future forecasting.

Another risk cause by functional optimization is lack of the ownership of the responsibilities falls on the boundaries of the departments. As an example finished goods being produced at the factories need to be taken care by the warehouses even though existing warehouse are 100% occupied.

These type of risks can be mitigated by setting departmental goals though collaborative approach with participation of all the members. Supply risk manager need to be appointed in order to make sure set goals doesn't have an impact on entire supply chain objectives.



### **5.1.3 Risk of lack of integration**

According to the interview conducted, one of important fact revealed was lack of the integration among members in their supply chains. This lead to silo effect causing disruption to entire supply chain.

Supply chain integration need to be done at least for downstream of the supply chain in order to mitigate the risk

### **5.1.4 Information flow risk**

This is most critical risk in local tile manufactures as revealed from the detailed interview conducted with managers. Due to investment cost of information systems, local manufacture are using basic version of the ERP systems or customized versions. As a result information visibility is available in the most of the organizations which lead to inaccuracy of information, lack of efficiency of the information, distorted information.

Bull whip effect, stock out of fast moving stocks, product obsolesce leading to increase warehouse cost are common issues in the local tile manufactures resulting increase product cost and less product margins.

Another factor arise due to bull whip effect inefficiencies at the warehouse operations, damage increase, lack of customer service level and responsiveness.

Due to the inefficiency of the information flow, demand forecast is being done manually based on the available information. But most of the information are distorted. As a result actual demand get exaggerated while slow moving discounted products also tend to be produced.

Information system need to be updated in order to get accurate information and also it must be flexible to get required alerts on obsolesce product, need to facilitate demand planning based on point of sales data and materials requisition plan triggered by the demand plan.

### **5.1.5 Manufacturing related risk**

According to the interview conducted with managers related to manufacturing revealed that their manufacturing plant has some limitation for producing different tile sizes at the same time. And minimum order quantity to be produced also one of the limitations they face. Major limitation or the issue face by the manufacturing department is cascading the final product in to different shades and size variations resulting reduction of final out put (Yield).

### **5.1.6 Supply related risk**

According to the one of the supply manger I interviewed explained that most of the raw materials that are required for the body of the tiles are sourcing from local suppliers. But those suppliers doesn't have a technology to purify those materials specially ball clay (One of the material use to produce) there are unnecessary particle being mixed with those raw materials. One advantage for the company when they buy materials from raw form, price of the materials is less. But on the other hand variation of the final product and yield percentage has a greater impact due to this reason. Therefore trade-off between advantages and disadvantages need to be carefully analysed.

### **5.1.7 Financial flow related risks**

According to the manager I interviewed suggested that their financial related risks are currency fluctuation, price of raw materials, fuel price increase, risk associate with new investment and recovery risk of receivables.

Hedging is one of the strategy that can be adopted but according to the literature there are many factors need to consider prior to adopt.

Risk of investment can be mitigated by forming a team encompassing all the departments in the supply chain.

### **5.1.8 Risk of natural disasters**

According to the literature it is noted that majority of the organizations in the world are not concentrating or have not taken necessary actions for possible risk could be occurred due to natural disasters. There are few reasons causing for not implementing risk mitigations plans.

1.) Revenue is not sufficient to implement a supply chain wise risk mitigation plan 2.) Most of the managers considers only the high possible, high impact risks, but most of them are ignoring high impact low possible risks, 3.) Rewards systems of most of the organizations doesn't encourage managers to take precautions against possible risks. 4.) Most of the organization who has implemented supply chain wide natural disaster management are located in the countries where likelihood of natural disaster is high than the other countries. One of the best examples are organizations in japan are more vulnerable for natural disasters of tsunami and earth quark compared with most of the other countries in the world. This information is based on the research done by PricewaterhouseCoopers for 209 companies with global foot prints in 2013 Tile manufacturing organizations in Sri Lanka are vulnerable for frequent flood related disasters according to the organizations I interviewed. Main issues arisen with flood menace is supply of raw materials locally. Since this is a recurrence effect they have taken preventive measures as to keep additional stocks from those raw materials which are sufficient enough to cater in case of flood effect. But they revealed further that due to government regulations feldspar and ball clay mines are being monitored and controlled by the government resulting scarcity for some periods.

Except flood there is no any natural disasters has been affected in local tile manufactures in Sri Lanka. Therefore it is not cost effective thinking about mitigation of natural disasters which are less likely to the happen when compared with their revenues.

## **5.2 Implications of the research**

### **5.2.1 Manufacturing limitations**

Unlike most of the other supply chains, manufacturing process are not flexible in the tile supply chains so that product postponement strategies can't be applied. Therefore most of the local tile manufacturing companies in Sri Lanka adopt make to stock strategy with time postponement. Till the demand is generated stocks will be stored at the centralized Warehouses.

In order to manage the demand they are adopting strategies such as shift demand in time, shift demand in market, shift demand in to similar feature products according to the findings of the interviews. Selling slow moving products at discounted price, moving less demand products in to new markets,

### **5.2.2 Lack of supply chain integrations**

Integration of the supply chain is at marginal level in the local tile manufacturing organizations. As a result they are suffering a great impact from the bullwhip effects. Warehousing cost is increased continuously and storage capacities are not enough to store finished goods being produced continuously. It lead to increase inefficiencies and many overheads to manage the inventory.

### **5.2.3 Lack of visibility**

Visibility in local tile manufacturing supply chains are at marginal levels similar to lack of integration leading to inaccuracy of the information of the actual demand. Market signals can't be identified due to that reasons causing obsolesce of the products. Information flow inefficiencies and marginal flexibility lead to increase the bullwhip effect further.

#### **5.2.4 Inherent issues of industry**

Manufacturing processes marginal flexibilities: Due to the inherent nature of the tile manufacturing processes, product postponements can't be applied. And another factor is all the tiles being manufactured need to be fired in a kiln which can't be stopped till particular SQM of tiles being produced. That led to limit the minimum no of SQM to be produced. Same issue lead to produce than actually required resulting excess inventory. Therefore customized orders can't be made when the volume is relatively low.

And another limitation of the manufacturing processes is small variation of the raw materials result in final product defect and when they change the settings to minimize the defects another defect likely to be formed. As an example when they identify a surface unevenness as a defect, they make some changes in the setting to rectify the issue. That changes most of the times result in shade variation of the final products according to the production managers I interviewed.

Locally purchasing raw material especially ball clay is being supplied in raw form. Therefore factories need to put some additional effort to process them before use. But they don't have sufficient technologies and space to do that processing perfectly. Some defects are likely to be formed due to that reasons. Technology need to be improved at the factories or at the supplier to get processed raw materials to reduce the variations of the final product.

#### **5.2.5 Demand related factors**

Due to rapid technological advancement, new tile sizes are being introduced in to the market globally at a reasonably low cost. This issue directly affect to local tile manufactures as demand for their tile sizes are being shifted to big tile sizes making small sizes obsolete. This increase the requirement of additional storages and additional cost to store them. That directly affect to the profitability of the organization causing to increase the prices of the product on the other hand making marginal affordability to buy the products for consumers.

### **5.2.6 Supply related factors**

Supplier's monitoring and quality checking is being carried out continuously by the local tile manufactures for their domestic suppliers. 90% of the raw materials are being supplied from local suppliers according to the managers I interviewed. Even though up stream system integration is at marginal level in the local tile manufacturing supply chains, they are maintaining a good supplier relationship and supplier monitoring system. This has been influenced by the basic theory of economies "supply against demand" for those raw materials in the country. Since there are only three main players in the country for local tile manufacturing and their cumulative market share from domestic tile consumption is amounted to 35%. According to managers I interviewed confirmed that there are enough local suppliers in the country and dual sourcing is not a difficult task to manage at a minimal cost.

But when it comes to the foreign suppliers, supplier performance monitoring is at marginal level. But their reliability and the quality of the materials are being supplied are up to specification as revealed in the interviews. In event of lack of the supply of materials from foreign suppliers they use two techniques to face that issue. First method is to go for next available supplier and the other method is they looking for alternative materials through R&D. One manager confirmed that they had a one incident of lack of specific kaoline type which led them to find an alternative which reduced the total raw material cost and same quality or above products.

### **5.2.7 Financial related factors**

According to the managers interviewed revealed that their supply chains are highly affected due to currency fluctuation, fuel price increase and inflation of the economy. As mitigation strategies they are adopting cost reductions of the entire supply chain through various tools

such as TPM and KPI base departmental goals related to cost reductions. Further they are in to analyse of past records to increase future demand forecast accuracy.

### **5.3 Conclusion**

Local tile manufacturing supply chains are vulnerable for specific risks than other supply chains such as limitation of the manufacturing capabilities resulting marginal flexibility. Rectification of one defect leading to another defect also considered to be unique for local tile manufacturing industry. Mitigation of those risk is not an easy task mainly due to firing of the tiles through a kiln.

Information flow accuracy and efficiency in the local tile manufacturing supply chains are at a risk. Demand forecasting and production planning accordingly based on inaccurate information flow is a very common among all the main tile manufactures in Sri Lanka. According to the finding of the study lack of attention and investment ability in to a proper information management system are the main reasons not to implement best in class information management system. Bullwhip effect is the main consequence among all the local tile supply chains resulting huge amount slow moving and obsolete items filled in the warehouses. The other impact is stock out situations for fast moving products resulting loss of sales and consumer dissatisfaction. Due to the lack of efficiency most of the required information can't be retrieved through the information system requiring manual preparations. therefore trade-off between benefits and investment on increasing of information visibility of the supply chain need to be analysed and to be taken required actions in order to prevent repercussion found through this study by the local tile manufacturing companies. Hence they will be able to reduce the stock out situations and obsolesce of the items leading to reduce warehouse cost.

Existing rewards systems in the local tile manufacturing supply chain encourage to optimize functional level goals sacrificing the entire supply chain objectives. The same factor has affected too many other issues as well, such as not taking responsibilities for roles that falls on to margins between two departments as I have described in the analysis section, increase of bullwhip effect and ignoring possible risk that could be arisen by the actions to optimize departmental goals. Therefore reward system need to be reconsidered and analysed to remove harmful goals of the departments which impact to entire supply chain objectives.

Another risk identified in the local tile manufactures during the study decisions are being taken based on the gut feelings of the top managements resulting many additional cost to the supply chains. It is further noticed that most of the supply chain top managements tend to give solutions consequences without identifying root causes. One of examples is increasing warehouse space and production capabilities without identifying root causes. Main root cause is to increase warehouses and productions capabilities is due to product obsolesce as a result of information inaccuracy for demand forecast. Rather they try to increase the information visibility they try to get rid of the impact of the root causes.

Risk of natural disaster are unlikely in Local tile manufacturing supply chains except the flood. All the manufacturing companies are aware of the flood impact and already have taken required actions to mitigate the impact in to their supply chain.



## 6. RECOMMENDATIONS

Based on the study below mentioned recommendations are proposed to reduce the local tile manufacturing supply chain related risks.

1. To set up a mechanism to process ball clay in order to minimize final product defects
2. Increase the information accuracy and efficiency in order to get timely alert and to increase the demand forecast accuracy based on the point of sales data.
3. Rewards system to be reconsidered to remove harmful departmental goals and to replace with new goals which are aligned with entire supply chain objectives.
4. Moderating team to be formed to make long term strategic decisions in order to mitigate the possible risk.
5. Moderating team to be consisted with risk favor and risk averse members to thoroughly discuss tradeoff against risk and benefits and to make better decisions.
6. Appointing an industry expertise person in to the supply chain as the risk manager and to be involved with each and every functional level decisions to mitigate risk and identification of root causes of the risk in advance.
7. Productions planning to be decentralized with strong central control
8. To remove the vagueness of the ownership of responsibilities falls on to the boundary of two departments
9. Increase the supply chain flexibility by reducing non value added activities from the supply chains and through process reengineering
10. Applying continuous improvement mechanism through entire supply chain to improve out dated processes in to more responsive processes
11. Appoint a person who is overlooking entire supply chain to make sure all the departments are working towards to achieve common supply chain goals.

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## ANNEXES

Questionnaire used as frame work for in-depth interviews conducted.

### **Supply related risk & mitigation**

1. What is your supplier selection procedure?
2. How many raw materials your company purchase from local suppliers?
3. What are the main issues with local suppliers?
4. How soon you can get the local raw materials in an emergency?
5. Has natural disasters affected your local suppliers such as flood?
6. If affected, what actions you have taken to mitigate the risk from those factors in to your organization?
7. What is your buffer stocks periods in months and why you keep that much period of buffer stock?
8. How many raw materials your company purchase from international suppliers?
9. What are the main issues with foreign suppliers?
10. Are dealing with multiple suppliers or one supplier for one material?
11. In case of incapability of your single supplier, what actions you have taken to reduce the impact?
12. Why you don't deal with dual suppliers for raw materials?
13. What are the disadvantages to maintain multiple suppliers?
14. Do you have any data about the supplier's current capabilities & stock levels?
15. How soon will you be able to supplier disruption to take necessary actions?
16. What are the government regulations affecting to your supply base?
17. How you develop new products? At what stage you deal with supplier?

### **Operational related risk & mitigation**

18. What are the limitation in your manufacturing activities?
19. How you forecast for future demand?
20. What is the accuracy of forecast?
21. What percentage of items being obsolesce?
22. What cause to increase the bullwhip effect?
23. What actions you have taken to reduce the bullwhip effect?
24. What factors lead to defect products?
25. What type of manufacturing related complaint on the product raised from the consumer?
26. What cause those type of defect?
27. What actions have you taken to mitigate those defects?
28. Are your manufacturing plant flexible enough to cater sudden demand?
29. What actions can be done to increase the flexibility?
30. What are the industry inherent limitation?

### **Reward System related risk**

31. Is your reward system align with overall supply chain objectives?
32. Is your reward systems affect to supply chain interruption such as product obsolesce / bullwhip effect/inaccuracy of information/ignoring possible risks/ product defect/lack of ownership ?

### **Demand related risk and mitigation**

33. What is your market share?
34. Who are your main competitors?
35. What advantage available with your competitors to compete with you?

36. What are your product value propositions?
37. What type of possible improvements can be done to improve the market share?
38. What external factors affect to consumer buying decision?
39. What factors you consider for new product developments?

### **Information sharing risk and mitigations**

40. What is the information management system you use?
41. What is the information accuracy level of the system?
42. Is your demand forecast done in the system or manually?
43. Is your material requisition plan done through the system or manually?
44. Do your system has the ability to trigger the required information/alerts related to inventory status/product obsolesce alert prior / inventory management information such as put away location ,etc ?
45. How secure is the information system from the disruptions?
46. Have you used a third party to handle your information system?
47. How you mitigate the possible risk with involve with a third party?

### **Financial flow related risk and mitigation**

48. What are the financial flow related risks in your supply chain?
49. What actions you have taken to mitigate those risks ?

### **Network Risk**

50. In your organization have you found any areas no one is willing to take responsibilities as a result of difficulties to identify the responsible person?
51. How sensitive your supply chain to market signals such as competitor move/competitor reactions/new trends resulting demand shift?



## Disruptions risk

52. What type of natural disasters your supply chain is vulnerable for?

53. What actions you have taken to mitigate the risk of them?

## Statics of global tile manufacturing and consumption

<b>WORLD MANUFACTURING AREAS</b>			
<b>AREAS</b>	<b>2016 (Sq.mt Mill.)</b>	<b>% on world production</b>	<b>% var. 16/15</b>
<b>EUROPEAN UNION (28)</b>	1,304	10.0	+7.1
<b>OTHER EUROPE</b> (Turkey included)	573	4.4	+1.1
<b>NORTH AMERICA</b> (Mexico included)	358	2.7	+8.5
<b>CENTRAL-SOUTH AMERICA</b>	1,086	8.3	-9.0
<b>ASIA</b>	9,331	71.5	+8.1
<b>AFRICA</b>	399	3.1	-3.4
<b>OCEANIA</b>	5	0.0	0.0
<b>TOTAL</b>	<b>13,056</b>	<b>100.0</b>	<b>+5.7</b>

Table III. – World manufacturing areas

<b>WORLD EXPORTING AREAS</b>			
<b>AREAS</b>	<b>2016 (Sq.mt Mill.)</b>	<b>% on world exports</b>	<b>% var. 16/15</b>
<b>EUROPEAN UNION (28)</b>	903	32.3	+5.5
<b>OTHER EUROPE</b> (Turkey included)	147	5.3	+5.8
<b>NORTH AMERICA</b> (Mexico included)	60	2.1	-7.7
<b>CENTRAL-SOUTH AMERICA</b>	141	5.0	+11.9
<b>ASIA</b>	1,513	54.2	-0.8
<b>AFRICA</b>	30	1.1	-14.3
<b>OCEANIA</b>	0	0.0	-
<b>TOTAL</b>	<b>2,794</b>	<b>100.0</b>	<b>+1.7</b>

Table IV. – World exporting areas

<b>WORLD CONSUMPTION AREAS</b>			
<b>AREAS</b>	<b>2016 (Sq.mt Mill.)</b>	<b>% on world consumption</b>	<b>% var. 16/15</b>
<b>EUROPEAN UNION (28)</b>	964	7.5	+5.9
<b>OTHER EUROPE (Turkey included)</b>	527	4.1	-0.9
<b>NORTH AMERICA (Mexico included)</b>	547	4.3	+7.9
<b>CENTRAL-SOUTH AMERICA</b>	1,180	9.2	-7.7
<b>ASIA</b>	8,818	69.0	+8.0
<b>AFRICA</b>	691	5.4	-5.5
<b>OCEANIA</b>	56	0.4	+7.7
<b>TOTAL</b>	<b>12,783</b>	<b>100.0</b>	<b>+5.0</b>

**Table V. – World consumption areas**

<b>TOP CONSUMPTION COUNTRIES</b>							
<b>COUNTRY</b>	<b>2012 (Sq.m Mill.)</b>	<b>2013 (Sq.m Mill.)</b>	<b>2014 (Sq.m Mill.)</b>	<b>2015 (Sq.m Mill.)</b>	<b>2016 (Sq.m Mill.)</b>	<b>% on 2016 world consumption</b>	<b>% var. 16/15</b>
1. <b>CHINA</b>	4,250	4,556	4,894	4,885	5,475	42.8%	12.1%
2. <b>INDIA</b>	681	718	756	763	785	6.1%	2.9%
3. <b>BRAZIL</b>	803	837	853	816	706	5.5%	-13.5%
4. <b>VIETNAM</b>	254	251	310	400	412	3.2%	3.0%
5. <b>INDONESIA</b>	340	360	407	357	369	2.9%	3.4%
6. <b>USA</b>	204	230	231	254	274	2.1%	7.9%
7. <b>SAUDI ARABIA</b>	230	235	244	263	248	1.9%	-5.7%
8. <b>TURKEY</b>	184	226	215	234	241	1.9%	3.0%
9. <b>MEXICO</b>	187	187	197	218	235	1.8%	7.8%
10. <b>THAILAND</b>	160	180	175	192	189	1.5%	-1.6%
<b>TOTAL</b>	<b>7,293</b>	<b>7,780</b>	<b>8,282</b>	<b>8,382</b>	<b>8,934</b>	<b>69.9%</b>	<b>6.6%</b>
<b>TOTAL WORLD</b>	<b>10,964</b>	<b>11,582</b>	<b>12,081</b>	<b>12,177</b>	<b>12,783</b>	<b>100.0%</b>	<b>5.0%</b>

Source: MECS, Acimac Research dept. "World production and consumption of ceramic tiles", 5th edition 2017

**Table VI. – Top consumption countries**

TOP IMPORTING COUNTRIES									
COUNTRY	2012 (Sq.m Mill.)	2013 (Sq.m Mill.)	2014 (Sq.m Mill.)	2015 (Sq.m Mill.)	2016 (Sq.m Mill.)	% on 2016 national consumption	% on 2016 world imports	% var. 16/15	
1. USA	147	165	164	179	194	70.8%	6.9%	8.4%	
2. SAUDI ARABIA	155	170	156	188	167	67.3%	6.0%	-11.2%	
3. GERMANY	89	89	95	100	115	91.3%	4.1%	15.0%	
4. IRAQ	105	121	102	106	112	98.2%	4.0%	5.7%	
5. FRANCE	107	96	99	99	104	87.4%	3.7%	5.1%	
6. SOUTH KOREA	61	65	76	72	75	60.0%	2.7%	4.2%	
7. PHILIPPINES	38	46	53	60	75	65.2%	2.7%	25.0%	
8. UAE	52	53	54	64	59	71.1%	2.1%	-7.8%	
9. INDONESIA	37	36	46	45	57	15.4%	2.0%	26.7%	
10. ISRAEL	43	48	44	52	57	91.9%	2.0%	9.6%	
<b>TOTAL</b>	<b>834</b>	<b>889</b>	<b>889</b>	<b>965</b>	<b>1,015</b>	<b>62.1%</b>	<b>36.3%</b>	<b>5.2%</b>	
<b>TOTAL WORLD</b>	<b>2,524</b>	<b>2,670</b>	<b>2,705</b>	<b>2,746</b>	<b>2,794</b>	<b>21.3%</b>	<b>100.0%</b>	<b>1.7%</b>	

Source: MECS, Acimac Research dept. "World production and consumption of ceramic tiles", 5th edition 2017

**Table VII. – Top Importing countries**