Optimization of Business Continuity Management (BCM) in Natural Disaster-Prone Regions: A Case of the Automobile Parts Makers

著者	MONTSHIWA Abednico Lopang
number	62
学位授与機関	Tohoku University
学位授与番号	工博第5429号
URL	http://hdl.handle.net/10097/00124496

氏　　　　　名	もんちわ　　あべどにこ　ろぱん MONTSHIWA,Abednico,Lopang
授　与　学　位	博士（工学）
学位授与年月日	平成２９年9月２５日
学位授与の根拠法規	学位規則第４条第１項
研究科，専攻の名称	東北大学大学院工学研究科（博士課程）技術社会システム専攻
学位論文題目	Optimization of Business Continuity Management (BCM) in Natural Disaster-Prone Regions: A Case of the Automobile Parts Makers(自然災害多発地域における事業継続マネジメント(BCM)の最適化：自動車部品企業の事例)
指　導　教　員	東北大学教授　長平　彰夫
論文審査委員	主査　東北大学教授　長平　彰夫　東北大学教授　須川　成利 東北大学教授　高橋　信

論 文 内 容 要 旨

Recently, there are increased research initiatives on Business Continuity Management (BCM). As a way of contributing on the development of this relatively new study field, this thesis presents an optimized diamond structured automobile supply chain network towards a robust Business Continuity Management model. The model is necessitated by the nature of the automobile supply chain, in which tier two companies are centralized and numerically limited and have to supply multiple tier one companies with goods and services. The challenge with this supply chain structure is the inherent risks in the supply chain because, once supply chain disruption takes place at tier 2 level, the whole supply chain network suffers huge loses. This challenge partly emanates from literature, which asserted that Business Continuity Plan (BCP) consists of two main aspects, being Business Impact Analysis (BIA) and Risk Analysis (RA). However, this approach does not seem to be sufficiently addressing the complex and elaborate nature of supply chain network in the automobile industry. In order to address this challenge, a conceptual model is proposed, which provides a holistic approach towards BCM and covers four phases in the process, being contextual factors, BCP, BCM and success evaluation factors. The conceptual model is adopted from ISO 22301 (2012), but strikes a significant variation from the standard. It also has limited similarity with other proposed BCM conceptual models.

In this conceptual model, the first thing to consider is contextual factors. These are factors unique to every company's and usually influenced by the companies' culture, mission and vision. Once the contextual factors are identified and established, the model introduces the second phase, which is business continuity plan (BCP). The logic is that, no effective plan can be realized until a thorough command of the 'contextual factors' is established. Under this phase (BCP), I established that Cha et al. (2008)found that the relationship between Business Impact Analysis (BIA) and Risk Analysis (RA) was crucial because the results of BIA and RA are merged to develop a suitable BCP. This significantly shaped what constitute our BCP, being BIA, risk ranking and supply chain cooperation (SCC). BIA was adopted directly from Cha et al. and the following BIA hypotheses were made:

Hypothesis 10: BIA has positive effects on recovery time

Hypothesis 11: BIA has positive effects on competitive advantages

Hypothesis 12: BIA has positive effects on manmade risk ranking

Hypothesis 13: BIA has positive effects on natural risk ranking

Hypothesis 14: BIA has positive effects on BCM

Hypothesis 15: BIA has positive effects on supply chain cooperation

RA was modified into risk ranking. The reason for this modification was that, while I appreciate the value of RA in BCP, I realized it might be made cost effective. The study is of the view that risk ranking can be the common ground between companies' ambitions of maximizing profit and inventory consideration to ensure continued supply (customer satisfaction) even during and after disruption. For instance, a company's risk are to be ranked by taking a number of factors, which exposes it to risks like place of operation, complexity of supply chain, size of the company, and the company product. Risk ranking was further divided into 2 (manmade and natural risk ranking) for compatibility issues. The following hypotheses were developed;

Hypothesis 16: Manmade risk ranking has positive impact on BCM

Hypothesis 17: Natural risk ranking has positive impact on BCM

Hypothesis 18: Manmade risk ranking has positive impact recovery time

Hypothesis 19: Natural risk ranking has positive impact recovery time

The last component under this phase is SCC. This is term possibly has great potential in informing the final BCP outcome. As is discussed earlier, companies are part of a huge supply chain networks and developing an effective BCP should take into consideration this view. The studies by Fujimoto et al. (2012) and MacKenzie et al. (2012) highlighted the integral significance of supply chain network during disruption. T was to that effect in our BCP. Given the importance of supply chain network in the flow of goods, services and information through the network in the automobile industry the study is of the view that introducing

SCC is pivotal in BCP.

The study employed three analysis techniques been; correlation, regression and Structured Equation Model (Smart PLS 2.0) analyses. The reason three analysis techniques were used is due to their complementary nature. Concisely, while correlation analysis establishes association among individual variables, regression seeks to identify a causal relationship of these variables, while Smart PLS 2.0 finds out the direct and total effect multiple variables have on each other coupled with sensitivity analysis.

Table 1 Results for Measurement Model Evaluation Criteria

	AVE	Composite Reliability	R Square	Cronbach's Alpha	Communality
Business Continuity Management	0.667	0.9231	0.7671	0.8998	0.667
Business Impact Analysis	0.6044	0.9131		0.8874	0.6044
Comparative Advantage	0.8688	0.9298	0.2934	0.8489	0.8688
Company Size	0.8046	0.925		0.8788	0.8046
Manmade risk ranking	0.7884	0.8817	0.3405	0.7319	0.7884
Natural risk ranking	0.5525	0.8595	0.2074	0.8022	0.5525
Recovery time	0.6725	0.8911	0.3858	0.8383	0.6725
Supply Chain cooperation	0.7617	0.9274	0.5345	0.8952	0.7617

Note; *p<0.05, **p<0.01, ***p<0.001

Note: Calculated with SmatPLS 2.0

Table 2 Latent variable correlations (calculation with Smart PLS 2.0)

	Business Continuity Management	Business Impact Analysis	Comparative Advantages	Company size	Manmade Risk Ranking	Natural Risk Ranking	Recovery time	Supply chain cooperation
Business Continuity Management	1							
Business Impact Analysis	0.8409	1						
Comparative Advantages	0.4019	0.2292	1					
Company size	0.0943	0.0043	0.3264	1				
Manmade Risk Ranking	0.4902	0.3833	0.3097	0.2053	1			
Natural Risk Ranking	0.374	0.3705	0.2027	0.1163	0.2377	1		
Recovery time	0.6014	0.4997	0.245	0.1058	0.2734	0.258	1	
Supply chain cooperation	0.7606	0.7209	0.1997	0.1202	0.5661	0.4449	0.5371	1

Note; *p<0.05, **p<0.01, ***p<0.001

Note: Calculated with SmatPLS 2.0

Table 3 Smart PLS 2.0 Direct and total effect Analysis results

	Direct effects					Total effects				
Hypotheses	Original Sample	Sign level	Standard Deviation	Standard Error	T Statistics	Original Sample	Sig Level	Standard Deviation	Standard Error	T Statistics
1	0.1381		0.0932	0.0932	1.4816	0.2081		0.1066	0.1066	1.9523
2	0.0701		0.1234	0.1234	0.5679	0.1048		0.1383	0.1383	0.7573
3	0.0044		0.142	0.142	0.031	0.005		0.1397	0.1397	0.0358
4	0.1222		0.1436	0.1436	0.8511	0.1222		0.1436	0.1436	0.8511
5	0.5707	***	0.155	0.155	3.6811	0.5706	***	0.1669	0.1669	3.4195
6	0.3558	**	0.1425	0.1425	2.5977	0.349	**	0.1363	0.1363	2.5602
7	0.255		0.2309	0.2309	1.1043	0.3463		0.1979	0.1979	1.7503
8	0.2479	**	0.0943	0.0943	2.6295	0.3069	***	0.0904	0.0904	3.3968
9	-0.2387		0.1347	0.1347	1.7719	0.0073		0.1504	0.1504	0.0484
10	-0.0736		0.279	0.279	0.2638	0.5016	***	0.1066	0.1066	4.7035
11	-0.2343		0.153	0.153	1.5309	0.2272	*	0.1065	0.1065	2.1323
12	-0.0296		0.1735	0.1735	0.1706	0.3818	**	0.1091	0.1091	3.499
13	0.1116		0.1489	0.1489	0.7499	0.3685	***	0.1023	0.1023	3.6027
14	0.623	***	0.0741	0.0741	8.4053	0.8405	***	0.0391	0.0391	21.5247
15	0.7215	***	0.0607	0.0607	11.891	0.7208	***	0.0649	0.0649	11.1042
16	0.1029		0.0713	0.0713	1.443	0.103		0.0687	0.0687	1.4996
17	0.0154		0.0763	0.0763	0.2015	0.0154		0.0763	0.0763	0.2015
18	-0.1093		0.1266	0.1266	0.8637	-0.0552		0.131	0.131	0.4212
19	-0.0048		0.1187	0.1187	0.0402	-0.013		0.1209	0.1209	0.1077

Note; *p<0.05, **p<0.01, ***p<0.001

Note: Calculated with SmatPLS 2.0

In this study, significant correlation and regression analysis results among Risk Rankings (RR), SCC and BIA ascertain the value of the model by establishing both association and causation. The multivariate data analysis calculations demonstrated that SCC has a positive total significant effect on RR and BCM while BIA has strongest positive effects on all BCP factors. Finally, sensitivity analysis demonstrated an increase of 20% yielded 10 significant levels of varying degree while the 20% reduction yielded 8 significant levels of varying degree. Comparing this with our unaltered study data, an increase of 20% seems to be more effective as it yields 10 significance levels while the unaltered study data yielded 9 significant correlation of varying degree. A reduction of 20% of company size is not effective as it lower than unaltered study data.

論文審査結果の要旨

自動車産業は、その経済波及効果が大きいため、基幹産業として各国の経済で重要な地位を占めているが、完成車メーカーの部品点数が3万点と多いため、国内外に及ぶ多階層で複雑なサプライチェーン構造になっており、1つの部品が不足しても車が生産できず大きなロスが発生する。

本論文は、グローバルに点在している自動車部品企業において、自然災害発生時にもサプライチェーンを維持し、自動車メーカー等に対して部品を供給し続けるために有効な事業継続マネジメント(BCM)を明らかにすることを目的として、質問票調査を実施し、統計解析を行った成果をとりまとめたもので、全文7章からなる。

第1章は、序論である。

第2章では、自然災害とサプライチェーンに関する先行研究の検討から、自動車産業におけるサプライチェーンの脆弱性としてサプライチェーンのダイヤモンド構造から、在庫に頼らない BCM が必要とされていることを明らかにしている。これは有益な成果である。

第3章では、事業継続計画(BCP)と BCM の成功との間の直接的な関係のみならず、BCM の策定段階から BCM 実施段階を経て BCM の成功に与える間接的な影響の両方を同時に解析する研究のフレームワークを構築し、これに基づいて 19 の仮説を導出している。これは、極めて大きな成果である。

第4章では、本論文での解析手法について、各分析手法の詳細な検討の結果から、サンプル数の制約が少ない構造方程式モデリング(PLS-SEM)を使用することを提案している。これは、有益な成果である。

第5章では、グローバルに立地している自動車部品企業から収集した質問票調査データの定性的な分析を行うとともに、PLS-SEM を使用した統計解析を行い、サプライチェーンを構成する企業間の協力体制が事業継続マネジメントの効果を高めることを明らかにしている。これは極めて重要な成果である。

第6章では、質問票回答企業のうち自然災害の多いアジア地域と北米地域の企業での BCM の比較分析を行い、アジア地域ではサプライチェーン間の協力及び企業規模が BCM の各要因に肯定的な影響を与えていたのに対し、北米地域ではサプライチェーン間の協力のみが BCM の各要因に影響していた。これは、極めて重要な成果である。

第7章は結論である。

以上要するに本論文は、グローバルに立地している自動車部品企業において、自然災害発生時にもサプライチェーンを維持し、自動車メーカー等に対して部品を供給し続けるために有効な事業継続マネジメント(BCM)を地域別に比較分析した成果を取りまとめたものであり、技術経営学への寄与は少なくない。

よって、本論文は博士(工学)の学位論文として合格と認める。