Risk Factor Analysis for Supply Chain Effectiveness: A Case Study on Textile Industry of Bangladesh

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ABSTRACT

Supply chains often differ substantially from each other. Hence, their impact and the way in which the affect the risk profile of firms differ, too. Over the years, attempts have been made to classify the related risk factors, but it was found that there are too many distinctive sources of risk and related variables. This study is an attempt to sort out major risk factors affecting supply chain effectiveness in the textiles industry of Bangladesh. The result of the exploratory research has clearly point to man-made disruptions as the most important factor, with customer dynamics, innovation, public policy factor and natural disruption factors on the ranks behind them. Interestingly, the factor which apparently is least controllable and predictable among all factors under consideration ends up in last place in our analysis, even though Bangladesh is among the most vulnerable and severely affected countries with respect to the impact of climate change. A possible interpretation of this finding is that the familiarity of the population with natural disasters, and the pro-active measures taken to limit their impact, weakens the perceived severity of the event types behind the natural disruption factor. In contrast, political instability, labor unrest and terrorism, which make up the man-made disruption factor, are perceived as the major threats to the industry.
Key words: Risk Factors, Supply chain, Textile Industry.

INTRODUCTION

Supply chains vary considerably, depending on what is being produced as well as on how and where production takes place. Supply chains of mass-market consumer products tend to differ markedly from those for goods with lower turnover and smaller markets; moreover, the importance of technology, the need for very specific components, and the market structure are of significant importance. Clearly visible

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differences can, for instance, be observed between the agricultural supply chains, natural resource supply chains, and newly focused service supply chains. Every individual supply chain has different characteristics, is exposed to different challenges, and requires different operating and policy environments. This adds complexity and it needs to be accounted for in related analyses (Elms & Low, 2013).

Almost every operational aspect of Supply Chain Management (SCM), such as operations management, materials handling, distribution, logistics, transportation, warehouse management, purchasing, marketing and information technology has been extensively studied, as Giunipero et al. (2008) point out. However, according to Christopher and Holweg (2011), there is rather limited literature that addresses risk management as a separate function that impacts contemporary SCM. It is on this aspect that the research presented here has focused.

Due to the heterogeneity of individual supply chains, the risk factors might vary with the particular type under investigation, causing their perceived impact on business to differ in magnitude from case to case. A typical example of such is the PRAM methodology was developed by Dow Chemical Company to identify and measure supply chain risks, and to assess their respective impact. The authors base their approach on four specific factors, which supply market risk, supplier risk, organization risk and supply strategy risk (Trkman and McCormack, 2009). While the same factors are also impacting supply chains in, e.g., the IT or Textile industries, the form they take and the strength of their respective impact can be expected to differ. In the literature of Supply Chain Risk Management (SCRM), past research does not seem to have led to a clear consensus about methodology and topic priorities (Behnezhad et al., 2013).

In many countries and regions, supply chains of several companies faced considerable challenges which, in some cases, ultimately stretched their capabilities to the breaking point. In some regions, this was due to the occurrence of natural disasters, but on a global scale, the economic turbulences due to the world financial crisis of 2007-2009 were the driving force behind this development. Supply chains, which once were thought of almost as an autopilot, in fact face many dangers from domestic and international sources. Due to its global nature and significant impact supply disruptions may have on the firm's financial performance, the supply chain arguably is a key element of a company's the risk profile. Risk is virtually all-pervasive and certainly a fact of life for any supply chain, given that it involves dealing with issues like quality and safety challenges, supply shortages, legal issues, security problems, regulatory and environmental compliance, weather and natural disasters, and terrorism(see Global Supply Chain Institute,2014). Standing up to this challenge is rendered even more demanding by the increased competitive pressure and the globalization of markets (Ouabouch & Amri, 2013).

The textile industry is considered by many the lifeline Bangladeshi economy. Its earnings of USD 12233.23 million amounted to a staggering81.7 percent of the country's total exports in the first eight months(July-February) of the fiscal year (FY) 2013-14,up from USD 10225.68 (80.2 percent of total export receipts)during the corresponding period of FY 2012-13 (source: Bangladesh Economic Update, 2014).Even after the devastating fire at Tazreen Fashion Garments in November, 2012, and the collapse of Rana Plaza, an eight-story commercial building, in April 2013, it is felt that there is no alternative to Bangladesh, of which the textile industry accounts for 13 percent share of GDP and recently boasted growth rates of 12 percent per annum. While Bangladesh offers some very promising incentives for enterprise establishment, including low production costs and the provision of specialized export processing zones, a number of challenges may also hurdles for companies targeting to source from here (Apparel, Fashion & Luxury Practice, 2011).

In order to add sustainability to the recently experienced growth of the country's textile industry, it is important for supply chain management professionals to know about potential risks factors from where disruption may arise in severe form, which means identifying them, get priorities right and take carefully targeted steps to mitigate. The current paper is intended to be a step into this direction.

LITERATURE REVIEW

In everyday language, the term "risk" is commonly used to denote the possibility of losing something of value. Given the large variety of its manifestations and potential sources, "risk" is by necessity a multidimensional construct. In a business context, on one hand, risk can arise from internal sources, e.g. inadequate or failed internal processes or systems, human error or misbehavior. On the other, risk can have its origin in external sources, e.g. price falls or slumps in demand for own products, supply disruptions or price increases for key inputs, or the failure of contracting partners to fulfill their obligations.

According to Juttner et al. (2003), supply chain risks hence comprise "any risks for the information, material and product flows from original supplier to the delivery of the final product for the end user". Slightly further down below, the author's state: "In simple terms, supply chain risks refer to the possibility and effect of a mismatch between supply and demand. 'Risk sources' are the environmental, organizational or supply chain-related variables which cannot be predicted with certainty and which impact on the supply chain outcome variables. Risk consequences are the focused supply chain outcome variables such as costs or quality, i.e., the different forms in which the variance becomes manifest" (Juttner et al. 2003).

Each particular supply chain has distinct characteristics, faces different challenges, and depends different operating and policy environments. Consumption patterns and production are changing around the globe, which is eventually forcing the people in charge to rethink the traditional assumptions about their functioning. One of the dominant drivers for today's globalized supply chain is the power of information.

On the other hand, new demands on the environment and the threat of depleting natural resources require attention from both business and government. To a growing number of observes, it seems clearly evident now that traditional growth models and patterns of consuming natural resources may be unsuited for a changing world. This calls for innovation efforts directed at making both production and consumption more sustainable.

Sustainability has another important side – that of social inclusion and distributional equity. A further challenge is how to manage the numerous risks relating to production models, market uncertainties and unpredictable consumer behavior. Technology and technological innovation, apart from being fascinating, place considerable demands on both public policy and industry (Elms & Low, 2013). Moreover, the arrival of just-in-time (JIT) and lean manufacturing technologies in industrial sector opens lots of opportunities and hopes. However, according to Engardio (2001) and Svensson (2002), JIT supply chains have specific risks of their own which may go unnoticed unless the related sources of vulnerability are thoroughly explored (Juttner et al. 2003).

In a country like Bangladesh, there is at least one supplier one virtually every day that has to deal with a threat to its business. More common and less publicized examples include power outages, labor unrest, cyber crime, local political scandals or problems to obtain bank funding. There is a danger that at least some of these potential supplier problems mayflies under the radar of supply management professionals, although they can lead to major business issues that ultimately flare up into supply chain disruption, legal issues or reputational damages.

As discussed by Lessard (2013), "many discussions of supply chain risk begin with graphic depictions of situations where a small disruption leads to an unexpectedly large impact". Sheffi (2005) describes the sequence of events beginning with a lighting strike to a Philips factory in New Mexico that led to the disruption of a generation of cell phones, with Nokia successfully overcoming the disruption through proactive management while Ericsson lost out", thus allowing a glimpse into the vulnerability of today's globalized supply chains, which is due to their high degree of complexity, the strong interdependence among its elements, and their considerable geographic dispersion and organizational fragmentation.

The typical length of supply chains in the textile industry is considerable since it includes, among others, raw materials production, complement production, and clothing production. Against this background, it does make sense to apply supply chain management to the textile industry, particularly in Bangladesh, where the enhancement of competencies in this field this is considered one of the most promising tools. (Ali & Habib, 2012).This is what motivates the authors to work in this arena.

Each of these varieties of supply chain has quite different characteristics, facing different challenges, and requiring different operating and policy environments. Consumption patterns and production are changing around the globe, and it's eventually forcing all of us to rethink the traditional assumptions about the workings of supply chains and the public policy shape. One of the dominant drivers for today's globalized supply chain is the power of information.

On the other hand, the necessity to protect the environment and avoid excessive depletion of natural resources requires attention from both business and government. Sustainability has another important aspect, which is the one of social inclusion and distributional fairness. There is a growing consensus that traditional growth models and consumption patterns are often at odds with these demands, and that human activity in business and government needs to focus more on sustainably and on promoting innovation.

Technology and technological innovation are fascinating issues, both for policy and industry (Elms & Low, 2013). Arrival of JIT and lean manufacturing technology in industry opens many opportunities and gives rise to great hopes; however, as Engardio (2001) and Svensson (2002)maintain, just-in-time supply chains have a number of specific risk that are concealed from the casual view, and some of the related vulnerability issues remain unexplored (Juttner *et al*. 2003).

Among the problems faced by developing countries like Bangladesh when nourishing textile industries, the most important tribulations persist in the field of financing, infrastructure, taxes and regulations, compliance, sustainability issues and - perhaps most importantly - political stability.

In this paper, an attempt will be made to explore the risk factors affecting the supply chain of textile industry in Bangladesh. The outcomes are intended to enhance the ability of decision makers in both business and government to set the priorities right and finding ways of mitigating risks and reducing unnecessary complexity.

Managing today's global supply chains involves the need to cater for variations in customer demand (Lee, 2002), as well as to cope with possible disruptions. Origins of possible disruptions have often been classified into three types, which are a) internal to the firm, b) internal to the firm's supply chain, and c) external to the firm (Schmidt and Raman, 2012). Due to its relative novelty, the concept of Supply Chain Risk Management (SCRM) still tends to be somewhat incoherent (Behnezhad *et al*., 2013),and no clear consensus about what might be a useful classification of risks has yet developed. Nevertheless, several classification patterns for the related risks, and a number of methodologies have been suggested, most of which mainly focus on predicting disruptive events rather than attempting to identify the root causes of uncertainties for a single business, an economic sector, or the economy as a whole. This task is, however, made difficult by the near-continuous continuous changes due to turbulences in the natural as well as the political, social and economic environment. In line with Trkman and McCormack (2009) we therefore advocate a comprehensive holistic approach to SCRM which does not focus exclusively on supplier-associated turbulences but takes various sources of uncertainty into account.

When it comes to disruptions originating from natural disasters, in Bangladesh, the Indian Ocean earthquake and tsunami of 2004 represents of the costliest natural disasters on record, wreaking some US$235 billion worth of damage, according to World Bank estimates. (In comparison, the cost inflicted by Hurricane Katrina on the State of Louisiana amounted to about $81 billion).

The earthquake and tsunami that struck Japan in 2011 is a powerful example how a natural disaster originating in one part of the world can have far-reaching consequences in areas that are very remote. Since Japan produces about 60 percent of the world's silicon for semiconductor chips, global prices for computer memory components spiked by 20 percent right after the disaster. Moreover, a considerable number of U.S. auto plants were forced to halt production until shipments of specialized paints and computer chips resumed. The full economic, cultural and sociological aftershocks of the earthquake in Japan—the worst disaster to hit the country since World War II— were felt in many industries and among many customers. Manufacturers scrambled to replace disrupted supplies, and some were even forced to close down. With the benefit of hindsight, Professor Willy Shih of Harvard Business School has given a conclusive explanation how deficiencies in the field of risk identification can exacerbate the consequences of such disaster: "In the race to provide better quality at lower prices, manufacturers picked very narrow, optimized supply chains," he says, manufacturers "put all of their eggs with one supplier that had the best product at the lowest price" (Park *et al*., 2013). As a consequence, disruption risk has recently received increasing attention. The reason is undoubtedly that, with longer transport routes and a seemingly ever-increasing need for speed, the impacts of disruptions have become more severe and the time and space for corrective action has shrunk. Becoming aware of the considerable fragility of their supply chains, many companies of different industries currently seek to rethink and adopt their supply chain strategies.

Labor actions, too, are of high significance to the flows of global trade. Improvements in infrastructure and logistics that are deemed desirable by decision makers in business and public policy often collide with the interests of those parts of the population that are required to relocates a consequence, which may give rise to considerable social unrest and hence add to the existing supply chain risks (Cowen, 2014). In many countries, terrorism and political instability are even more dangerous sources of risk. While the event that has received most attention in recent history certainly is the 9/11/2001 World Trade Center attack, sabotage and other destructive actions, and politically motivated violence have development into near-permanent threats in some countries. This, too, increasingly affects supply chains because of the increasing trend to global outsourcing and the attendant increase in the length and complexity of supply chains. (Kleindorfer & Saad, 2005). Hence, these risks call for constant vigilance.

The global financial crisis of 2007-09 came as a powerful reminder of the risks that can emerge from fragile financial systems. Moreover, uncertainties prevail with regard to the costs and availability of trade and investment financing. Since such risks affect both government and business, it appears obvious that acting on shared responsibilities can make much difference in enhancing the human capacity to deal with such uncertainties.

The revolution in manufacturing known as ‘global value chains‘ has changed the world of trade policy as much as it has changed the global industrial landscape. Recent research suggests that border management as well as transport and telecommunications infrastructure services have a far higher impact than trade tariffs do. This has led to the supposition that improving infrastructure and management can increase global GDP to a much larger extent than the complete elimination of tariffs could. This supports the view that trade policy, financial policy, and regulations are also risk factors for supply chains.

Product and process innovation are further key factor of success in business. Kenna (2011) exemplifies this by pointing to the case of Zara, one of the World’s top retailer brands of textile fashion. Zara uses air shipment nearly for all its shipments includes sourcing from Asia. Despite high costs of air shipping, Zara is still one of the most profitable clothing retailer with high brand value and a great deal of customer satisfaction because their business model is strongly focused on fashion. Zara’ plans to move in the online retail world, Zara’s strategic online presence will help in expansion may even enable the company to surpass H&M in the U.S. market.

Compared to other retailers and fashion, Zara stocks only clothing in limited quantity. The company Zara has a design team of 200 people (compared to competitors who have significantly smaller design teams).With such a stronger team all new styles became available in Zara stores much faster than in those of its competitors, enabling Zara to be “ahead of the curve” in the world of fashion.

Another source of competitive advantage for Zara’s is its pricing model. Zara tends to price its products based on its styles and - perhaps surprisingly - on location. Its charges higher prices in the American market and in some parts of Asia than in Europe. The combination of the above factors makes Zara a role model as to how business model, organization, and technology are important variables in supply chain.

RESEARCH OBJECTIVES

The main objective of the study is to find out the Risk factors of Supply chain that the entrepreneur or executives/professionals involved in supply chain management consider when they choose for their industry.

RESEARCH METHODOLOGY

The survey for the research has been conducted in the very densely industrialized areas of Gazipur, Tongi, Savar, Mirpur, Narayngonj and Narsinghdi, which are part of the Greater Dhaka industrial area. The respondents were approached at their respective manufacturing location. The questionnaire consisted of 15 Liker scaled statements on which the respondents were asked to provide their opinion, resulting in 15 variables. There is a direct relationship between the number of scale points and the reliability score. The scale used in the current study was from “1” meaning “Strongly Agree” to “5” meaning “Strongly Disagree” (Rahman, 2009). All the Liker scaled statements were randomized throughout the questionnaire to reduce any potential bias that could result from answering statements that represented the same concept. Most of the respondents held management positions in logistics and supply chain management. The primary data required collected through personal interviews. In addition, supplementary information was collected from a number of sources including academic books, journals, and websites in order to and thus to identify the key variables. The research is exploratory in nature.

Sampling Methods

The sample was gathered by simple random sampling. The respondents were representatives or professionals involved in supply chain operations of 100% export oriented textile manufacturers. 135 questionnaires were distributed and 104 questionnaires were received back. Therefore there are 104 usable cases were obtained, implying a response rate of 77%. The data collection procedure for the survey took one-and-a-half months.

Method of Data Analysis

The data gathered data from the survey were been analyzed with factor analysis, using the statistical software package SPSS, version 17. Factor analysis is a statistical tool to reduce and compound variables that have high degree of mutual dependency in statistical terms. Here, it was used determine the major risk factors.

Limitations of the Research

The sample size is comparatively small for conducting such an investigation research. The fact that there are only 104 respondents, which appears to be a small number given the size of the textile Industry in Bangladesh, may give rise to concerns regarding the representativeness of the results. This limitation resulted from time and funding constraints. However, since similar research activities have not yet been carried out for Bangladesh, the current investigation may nevertheless serve as a starting point for further related research efforts.

Another possible limitation of this investigation is that there was no open-ended question by which one would have been able to identify previously unnoticed risk factors encountered by supply chain management professionals. The reason for this having occurred is that the respondents were frequently found to be very reluctant to share strategically relevant information about their organization. As a consequence, the limited number of questions asked, and their standardized nature, was means of encouragement for the interviewees to participate in the survey.

FINDINGS

The following sections present the business area of the respondents, the principal factors or components that are considered major risk factors for supply chain of Textile Industry, the variables that constitute the principal factors or components and the model fit.

Profile of the respondents

The total number of respondents for this study was 104 (Appendix 1), all of whom came from a specific category, namely textile manufacturers that are 100% export oriented. 30.77% of the respondents were from the yarn manufacturing sector, 16.35% from the sector of dyeing and 52.88% from the clothing sectors. All respondents were either managers or from even higher ranks within the respective companies, and all of them worked in supply chain management.

Correlation Matrix Analysis

The variables must be correlated for the factor analysis to be applied in a meaningful manner (Malhotra, 2004). If all of the selected variables have weak pair wise correlations, the resulting factors will not extract important information but simply reproduce the original variables. From the correlation matrix (see Appendix 3), it was, however, found that statistically significant correlations do exist between several variables of our sample."Technology" is highly correlated (0.650) with variable "Organization". Similarly TECH and BM, SEI and ER , BFCT and SEI, TERR and PI, LU and TERR, EARTHQ and CLFL,TSUNAMI and EARTHQ, TP and REGU, FINP and TP, BFCT and ER,LU and PI, ORGA and BM,FINP and REGU,TSUNAMI and CLFL are correlated and significant correlation is evident (Appendix 3). The definitions of these variables are presented in Appendix 2. The anti-image correlation matrix is used to measure the sampling adequacy. Variables that have anti-image correlation below the acceptable level (0.05) can be excluded from the factor analysis. The correlation matrix (**Appendix 3**) shows that all the variables used in the study have anti-image correlation coefficients above the acceptance threshold.

The Model Fit

The basic assumption underlying factor analysis is that the difference between the observed correlations (as given in be input correlation matrix) and the reproduced correlation (as estimated from the factor matrix) can be examined to determine the model fit (Malhotra, 2006). The differences between estimated and reproduced correlations are named the residuals. If there are many large residuals, the factor model does not provide a good fit to the data and the model should be reconsidered. In the case of our sample, there are only29residuals (27%), which are larger than 0.05.Thisit indicates that the fit of factor model used in the study is acceptable (Appendix4)

Risk Factors for Effective supply chain in Textile industry of Bangladesh

A principal component analysis (PCA) with varimax rotation was performed to extract those factors that are essential for professionals involved in supply chain management. PCA is recommended when the primary concern is to determine the minimum numbers of factors that would be account for maximum variance in the data (Malhotra, 2006).

Formal statistics are available for testing the appropriateness of the factor model. In order to measure the appropriateness of the factor analysis, Kaiser-Mayer-Olkin (KMO) measure of sample adequacy was examined. The KMO (Kaiser-Meyer-Olkin) statistics varies between 0 and 1.Avalue of 0 indicates that the factor analysis is likely to be inappropriate because sum of partial correlations is minimal. In our sample, tgevalue of KMO was 0.676, which is an indication of sampling adequacy and thus the appropriateness of the factor analysis (Appendix 5).Bartlett's test of sphericity, which is another indication of the strength of the relationship among variables, is also significant for our sample (Appendix 5).

The Scree Plot is graphs that display the Eigen values against all the factors. The graph is useful for determining how many factors to retain. The point of interest is where the curve starts to flatten. It can be seen that the curve begins to flatten between factors 6 and 7. Note also that factor 6 has an Eigen value of less than 1, so only five factors have been retained (Appendix 7).

From the result we observe factors extractable from the analysis along with their Eigen values, the percent of variance attributable to each factor, and the cumulative variance of the factor and the previous factors. Notice that the first factor accounts for 26.219% of the variance, the second 22.50% and the third 14.217%, fourth 10.651%, and the fifth 7.106%. All of the remaining factors are not significant (Appendix 6).

Moreover, a rotated component (factor) matrix analysis is used. The idea of rotation is to reduce the number factors on which the variables under investigation have high loadings. Rotation makes the interpretation of the analysis easier. From result we can see that political instability, labor unrest and terrorism are substantially loaded on Factor (Component) 1 while economic recessions, buyers' frequent changes in taste, social and environmental impact are substantially loaded on Factor 2.Business model, organization and technology are substantially loaded on Factor 3, and regulation, financial policy and trade policy are loaded on factor 4. Finally, factor 5 is substantially loaded with variables earthquake, cyclone and flooding as well as tsunamis (seeAppendices8 and 9).From the result of the factor analysis, it can be inferred that there are five factors which founds responsible for the major disruption of an effective supply chain considering Textile Industry. These are the Manmade Disruption factor (MMDF), the Customer Dynamics factor (CUDF), the Innovation factor (INNF), the State Policy factor (SPF) and the Natural Disruption factor (NADF).

Table 1: Risk factors for effective supply chain in Textile Industry of Bangladesh

Component	Factors	Rotation Sums of Squared Loadings		
		Total	% of Variance	Cumulative %
1	Man-made disruption	3.110	20.736	20.736
2	Customer Dynamics	2.655	17.700	38.436
3	Innovation	2.296	15.309	53.745
4	State Policy Factor	2.046	13.638	67.383
5	Natural Disruption	1.996	13.309	80.692

Extraction Method: Principal Component Analysis

The Eigen value represents the total variance explained by each factor. The table shows that the Eigen value of Man-made Disruption factor is **3.110**, which implies that the variance explained by the first factor is **20.736%.**The corresponding outcome for the Customer Dynamics factor is **2.665,** which implies that the variance explained by the second factor is **17.700%.** The variances explained by the factor Innovation is**15.309%** with and Eigen value of **2.296**.The result of the factor analysis shows that these five factors collectively produce about **60.00%**of the variance observed in the data set. The total variance explained by each of the factors with initial Eigen values is presented in the appendix section (Appendix 6).

Determinants of Manmade Disruption Factor (MMDF)

Manmade Disruption factor has three elements –Political Instability (PI), Labor Unrest (LU) and Terrorism (TERR), the associated factor loading of first element or variable (PI) is 0.950, which implies that Manmade disruption factor is highly correlated with the first factor Political instability (PI). Factor loading indicate the correlations between the variables and the resulting factor and loadings greater than 0.5 collectively construct the factor.

Table 2: Manmade Disruption Factor (MMDF)

Variable Number	Name of the Variable	Factor Loading
5	Political Instability(PI)	0.950
13	Terrorism(TERR)	0.933
9	Labor Unrest(LU)	0.930

The MMD factor is also highly correlated with variable Terrorism (TERR) with loading 0.933 and Labor Unrest (LU) with loading 0.930.The factor loading associated with each of the element or variable is presented in the rotated component matrix in the appendix (see Appendix 8).

Determinants of Customer Dynamics Factor (CDF)

The second factor – Customer Dynamics factor (CDF) – is the result of three elements or variables. These are Economic Recession (ER), Buyers' Frequent Change in Taste (BFCT), and Social and Environmental Impact(SEI).

Table3: Customer Dynamics Factor (CDF)

Variable Number	Name of the Variable	Factor Loading
10	Buyers Frequent Change in Taste(BFCT)	0.938
4	Economic Recession (ER)	0.892
14	Social and Environmental Impact(SEI)	0.770

The BFCT variable has highest correlation with the determinants of Customer Dynamics factor as indicated by its factor loading of 0.938. This factor is also highly correlated with the variable Economic Recession(ER) and Social and Environmental Impact (SEI). The associated loadings for these two elements or variables are 0.892and 0.770respectively.

Determinants Innovation Factor (INNF)

Three variables constitute third factor - Innovation factor. The Innovation factor is highly correlated factor with variable Business Model (BM), which has loading of 0.892. The other element or variable that makes up the Innovation factor is the Organization (ORGA) and Technology (TECH). The associated factor loading of this variable are 0.870and 0.693 respectively as indicated in the following table.

Table 4: Innovation Factor (INNF)

Variable Number	Name of the Variable	Factor Loading
2	Business Model (BM)	0.892
8	Organization(ORGA)	0.870
15	Technology(TECH)	0.693

Determinants of State Policy Factor (SPF)

Regulation (REGU), Financial Policy (FINP) and Trade Policy (TP) are the three variables that jointly produce the fourth factor- State Policy Factor. The State Policy Factor is highly correlated with the Business Model variable of Supply chain Risks, which has loading of 0.827. The other two variables have factor loadings of 0.760 and 0.752, respectively, which indicates a strong correlation with the State Policy factor.

Table 5: State Policy Factor (SPF)

Variable Number	Name of the Variable	Factor Loading
3	Regulation(REGU)	0.827
7	Financial Policy (FINP)	0.760
11	Trade Policy (TP)	0.752

Determinants of Natural Disruption Factor (NADF)

Earthquake (EARTHQ), Cyclone and Flooding (CLFL), and Tsunamis are the three variables that produce the fifth factor. Natural Disruption Factor is highly correlated with the Earthquake (EARTHQ variable of the risk factors for Supply chain in Textile Industry, which has loading of 0.862. The other two variable Cyclone and Flooding has factor loading of 0.840and Tsunamis has factor loading of 0.568 indicate correlation to the Manmade Disruption factor.

Table 6: Natural Disruption Factor (NADF)

Variable Number	Name of the Variable	Factor Loading
12	Earthquake (EARTHQ)	0.862
1	Cyclone and Flooding (CLFL)	0.840
6	Tsunamis (TSUNAMI)	0.568

CONCLUSION

This study was a first attempt to identify the risk factors relevant for the textile industry in Bangladesh. Factor-analytic techniques were used to identify those variables which represent important sources of disruption in all dimensions of a company, and to group them in accordance with their mutual correlation.
According to the WTO (2012) Bangladesh, with its estimated US$ 20 billion of textile exports accounts for 4.8% of related world trade, is the second largest exporter in the World, trailing only(US$154 billion and 37.3% of the world trade). This indicates the present strong position of the Bangladeshi textile industry on world markets. On the other hand, there is clear evidence that this industry is very vulnerable to labor conflicts and social unrest losses. A recent estimate by (Roy and Borsha, 2013) indicated that one nationwide strike day causes the readymade garments Industry to lose 3.6 billion Bangladeshi Taka (around USD 63m) in revenues, which translates in a1.56 % loss in the country’s GDP per year.

One main finding of this study is that man-made disruptions are considered the most momentous source of perceived supply chain risk in the Bangladeshi textile industry, leaving even natural disasters like earthquakes, tsunamis, or flooding, to which Bangladesh is particularly susceptible, far behind. This striking outcome clearly points to the outstanding importance of the prevailing social and political framework for the long-term success of business. Sustainable economic growth requires government policies that support legal security and enforceable rights, promotes innovation, and encourages fair competition. Failure to enforce, for instance, employment laws in full scale can cause labor unrest issues and may even give rise to sabotage, other destructive activities or even terrorism. Given the highly competitive nature of today’s market environment, it is hence vital that governments are aware of this connection and create a favorable environment for business development.

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APPENDICES

Appendix 1: Demographic Profiles of the Respondents

Industry	Frequency	Percent
Yarn manufacturing Industry	32	30.77
Dyeing Industry	17	16.35
Clothing Industry	55	52.88
Total	104	100

Source: Primary Data

Appendix 2: Acronym and Description of Variables and Factors

Variable	Description of the Variables
CLFL	Cyclone and Flooding
BM	Business Model
REGU	Regulation
ER	Economic Recessions
PI	Political Instability
TSUNAMI	T-sunamis
FINP	Financial policy
ORGA	Organization
LU	Labor unrest
BFCT	Buyer frequent change in taste
TP	Trade policy
EARTHQ	Earthquake
TERR	Terrorism
SEI	Social and Environmental Impact
TECH	Technology

Factor	Description of Factors
MMD	Man-made disruption
CUD	Customer Dynamics
INN	Innovation
SPF	State Policy Factor
NAD	Natural Disruption

Appendix 3: Correlation and Anti Image Correlation Matrix

Correlation and Anti -Image Correlation Matrix

	CLFL	BM	REGU	ER	PI	TSUNAMI	FINP	ORAG	LU	BFCT	TP	EARTHQ	TERR	SEI	TECH	Anti-image correlation
CLFL	1.000															.581*
BM	-.018	1.000														.633*
REGU	.071	.073	1.000													.522*
ER	.041	.076	.092	1.000												.632*
PI	-.357	-.158	-.037	.102	1.000											.746*
TSUNAMI	.371	-.206	-.119	-.448	-.315	1.000										.790*
FINP	-.150	-.022	.460	-.110	-.156	.092	1.000									.585*
ORAG	-.062	.690**	.331	.161	-.304	-.238	.244	1.000								.579*
LU	-.418	-.179	-.041	.119	.972**	-.333	-.153	-.315	1.000							.689*
BFCT	.062	.112	.210	.847**	-.028	-.425	-.121	.188	.015	1.000						.669*
TP	-.034	-.032	.476**	-.188	-.228	-.042	.384**	.191	-.199	-.053	1.000					.734*
EARTHQ	.631**	-.123	-.186	-.061	-.285	.578**	-.042	-.097	-.339	-.115	-.223	1.000				.569*
TERR	-.366	-.206	.031	.079	.928**	-.323	-.132	-.332	.946**	-.012	-.119	-.296	1.000			.801*
SEI	.030	.050	.261	.512**	-.286	-.196	.131	.111	-.215	.636**	.139	-.085	-.244	1.000		.681*
TECH	-.002	.516**	.343	.206	-.309	-.314	.086	.650**	-.295	.356	.252	-.273	-.283	.347	1.000	.802*

*Measure of Sampling Adequacy (MSA)

**Correlation is significant at the 0.01 level (1 Tailed).

Appendix 4: Residuals Representing the Model Fit

	CLFL	BM	REGU	ER	PI	TSUNAMI	FINP	ORGA	LU	BFCT	TP	EARTQ	TERR	SEI	TECH
CLFL		.429	.238	.339	.000	.000	.064	.267	.000	.265	.367	.000	.000	.379	.490
BM			.232	.221	.055	.018	.412	.000	.034	.130	.374	.107	.018	.307	.000
REGU				.175	.355	.115	.000	.000	.341	.016	.000	.029	.378	.004	.000
ER					.151	.000	.132	.051	.114	.000	.028	.289	.211	.000	.018
PI						.001	.057	.001	.000	.389	.010	.002	.000	.002	.001
TSUNAMI							.175	.007	.000	.000	.337	.000	.000	.023	.001

	OLFL	BM	REGU	ER	PI	TSUNAMI	FNP	ORGA	LU	BFCT	TP	EARTQ	TERR	SEI	TECH
FNP								.006	.060	.111	.000	.336	.091	.093	.192
ORAG									.001	.028	.026	.163	.000	.132	.000
LU										.441	.021	.000	.000	.014	.001
BFCT											.295	.122	.454	.000	.000
TP												.011	.115	.080	.005
EARTHQ													.001	.197	.002
TERR														.006	.002
SEI															.000
TECH															

Extraction Method: Principal Component Analysis.

a. Residuals are computed between observed and reproduced correlations. There are 29 (27%) non-redundant residuals with absolute values greater than 0.05

Appendix 5: KMO and Bartlett's Test

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.676
Bartlett's Test of Sphericity	Approx. Chi-Square	1218.426
	df	105
	Sig.	.000

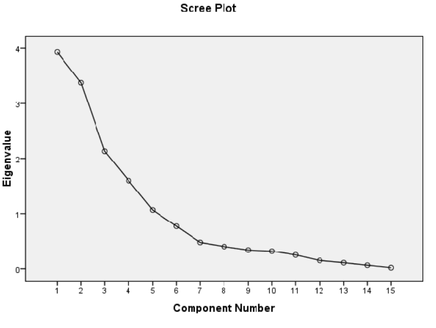
Appendix 6: Total Variance Explained

Component	Initial Eigen values			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.933	26.219	26.219	3.933	26.219	26.219	**3.110**	20.736	20.736
2	3.375	22.500	48.719	3.375	22.500	48.719	**2.655**	17.700	38.436
3	2.133	14.217	62.936	2.133	14.217	62.936	**2.296**	15.309	53.745
4	1.598	10.651	73.587	1.598	10.651	73.587	**2.046**	13.638	67.383
5	1.066	7.106	80.692	1.066	7.106	80.692	**1.996**	13.309	**80.692**
6	.771	5.139	85.832						
7	.477	3.182	89.014						
8	.402	2.680	91.693						
9	.338	2.255	93.949						
10	.318	2.123	96.072						

Component	Initial Eigen values			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
11	.251	1.672	97.743						
12	.149	.991	98.735						
13	.109	.725	99.460						
14	.063	.418	99.878						
15	.018	.122	100.000						

Extraction Method: Principal Component Analysis

Appendix 7: Scree Plot



Appendix 8: Rotated Component Matrix and Correlation

Variables	Component/ Factor				
	MMD	**CUD**	**INN**	**SPF**	**NAD**
CLFL	-.221	.109	.015	-.017	**.840**
BM	-.076	-.017	**.892**	-.113	-.039
REGU	.140	.224	.228	**.827**	.101
ER	.149	**.892**	.112	-.134	.035
PI	**.950**	-.029	-.128	-.109	-.172
TSUNAMI	-.306	-.448	-.298	.044	**.568**
FINP	-.097	-.104	.011	**.760**	-.033
ORGA	-.182	.078	**.870**	.223	-.042
LU	**.930**	.015	-.164	-.096	-.243
BFCT	.022	**.938**	.137	-.030	-.008
TP	-.198	-.060	.008	**.752**	-.198
EARTHQ	-.186	-.092	-.128	-.150	**.862**
TERR	**.933**	-.009	-.174	-.017	-.194
SEI	-.318	**.770**	-.053	.209	-.100
TECH	-.252	.305	**.693**	.219	-.186

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 5 iterations.

Appendix 9: Rotated Component Matrix Between Variables and Factors

Rotated Component Matrix					
Variables	Component or Factor				
	1	2	3	4	5
PI	.950				
TERR	.933				
LU	.930				
BFCT		.938			
ER		.892			
SEI		.770			
BM			.892		
ORGA			.870		
TECH			.693		
REGU				.827	
FINP				.760	
TP				.752	
EARTHQ					.862
CLFL					.840
TSUNAMI					.568

Appendix 10: Component Plot in Rotated Space

Component Plot in Rotated Space