

Impact of Climate Change on Business Process in the Distribution Industry*

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Abstract

Purpose - The purpose of this study is to examine the possible ways to minimize damage by analyzing the influence that may be exerted upon the business process of the distribution industry by unexpected climate change.

Research design, data, and methodology - The optimum business process is to be implemented after dividing the diversified business process of the distribution industry into the four stages of the Business Continuity Plan (BCP).

Results - First, the upper-level risks that would be impacted most sensitively by climate change have been selected. Second, the impact and characteristics of the environment have been discovered. Third, weighted values by criteria item of upper-level business risks have been analyzed. Fourth, it was possible to define the business priority order based on the individual and then to adjust the Recovery Time Objective (RTO).

Conclusion - In this study, the priority order has been defined quantitatively by calculating the priority order score. Further, the priority order has been determined depending on whether any targeted business unit is applicable to the items of the business nature criteria.

Keywords: Business Process, Distribution Industry, Retail Business, Weather Merchandising.

JEL Classifications: D81, L81, Q54.

1. Introduction

Entering the 21st century following the second half of the 20th century, the economic development that has been achieved through the process of metamorphosing from a developing country to an industrialized one in many countries has provided us with not only the honey-water of enhanced material living stand-

ard but also the serious adverse effects of wealth concentration and damaged nature. One of those adverse effects may be said to be the abnormal climate change which was prompted by global warming.

Global warming has emerged through the pollution which may be called a byproduct of the development and growth obtained from industrialization, and such pollution is becoming the main culprit of raising the temperature of all the continents and oceans of the whole world.

While climate change aroused by global warming provokes El Nino and is currently causing tremendous damage like aggravating food shortages in various places on earth, one particular phenomenon is that damage caused by the polarization of flood and drought is taking place. In other words, certain areas are experiencing floods while others are experiencing the damage of desertification due to the droughts caused by depleted water resources.

The problem is that, as I have mentioned already in the above, global warming is being accelerated more and more by the industrialization of developing countries, and cases of the damage from abnormal climate such as intensive heavy rain caused by unusual weather change, super-typhoon, etc., including the Hurricane Katrina that made 80% of New Orleans immersed in water in 2005, are taking place one after another and here and there in the global village.

In his work of 'Chaoitics,' Philip Kotler is explaining such a phenomenon as follows: Of course, Chaotics includes the social disasters that may provoke depression and stagnation all over the economy instantaneously due to a financial crisis, and it also includes the natural disasters that destroy everything and throw the world into great confusion like typhoon, tornado, tsunami, etc. resulting from sudden climate change (Kotler, 2009).

Regarding such a phenomenon, Jeremy Rifkin warned about destroying the ever-worsening ecosystem in his work of 'The Empathic Civilization' where he anticipated that the number of all the global refugees, who have left their home behind due to lack of water and food, will reach over 200 million in the middle of the 21st century while it is currently estimated to be about 25 million.

In fact, the history of destroying ecosystem lasts well over a period of one century and since the turn into the 20th century, mankind has been abusing coal, petroleum, natural gas, etc. in

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order to make energy and other materials that were necessary for industrialization and living, and the abused materials have been accumulated in the earth atmosphere while exerting a bad influence upon the climate and ecosystem of the earth. In particular, as a phenomenon provoked by climate change, large scale natural and human disasters of hurricane, flood, drought, forest fire, temperature rise, etc. are hitting serious blows on the global industrial world while exerting a destructive influence upon both the ecosystem and the industries with the boomerang effect of digital evolution.

According to the Disaster Annual 2008, which was published by the National Emergency Management Agency (NEMA), the average amount of property damages caused by unusual weather changes (NEMA, 2008) has turned out to be almost KRW2,300 billion in the 2000s which accounts for 18 times that in the 1960s of KRW127.67 billion (Kim & Shin 2012).

Such damages from unusual weather changes have been causing serious damages on the distribution industry due to its business attributes, and in case of large-scale distributors of department stores or discount stores, they are endeavoring to establish their 'Weather Merchandising' strategies so as to reduce product damage cases caused by climate change.

This is because the distribution industry is, due to its attributes, playing the role of a link between the manufacturing industry and end-users and is sensitive to climate change. In addition, Customers select the best store based upon their evaluation criteria set from their personal experiences, information, perceptions, and images (Kim, 2013). As a matter of fact, the 'risk' has traditionally been recognized to mean something negative that might bring about damage to corporate value or decrease in cash-generating ability. However, in this study, the risk of an abnormal change of weather means the uncertainty that exerts a negative impact on the achievement of management goals depending on the abnormal changes of weather under the circumstances surrounding enterprises (Kim & Shin, 2012). Therefore, the purpose of this study lies in the construction of an optimal business process for minimizing damages stage by stage through identifying the business process factors that would be an obstacle in operating a business, where the diversified business process of the distribution industry is divided into the 4 stages of prevention, emergency response (ER), response and recovery upon the occurrence of a situation that would influence the business and sales due to an unexpected climate change.

2. Theoretical Background

2.1. Domestic Study Trend

The majority of weather-related studies with regard to the distribution industry up until now are, regardless of domestic or foreign, taken by the theses about the Weather Merchandising (WMD) which is to plan and manage the products handled in stores according to weather conditions. Most of such studies are the theses that are focused upon the impact of weather factors

as effected on sales. And the contents of the majority of them are, not like those of an academic study, those for examining and analyzing, internally in the enterprise as focused upon weather-related products, the sales volume that are varied with weather changes. The characteristics of such previous studies are that those theses are focused on planning and managing the handled products in a dimension of preventing unusual weather change depending upon the weather information available from the Korea Meteorological Administration (KMA) rather than getting prepared for unexpected climate changes caused by unusual weather changes.

In view of the previous studies regarding the impact of climate change as exerted on the distribution industry, comparative analyses have been made on the correlation between climate and sales by comparing home-shopping stores with convenient stores and large-scale marts with department stores. As a result, it has been revealed that, in case of department stores, the rainy time zones were the most influencing factor to their sales, whereas in case of both large-scale marts and home-shopping sites, their sales were influenced mostly by whether rainy or not and in case of convenient stores, mostly by atmospheric temperature (Lee, Ko & Cheon, 2010).

2.2. Limitations of Previous Studies

Nowadays, unusual weather changes are causing sudden climate changes and then inducing a lot of disasters here and there on the earth. In such a situation, previous studies of studying the Weather Merchandising, which have been based only upon the KMA's weather forecasts and past weather information data, are leaning toward the prevention part of planning and managing of products, thus having limitations in providing business-wide, specific process alternatives that would allow us to prepare for situations of unexpected unusual weather changes or the resulting sudden climate changes as well as to provide practical assistance in the continuity of business. Consequently, in respect of the risk caused by climate change has not been under positive attention of domestic firms yet as the impact of the damage which is uncontrollable by an individual firm has been recognized as too much of a far-reaching global risk. In fact, CEOs of domestic firms are in recognition of such a situation that an abnormal weather change might be a material risk against an enterprise, but the reality is that they are lamenting the nonexistence of the information and strategies that are required for making effective decisions with regard to the risk from abnormal weather changes.

3. Methodologies

3.1. Research model

This study has been carried out by utilizing the methodology of a year-round business operation plan, namely the Business Continuity Planning (BCP). The BCP is a methodology for main-

taining the continuity of business operation while it is a process system by which a plan for recovering the business operation cycle in consecutive order is established within an appropriate time period upon the occurrence of any business operation risk because of any accident or emergency situation which may be caused by various factors as related to the nature, human being and technology.

Utilizing the BCP methodology, the study has been carried out in the order given as follows:

First, The crises that are classified as disaster/calamity caused by abnormal weather change, etc., so to speak, among others the risks that may exert an impact on any vulnerable part of an organization have been classified and the risk assessment (RA) has been carried out in expectation of figuring out the frequency and the impact size of the risks that are relevant to the organization.

Second, when any business process has been lost, the size of resulting loss has been assessed.

Third, utilizing the analysis technique of the Business Impact Analysis (BIA), the correlation between the climate change and the distribution business process has been analyzed.

Fourth, utilizing the Business Continuity Plan (BCP) as applied upon the surveyed qualitative data, alternatives of the optimum business process have been presented by individual stage.

In this study, after selecting business-related employees, the risks of business area are to be assessed through RA (Risk Assessment) and BIA (Business Impact Analysis) of BCP (Business Continuity Plan) and the risks of higher order are to be identified. Also each employee's business priority order is to be defined by calculating weighted-value scales and financial loss.

3.1.1. Selection of Firm To Be Studied and Its Business Scope

In this study, the business division of 'D' Cold Storage of 'K' Industries was selected for risk assessment. In this case, this business entity of 'D' Cold Storage has been selected under the assumption that this division, being engaged in a warehousing business for providing storage services of agricultural, marine and livestock products, might be involved in cases of serious property loss and/or human injury upon occurrence of any large disaster caused by an unusual climate change, etc.

The results of examining major crises of the applicable firm are given as follows:

<Table 1> The results of examining major crises

Risk Category	Item of Examination	Current State	Risk Factor
Natural Calamity	Any damage caused by earthquake and/or subsidence?	No earthquakes until now but partial subsidence caused by construction of new building is concerned about.	Earthquake, subsidence

	Any damage caused by landslide, avalanche of earth and rocks?	Minor amounts of Earth and rocks are sliding down.	Landslide, avalanche of earth/rocks
	Any damage caused by forest fire?	None until now but with high possibility for forest fires in spring and autumn.	Flood, typhoon, heavy rain
Human Disaster	Any damage caused by gas accidents?	Monthly check on gas is done by a subcontractor.	Gas accident
	Any damage caused by fire?	None until now but with inherent risk existing always.	Fire
	Any damage caused by power failure?	No major problems due to emergency power supply/ generator, but vulnerable to lightning.	Power failure
	Any damage caused by traffic accidents in warehouse?	Owing to daily safety training, no major problems are expected in future.	Traffic accident
	Any damage caused by explosion from ignition of oil mist in machine room?	Machine Room manager checks any leakage of refrigerant and oil everyday.	Leakage of refrigerant, oil
Social Disaster	Catching an infectious disease.	Semi-annual training on preventing infectious disease and annual vaccination	Infectious disease
Management Disaster (Non-Financial Factor)	Non-conformance to legal regulations by enterprise	Non-conformance to legal regulations are found.	Legal regulations

3.1.2. Major businesses and their process flows of the applicable firm

Major business

Receiving: Registration of Information on Scheduled Receiving, Registration of Scheduled Receiving Status, Label Creation, Receiving Label Printing, Receiving Information Storage, Receiving Inspection, Housing (PDA) Treatment, Receiving Confirmation, Receiving Station Decision

Shipping: Registration of Shipping Slip. Occurrence of Certificate of Custody, Issuance of Shipping Instructions, Issuance of Picking List, Picking Confirmation (PDA), Shipping Inspection (PDA), Shipping Confirmation, Shipping Handling Operation.

Settlement: Settlement Handling, Division of Transaction Details, Issuance of Transaction Details, Preparation of Tax Calculation Sheet, Issuance of Tax Calculation Sheet, Taping of Tax Calculation Sheet

Detailed Business Flow of the Core Businesses among Major Businesses

Receiving: Registration of Information on Scheduled Receiving ⇒ Receiving Inspection ⇒ Item Sorting ⇒ Receiving Confirmation

Shipping: Registration of Shipping Statement ⇒ Shipping Inspection

Settlement: Settlement Processing

3.2. Detailed businesses and the analysis on their interrelationship

3.2.1. Detailed businesses and the analysis on their interrelationship of the applicable firm

Table 2 shows an analysis on the correlation among major businesses. Above all, those businesses have been categorized as receiving, receiving inspection, sorting, receiving confirmation, shipping, shipping inspection, and settlement while the correlation among business units and responsible departments has been classified as in the following table.

<Table 2> Detailed Business Activities

Business Category		Activity and Team In Charge		Business Code	
Business Classification	Business Code	Activity	Team In Charge	Leading	Lagging
Receiving	F1	Registration of Information on Scheduled Receiving	Business Team	F0	F2
Receiving Inspection	F2	Receiving Inspection	Quality Control Team	F1	F3
Sorting	F3	Item Sorting	Admin Team	F2	F4
Receiving Confirmation	F4	Receiving Confirmation	Admin Team	F3	F5
Shipping	F5	Shipping Registration	Admin Team	F4	F6
Shipping Inspection	F6	Shipping Inspection	Quality Control Team	F5	F7
Settlement	F7	Settlement	Admin Team	F6	FF

The below figure shows the sequential process flow of all the businesses involved:

4. Empirical Analysis

4.1. Risk Assessment

Risk assessment is to anticipate the risk categories that may influence vulnerable parts of an organization among the risks

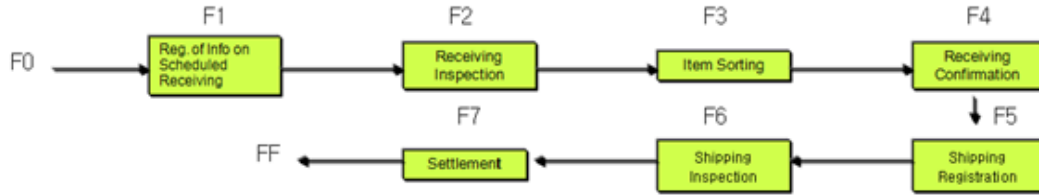
caused by abnormal climate change as well as to anticipate the frequency and impact size of the risks. Therefore, through making the risk assessment, the impact of risks as exerted on businesses will be understood properly and the possibility of risk occurrence will be identified at an early stage, thus enabling the anticipation of how much of an impact will be exerted by risks on the achievement of a firm's goal while measures are being taken for reducing the possibility of risk occurrence to a level that is acceptable to an organization.

Table 3 shows the identified risk factors which have been categorized as the 4 parts of natural calamity, human disaster, social disaster and management disaster. The causes and vulnerability of each category are given as follows:

<Table 3> Risk Factor Analysis

Risk Category	Cause	Vulnerability
Natural Calamity	Occurrence of shutdown or inaccessibility due to collapse of installations caused by earthquake and/or ground subsidence	Moderate
	Occurrence of shutdown or product damage due to collapse and immersion of cutting area caused by typhoon, flood and/or heavy rain	Moderate
	Occurrence of inaccessibility or product damage due to warehouse collapse caused by landslide and/or avalanche of earth and rocks	Moderate
	Occurrence of business interruption due to employees' health problems caused by yellow-dust damage	Moderate
	Occurrence of inaccessibility or snow removal need due to blocked access road caused by heavy snow	Moderate
	Occurrence of ceased operation of employees (including service workers) due to damage from employees' food poisoning	Moderate
Human Disaster	Occurrence of fire caused by gas accidents	Moderate
	Warehouse damage caused by fire	High
	Interruption of power supply caused by power failure and inoperativeness of emergency generators	High
	Casualties caused by traffic accidents in warehouse	Low
	Facility damage caused by explosion of ignited oil mist in machine room	High
	Occurrence of fire caused by short circuit	Moderate
	Occurrence of product damage due to excessive maintenance time upon occurrence of machine failure caused by lack of professionals	Moderate
Occurrence of inaccessibility and ceased operation within factory area caused by forest fire	High	

Table 4 shows the contents of the analysis on vulnerability of businesses. The 4-part domain has been categorized and analyzed as threat factor, risk, risk category and vulnerability.



<Figure 1> Process PERT Diagram

<Table 4> Vulnerability Analysis

Risk Category	Cause(Risk Factor)	Impact(Risk)	Risk Category	Vulnerability
Natural Calamity	Collapse of installations caused by earthquake and/or ground subsidence	Shutdown, inaccessibility	Natural Calamity	Moderate
	Collapse of cutting area by typhoon, flood and/or heavy rain / damage of immersion, heavy snow	Shutdown, product damage	Natural Calamity	Moderate
	Warehouse collapse caused by landslide and/or avalanche of earth and rocks	Inaccessibility, product damage	Natural Calamity	Moderate
	Damage from occurrence of yellow-dust?	Business interruption caused by employees' health problem	Natural Calamity	Moderate
	Damage of access road caused by heavy snow?	Inaccessibility, snow removal need	Natural Calamity	Moderate
	Damage from employees' food poisoning	Ceased operation of employees' (including service workers) food poisoning	Natural Calamity	Moderate
Human Disaster	Occurrence of fire caused by gas accidents	Ceased operation, loss of building and product	Human Disaster	Moderate
	Warehouse damage caused by fire	Ceased operation, loss of building and product	Human Disaster	High
	Power failure and ceased power supply caused by inoperativeness of emergency generators	Ceased operation	Human Disaster	High

Risk Category	Cause(Risk Factor)	Impact(Risk)	Risk Category	Vulnerability
Human Disaster	Personal damage caused by traffic accident in warehouse	Partially ceased operation, penalty	Human Disaster	Low
	Loss or damage of facilities caused by explosion of ignited oil mist in machine room	Ceased refrigeration, loss of functioning	Human Disaster	Low
	Occurrence of fire caused by short circuit	Ceased operation, loss or damage of building and/or property	Human Disaster	Moderate
	Insufficient professional manpower	Excessive maintenance time caused by lack of professional manpower	Human Disaster	Moderate
	Any damage caused by forest fire?	Inaccessibility and ceased operation for outbreaks in Spring, Autumn	Human Disaster	High
	Human Disaster	Any damage caused by safety accident in work place?	Occurrence of ceased operation, financial loss	Human Disaster
Any damage caused by volume reduction of subcontractor?		Occurrence of declined profitability caused by volume reduction	Human Disaster	Moderate
Any damage caused by aircraft crash?		Occurrence of ceased operation, need for settlement	Human Disaster	Low
Social Disaster	Occurrence of employees' infectious disease	Ceased operation	Social Disaster	Moderate

	Any damage caused by employees' strike?	Occurrence of Spring strike caused for wage raise	Social Disaster	Moderate
Management Disaster (Non-Financial Factor)	Non-conformance against legal regulations enforced on enterprises	Penalty	Management Disaster (Non-Financial Factor)	Moderate

	workplace		
	Occurrence of declined profitability caused by reduced volume of items from subcontractors		Moderate
Natural Disaster	Occurrence of infectious disease among employees		Moderate
	Occurrence of ceased operation/wage increase caused by employees' strike		Moderate
	Occurrence of obligation to pay a fine (financial loss) caused by non-conformance against the legal regulations enforced on enterprises		Moderate

Table 5 is a table containing the identified risks of which the details are given as follows:

<Table 5> Risk Identification

Risk Category	Cause	Vulnerability
Natural Disaster	Occurrence of shutdown or inaccessibility due to collapse of installations caused by earthquake and/or ground subsidence	Moderate
	Occurrence of shutdown or product damage due to collapse and immersion caused by typhoon, flood and/or heavy rain	Moderate
	Occurrence of inaccessibility or product damage due to warehouse collapse caused by landslide and/or avalanche of earth and rocks	Moderate
	Occurrence of business interruption due to employees' health problems caused by yellow-dust damage	Moderate
	Occurrence of inaccessibility or snow removal need due to blocked access road caused by heavy snow	Moderate
	Occurrence of ceased operation of employees (including service workers) due to damage from employees' food poisoning	Moderate
Human Disaster	Occurrence of fire caused by gas accidents	Moderate
	Warehouse damage caused by fire	High
	Interruption of power supply caused by power failure and inoperativeness of emergency generators	High
	Casualties caused by traffic accidents in warehouse	Low
	Facility damage caused by explosion of ignited oil mist in machine room	High
	Occurrence of fire caused by short circuit	Moderate
	Occurrence of product damage due to excessive maintenance time upon occurrence of machine failure caused by lack of professionals	Moderate
	Occurrence of inaccessibility and ceased operation within factory area caused by forest fire	High
Human Disaster	Occurrence of ceased operation and financial loss caused by safety accidents within	Moderate

4.1.1. Risk Measurement

For risk assessment, the two aspects of "Possibility of occurrence" and "Impact" of an event is assessed and with regard to this in general, the analysis is done in combination of both the qualitative and quantitative methods. In so doing, the affirmative or negative impacts of future events are assessed by individual, by category and by company while risks are measured for both types inherent risk and remaining risk.

Table 6 and Table 7 indicate the risk occurrence possibility measure and the impact size measure respectively and the measurement range is from 1 to 5 whose details are given as follows:

<Table 6> Measurement of the Possibility of Occurrence

Level	Explanation Measurement	Possibility of Occurrence	Explanation
1	Possibility of occurrence is slim	None or once in 10 years	No record of accidents
2	Possibility of occurrence is low	At least once in 5 years	Possibility for accident exists
3	Possibility of occurrence exists	At least once in 3 years	Record of accidents exists
4	Possibility of occurrence is high	At least once in 2 years	Accidents happen once in a while
5	Frequent occurrence	At least once in 1 year	Accidents happen frequently

<Table 7> Measurement of Impact Size

Level	Explanation Measurement	Impact Size (in KRW)	Explanation		
			Personal Damage	Damage Range	Property Damage
1	Minor	Less than 50 million	No injury cases	No problem in operation	Almost none
2	Light	50~100 million	First aid needed	Operation influenced partially	Slightly exists

3	Ordinary	100~500 million	Injury, medical treatment needed	Problem exists in operation	Considerably exists
4	Major	500~1,000 million	Injury, loss of production capabilities	Partial shutdown of warehouse, ceased operation	Greatly exists
5	Fatal	Over 1,000 million	Death	Ceased operation	Exists on a fatal level

Table 8 shows the risks that have been assessed by utilizing the measures for the risk occurrence possibility and the impact size. Risks of the highest level are the ceased operation caused by fire and the human disaster caused by product loss and/or damage. The details are given as follows:

<Table 8> Risk Assessment

Risk Group	No.	Risk	Possibility of Occurrence	Impact Size	Risk Level
Natural Calamity	1	Occurrence of shutdown or inaccessibility due to collapse of installations caused by earthquake and/or ground subsidence	2	4	8
Natural Calamity	2	Occurrence of shutdown or product damage due to collapse/immersion caused by typhoon, flood and/or heavy rain	4	3	12
Natural Calamity	3	Occurrence of inaccessibility or product damage due to warehouse collapse caused by landslide and/or avalanche of earth and rocks	3	2	6
Natural Calamity	4	Occurrence of business interruption due to employees' health problems caused by yellow-dust damage	2	2	4
Natural Disaster	5	Occurrence of inaccessibility, snow removal need due to blocked access road caused by heavy snow	3	2	6
Natural Disaster	6	Occurrence of ceased operation of employees (including service workers) due to damage from employees' food poisoning	1	5	10
Human Disaster	7	Occurrence of ceased operation, product damage	3	2	6

		caused by fire from gas accidents			
Human Disaster	8	Occurrence of ceased operation, product damage caused by occurrence of fire	4	4	16
Human Disaster	9	Occurrence of interruption of power supply, ceased operation caused by power failure and inoperativeness of emergency generators	2	1	2
Human Disaster	10	Occurrence of ceased operation, harmful effect of accident control caused by traffic accidents in warehouse	2	2	4
Human Disaster	11	Occurrence of maintenance need facility loss or damage caused by explosion of ignited oil mist in machine room	3	3	9
Human Disaster	12	Occurrence of product damage, excessive maintenance time in case of machine failure caused by lack of professionals	2	2	4
Human Disaster	13	Occurrence of ceased operation, product damage due to occurrence of fire caused by short circuit	4	1	4
Human Disaster	14	Occurrence of inaccessibility and ceased operation within factory area caused by forest fire	1	1	1
Human Disaster	15	Occurrence of ceased operation, financial loss caused by safety accidents within workplace	1	2	2
Human Disaster	16	Occurrence of declined profitability caused by reduced volume of items from subcontractors	2	2	4
Social Disaster	17	Occurrence of ceased operation caused by infectious disease among employees	1	2	2
Social Disaster	18	Occurrence of ceased operation, wage increase caused by employees' strike	2	1	2
Management Disaster	19	Occurrence of financial loss due to obligation to pay a fine caused by non-conformance against the legal regulations enforced on enterprises	2	2	4

4.2. Business Impact Analysis

The business impact analysis is to assess the loss size when the business process has been lost due to unusual change in weather, etc. and the stage of Business Impact Analysis is the one for analyzing how much of an impact will be exerted on the current business process by the most dangerous crisis that have been derived from the risk analysis, and this stage was analyzed in the following order:

In the first stage, after defining the unit business, the business impact analysis was carried out as in the following figure:

Table 9 is a table of the unit businesses that have been defined for carrying out the impact analysis. The business process of 7 stages in total has been categorized by business unit and responsible department as well as by leading and lagging:

<Table 9> Definition of Activity

Business Category		Activity & Team In Charge		Business Code	
Business Classification	Business Code	Activity	Team In Charge	Leading	Lagging
Receiving	F1	Registration of Information on Scheduled Receiving	Business Team	F0	F2
Receiving Inspection	F2	Receiving Inspection	QualityControl Team	F1	F3
Sorting	F3	Item Sorting	Administrative Team	F2	F4
Receiving Confirmation	F4	Receiving Confirmation	Administrative Team	F3	F5
Shipping	F5	Shipping Registration	Administrative Team	F4	F6
Shipping Inspection	F6	Shipping Inspection	Quality Control Team	F5	F7
Settlement	F7	Settlement	Administrative Team	F6	FF

<Table 12> Average of Each Person's Importance

Item	1. Financial Loss	2. Continuity of On-site Job	3. Loss of Resources	4. Connectivity between Teams	5. Customer Satisfaction
1. Financial Loss	1.00	1.138333	1.083333	0.776667	0.498333
2. Continuity of On-site Job	1.638333	1.00	2.333333	1.333333	0.61
3. Loss of Resources	1.333333	0.443333	1.00	1.833333	0.61
4. Connectivity between Teams	1.916667	1.388333	1.221667	1.00	0.471667
5. Customer Satisfaction	2	2.333333	2.166667	2.166667	1.00

4.2.1. Calculation of Measurements of Weighted Values Establishment of Business Criteria Items

Table 10 and Table 11 are the tables that indicate how the item establishment for business criteria and the business assessment measure will be utilized in order to calculate weighted value measurements:

<Table 10> Calculation of Measurements of Weighted Values Establishment

Criteria Item	Subject	Quanti-/Quali-
1. Financial Loss	Importance of financial loss	Quantitative
2. Continuity of On-Site Business	Impact on items caused by noncooperation on-site personnel	Qualitative
3. Loss of Resources	Degree of human, material resources	Qualitative
4. Inter-department Connectivity	Importance of cooperation in inter-department business process	Qualitative
5. Customer Satisfaction	Impact of trading partners' satisfaction and items as exerted on enterprise	Qualitative

<Table 11> Business Assessment Measure

Comparison Value	Assessment Criteria of 3-Point Measure
1	Ordinary
2	Important
3	Very important

<Table 15> Definition of Business Priority Order

Business Classification	Weighted Value		0.15	0.21	0.16	0.18	0.30	1.00	Qualitative Priority	Qualitative Priority Score	Financial Loss KRW'000	Qualitative Priority	Qualitative Priority Score	Final Score	Final Priority
	Business Code	Activity	Financial Loss	Continuity of Overtime Work	Loss of Resources	Connectivity between Teams	Customer Satisfaction	Qualitative Weights Total							
Receiving	F1	Registration of Information on Scheduled Receiving	0.50	0.83	0.17	0.33	0.17	0.312	5	0.13	179.000	1	0.211	0.142	4
Receiving Inspection	F2	Receiving Inspection	0.33	0.67	0.50	0.50	0.33	0.410	3	0.17	108.672	3	0.128	0.164	3
Sorting	F3	Item Sorting	0.33	0.67	0.33	0.67	0.50	0.464	1	0.20	156.472	4	0.185	0.198	1
Receiving Confirmation	F4	Receiving Confirmation	0.67	0.50	0.00	0.50	0.00	0.195	7	0.08	99.672	5	0.118	0.086	7
Shipping	F5	Shipping Registration	0.50	0.33	0.17	1.00	0.17	0.327	4	0.14	96.472	7	0.114	0.136	5
Shipping Inspection	F6	Shipping Inspection	0.33	0.50	0.00	0.33	0.83	0.413	2	0.17	109.670	2	0.129	0.165	2
Settlement	F7	Settlement	0.83	0.33	0.17	0.67	0.17	0.268	6	0.11	97.642	6	0.115	0.111	6
Total								2.389		1.00	847.600		1.00	1.000	

<Table 16> Adjustment of RTO

Final Priority	Job Classification	Job Code	Activity	Team in Charge	Leading Job Code	Lagging Job Code	1st RTO	2nd RTO	Analysis Result of BCP View	3rd RTO	CEO's Strategic View	Final RTO
1	Sorting	F3	Item Sorting	Admin Team	F2	F4	T4	T4	DelayTime Reduction	T3	1st Priority on Customer Satisfaction	T2
2	Shipping Inspection	F6	Shipping Inspection	Quality Control Team	F5	F7	T5	T5		T5	1st Priority on Customer Satisfaction	T4
3	Receiving Inspection	F2	Receiving Inspection	Quality Control Team	F1	F3	T4	T4	Receiving Inspection Delay Reduction	T3	1st Priority on Customer Satisfaction	T2
4	Receiving	F1	Registration of Information on Scheduled Receiving	Business Team	F0	F2	T3	T3		T3	1st Priority on Customer Satisfaction	T2
5	Shipping	F5	Shipping Registration	Admin Team	F4	F6	T5	T5	Shipping Registration Delay Reduction	T4		T4
6	Settlement	F7	Settlement	Admin Team	F6	FF	T6	T6		T6		T6
7	Receiving Confirmation	F4	Receiving Confirmation	Admin Team	F3	F5	T5	T5	Receiving Confirmation Delay at Minimum	T4	1st Priority on Customer Satisfaction	T3

In view of the calculation criteria of business recovery time as shown in Table 17, they were seen to be categorized from T1 to T7 and the recovery times to range from 1 hour to 10 hours with a great diversity.

<Table 17> RTO Calculation Criteria

Category	T1	T2	T3	T4	T5	T6	T7
Recovery Time	1h	3h	5h	7h	10h	1d	2d

Table 18 indicates the process diagram for business recovery time. In case of scheduled receiving, the final business recovery time has turned out to be T2, whereas the receiving confirmation has turned out to be T3 and the settlement to be T6. The details are given as follows:

<Table 18> Business PERT Diagram

Business Code /PERT	Registration of Information on Scheduled Receiving (F1)	Receiving Inspection (F2)	Item Sorting (F3)	Receiving Confirmation (F4)	Shipping Registration (F5)	Shipping Inspection (F6)	Settlement (F7)
1st RTO	T3	T4	T4	T5	T5	T5	T6
2nd RTO	T3	T4	T4	T5	T5	T5	T6
3rd RTO	T3	T3	T3	T4	T4	T5	T6
Final RTO	T2	T2	T2	T3	T4	T4	T6

5. Conclusion

5.1. Summary of Study Results

This study is a thesis for which the methodology of Business Continuity Plan (BCP) has been utilized. First of all in this study, the amount of potential loss of income has been calculated by tabulating products and services using a quantitative method when an unusual weather change has occurred and by examining the potential loss of income caused by interruption of the applicable business on the basis of the annual income amount of the applicable products and services. Also, the priority order has been defined quantitatively by calculating the priority order score in accordance with the size of the potential loss amount of targeted unit business.

As a qualitative method, first, the priority order has been determined depending on whether any targeted business unit is applicable to the items of business nature criteria, and in doing so, the Analytic Hierarchy Process (AHP) has been utilized for determining the priority order and scoring by item with regard to the items of business nature criteria.

Second, the importance scores derived from the AHP method of the items of applicable business nature criteria have been added to those of targeted business units and according to

these scores, the priority order of targeted business units has been determined.

Third, the priority order score of each applicable business unit has been calculated depending upon the size of each business unit's score which is the sum of scores of the items of applicable business nature criteria, and the results have been utilized for combining the qualitative and quantitative priority orders.

The study results are given as follows:

1. The upper-level risks that would be impacted most sensitively by climate change have been selected through an analysis on the threatening factors of business and a risk assessment.

2. Through a qualitative assessment, the impact and characteristics of the environment, with high possibility for bringing about losses caused by unusual weather changes, have been discovered and it was possible to identify the cause-and-effect relationship and the vulnerability between the threats and the

risks that may influence businesses.

Through a quantitative assessment, first, weighted values by criteria item of upper-level business risks have been analyzed. Based upon the results, it was possible to calculate the financial loss.

Second, accordingly, it was possible to define the business priority order by individual and to adjust the Recovery Time Objective (RTO).

5.2. Expected Effects and Implications of the Study

5.2.1. The expected effects of this study

First, the point is that, regarding the impact of unusual weather changes upon business operation, high-level risks have been analyzed by introducing the threat factor analysis, vulnerability analysis, risk identification, risk measurement, risk assessment, risk matrix, etc. while covering all the business tasks.

Second, another point is that all the results of building up or carrying out the definition of unit business, the calculation of weighted value measurement, the examination of importance by individual, the definition of weighted value by criteria item, the calculation of financial loss, and the definition of business priority order by individual, have been derived from a business impact analysis,

Third, another point again is that, through the process of both the above two points, it was made possible to adjust the recov-

ery time so that businesses could be carried out continuously even in a situation of unusual weather changes

5.2.2. The implications of this study

In terms of the business priority order by individual, the implications of this study are given as follows:

First, the item sorting business has turned out to be the most important one in the final priority order. This implicates that, in consideration of the business continuity aspect, the item sorting business will exert the most crucial impact universally on each individual's businesses in all the subjects of financial loss, on-site business continuity, loss of resources, inter-department connectivity, customer satisfaction, etc.

Second, the shipping inspection has turned out to be the second most important business. This implicates that the shipping inspection business will, although without exerting any considerable impact on the loss of resources, exert a crucial impact on both the customer satisfaction factor and the on-site business continuity factor.

Third, the third most important business in the final priority order has turned out to be the receiving inspection. This implicates that the receiving inspection business will exert a crucial impact on both the on-site business continuity factor and the resources loss factor.

Fourth, the registration of information on scheduled receiving has turned out to be the fourth most important thing to do. This implicates that the registration of information on scheduled receiving will, although without exerting any considerable impact on the loss of resources or customer satisfaction, exert a crucial impact on the on-site business continuity.

Fifth, the next ones in the priority order have turned out to be those in the sequential order of shipping registration, settlement and receiving.

In summary of the above final priority order as set by individual, it is implicated that the consequential priority order of each business unit will be assessed by how heavily an impact would be exerted on all the 5 business areas of the financial loss, on-site business continuity, loss of resources, inter-department connectivity, and customer satisfaction.

5.3. Study Limitations and Future Tasks

The limitations of this study revealed in the meantime and the future tasks are given as follows:

First, the on-site survey for this study was carried out with the limited number of only 6 persons of questionnaire target, and the number of questionnaire targets is required to be increased in order to enhance the validity and reliability of study.

Second, the BCP methodology is composed of 4 stages in total, but in this study, the final stage of Emergency Response has been omitted, and additional studies are required in the future on the following subjects:

- Clear reporting, response and controlling procedure in respect of any accidents.
- Communication with stockholders.

- Plans for resuming interrupted activities.

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