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AN IDEF0 MODEL FOR A TERRORIST RESISTANT
GLOBAL SUPPLY CHAIN (GSC)

A Thesis by

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Bachelor of Science, Wichita State University, 2005

Submitted to the Department of Industrial and Manufacturing Engineering
and the faculty of the Graduate School of
Wichita State University
In partial fulfillment of
the requirements for the degree of
Master of Science

May 2009

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GLOBAL SUPPLY CHAIN (GSC)

The following faculty members have examined the final copy of this thesis for form and content, and recommend that it be accepted in partial fulfillment of the requirement for the degree of Master of Science.

Lawrence Whitman, Committee Chair

Don Malzahn, Committee Member

Barbara Chaparro, Committee Member

DEDICATION

To my dearest parents and family members

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First of all, I would like to thank my advisor Dr. Lawrence Whitman for the support and guidance during my thesis development. Five years ago, when I first stepped into the Industrial and Manufacturing Department (IMfgE) of Wichita State University, I took most of my undergraduate and graduate core courses under Dr. Whitman. Although English is not my mother tongue, the arrangement of Dr. Whitman's journal and topic paper practices has trained and improved my level of writing and also cultivated a habit of reading journals. Therefore, I would thank him for assisting me in my internship program and also for his numerous advice over my future (and current) career.

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ABSTRACT

After the infamous terrorist attacks on September 11th 2001 in the United States, the world has become increasingly vulnerable to terrorist activities. International businesses that function through Global Supply Chain (GSC) were highly disrupted by the tragedy. Meanwhile, many types of anti-terrorism initiatives were introduced by the US government and world governments in order to improve the security structure of the nations. However, these initiatives have caused a need for additional information and procedures to complete the simplest of transactions. Due to time constraints, difficulties and complexities of implementation; the development of anti-terrorism initiatives remains unbalanced. By developing an IDEF0 model for a terrorist resistant GSC, each individual company would be able to manage and modify their respective GSC while participating in anti-terrorism initiatives. The IDEF0 model for a terrorist resistant GSC is designed to fit all types of companies in different industries and locations. On the whole, this IDEF0 model is designed to be a protocol for the industry. In chapter four, the thesis report concludes with a detailed description of each IDEF0 activity from the point of view of the education and industry professionals.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

The popularity of the term Supply Chain (SC) has grown exponentially over the recent decades and its usage is now firmly ingrained in the business world. The growth of the world economy has resulted in the amalgamation of supply chains, forming what is now commonly referred to as a Global Supply Chain (GSC). However, GSC is continuously exposed to threats of terrorism, especially after the September 11th terrorist attacks. International business is one among many sectors that faces severe disruptions from the threats of terrorism. GSC of many industries faces new challenges: changes in procedures, the need for additional information to identify factors that affect the complexity of logistics processes, and the duplication of confirmation that occurs between different parties along the GSC.

Risk is a recognized factor associated with GSC operations, with terrorism being given new attention as a key risk factor. After the terrorist attacks on September 11th 2001, the derivatives of terrorism brought about the evolution of GSC; e.g. the implementation of initiatives to improve national security systems, developing new or removing redundant procedures, and collecting additional information in order to protect the myriad the interests of many parties involved in cross-border commerce. Unfortunately, the evolution of GSC has created new issues such as an increase in lead times and a reduction in the volume of transactions. Ultimately, companies must strike a balance between protecting security interests while striving to maintain an efficient global supply chain.

One of the better ways to manage and simplify the flow of processes of GSC is to develop an IDEF0 model. IDEF is known as Integrated Definition Methods and IDEF0 is a functional model of the said method, which is designed to plan decisions, actions and the activities of systems, such as GSC. Among the many advantages of supervising a global supply chain by using the IDEF0 model is that the model helps to organize the analysis of the GSC and also promotes good communication between the company with the supplier and customer, as well as third party logistics (3PL) companies and the government. Meanwhile, the IDEF0 model is also very efficient in establishing the scope for functional analysis. Basically, the contents of the proposed IDEF0 model define the processes of a GSC.

1.2 Strategy

Integrated Definition (IDEF) - IDEF0 function modeling method will be utilized in order to support the development of terrorist resistant GSC.

1.3 Thesis objective

Today, global businesses rely heavily on Global Supply Chain (GSC). The IDEF0 model is an enhanced method to define and manage a GSC. The objective of this thesis is to develop an IDEF0 model for terrorism resistant GSC. The model will be based on information gathered from global logistics and the policies and operations of regional organizations and initiatives developed by the United States government. This model will help identify the major factors that affect the performance of GSC under the threat of terrorism.

1.4 SWOT analysis

One way to understand and familiarize oneself with the current state of GSC is through the use of SWOT (strengths, weaknesses, opportunities and threats) analysis.

Figure 1 presents the SWOT analysis that clearly defines the major contents and the dilemmas of existing GSC.

Performing a SWOT analysis is critical to developing an IDEF0 model. This is because the contents of SWOT analysis are based on the considerations of research studies and current issues affecting the GSC. Meanwhile, the development of an IDEF0 model will be mostly based on the outcome of the SWOT analysis.

SWOT analysis of GSC

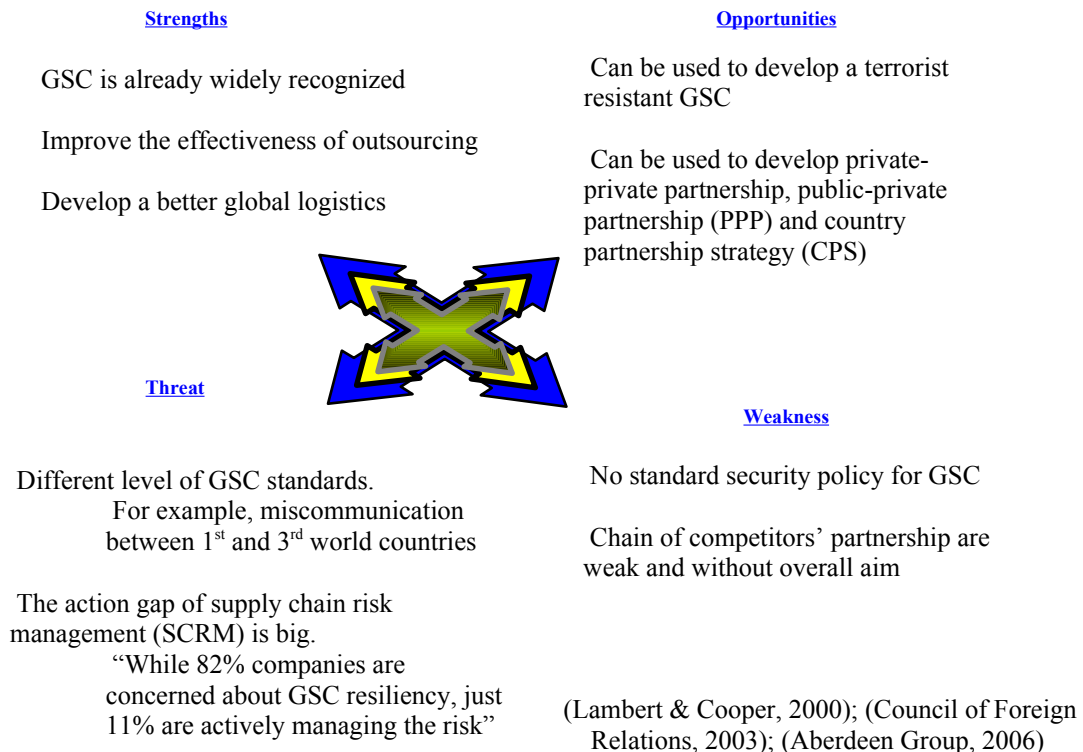


Figure 1: SWOT analysis of GSC

1.4.1 Strengths

The most compelling strength of an existing GSC is that it is already widely known and used in almost every global organization. For international businesses, GSC

has improved the effectiveness of their outsourcing operations as well as improving international logistic routes in order to minimize lead times.

1.4.2 Weakness

Although the system is already widely used, there is no standard security procedure in place for GSC. Uninformed and imperfect security procedures have caused inefficiencies in GSC, especially between international transactions across different countries or regions. Another issue is that chain of competitors' partnerships are weak and without overall aim. This issue has constrained the performance of the best practice GSC.

1.4.3 Opportunities

The current state of GSC is still vulnerable to threats of terrorism. However, improvements can be made to GSC so as to make it terrorism resistant. Current Information Technology (IT) systems used in GSC are physically powerful, and GSC itself has been stable within the last decade. Therefore, it is only logical that new security measures and terrorism initiative programs should be added in order to strengthen and secure existing systems. Later, a terrorist resistant GSC would be competent enough to handle the development of private-private partnership, public-private partnership (PPP) and country partnership strategy (CPS).

1.4.4 Threat

One of the biggest threats of GSC is the level of global co-operation (or the lack of it) between countries, especially between first and third world countries, as well as the level of co-operation between regional organizations that are still under deliberations and talks. There are quite a few major constraints at the moment that affect the development

of terrorism-resistant systems. One of the most critical ones is the action gap of supply chain risk management (SRCM) which is still wide. According to Aberdeen Group (2006), 82% companies are concerned about GSC resiliency, just 11% are actively managing the risk. The huge percentage difference has shown that the reaction of industry against terrorism is still very weak and unenergetic.

1.5 Thesis road map

A road map is a method used to enable and assist both the author and reader in understanding the present and desired condition of this thesis. The contents of the road map include descriptions of current and desired conditions, the obstacles that thwart the accomplishment of the desired condition, the strategies to be used to overcome the obstacles as well as the objectives for achieving the strategy. Figure 2 shows the thesis road map.

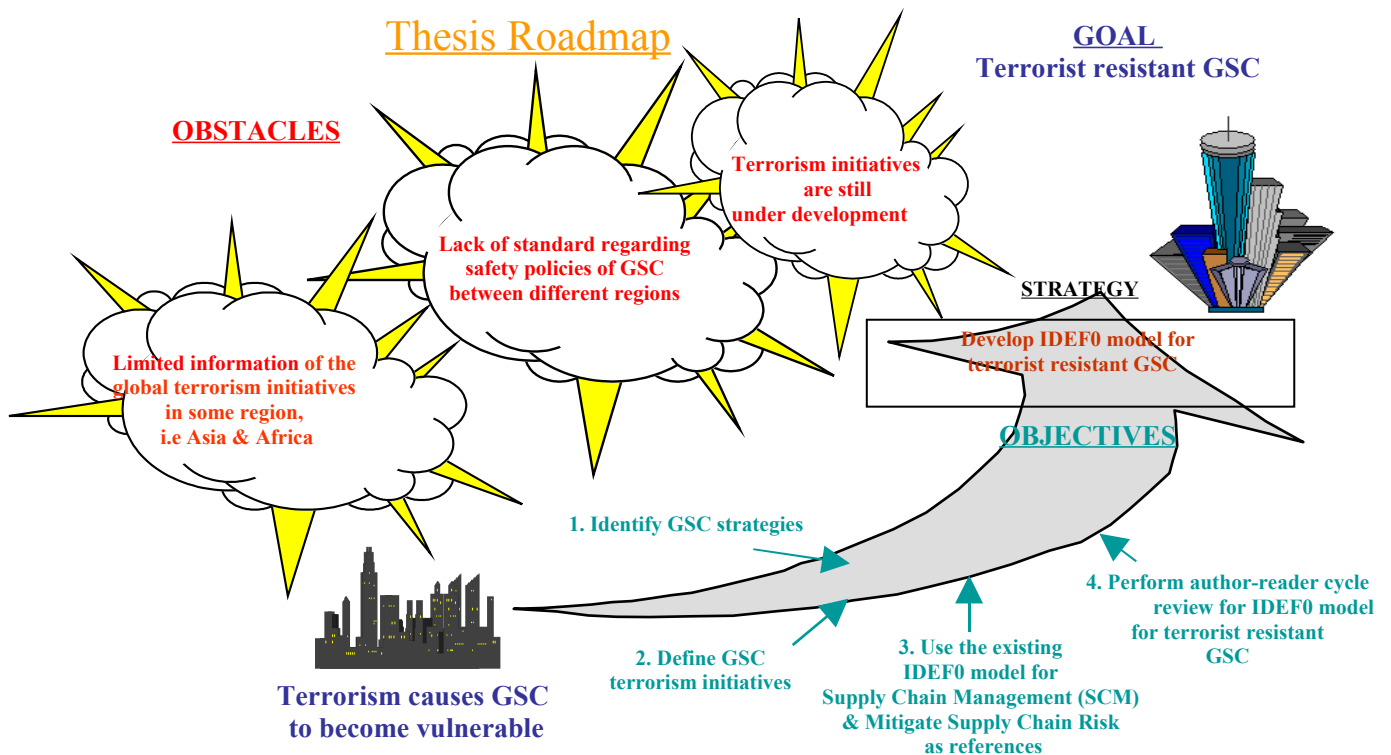


Figure 2: Thesis road map

1.5.1 Current condition

After the September 11th terrorist attacks, the operation of GSC have been under the threat of terrorism. Every terrorism-related incident introduces new difficulties to GSC. Rules and regulations are continuously being modified and procedures have been adjusted endlessly in order to adapt to current conditions. These changes are the only way to secure the GSC. However, there are several side effects of such changes; e.g. an increase in lead times, lack of co-operation between the customs departments of different countries, and miscommunication between companies, all of which will only serve to hamper the flow of transactions in GSC.

1.5.2 Desired condition

Although terrorist activities cannot be completely eradicated, the creation of a terrorism-resistant GSC should be sufficient to secure international businesses. By improving the level of understanding between corporations and countries and implementing effective anti-terrorism initiatives, the security of the GSC as a whole should theoretically improve. In addition, the model itself is customized to fit any environment and it can also be modified for future changes or improvements.

1.5.3 Obstacles

The content of the obstacles mainly arise from the lack of research and improper understanding of the industries. The road map defines three major obstacles that prevent one from reaching the desired condition. They are:

1.5.3.1 Lack of terrorism prevention plans in some regions, i.e. third world countries in Asia and Africa: Although terrorist events affect GSC continuously, there are still a number of countries in Asia and Africa that remain unconcerned about such incidents.

The lack of anti-terrorism initiatives in such countries is a great disadvantage to local businesses in their dealings with Western countries.

1.5.3.2 Lack of standard safety policies of GSC in different regions: The risk of terrorism varies between countries and regions. At present, countries at the Middle East battlefield region are more at risk compared to other part of the world. In general, due to the different advancement of the country and different prerequisites for security systems have resulted in the delivery of different security standards, giving rise to more barriers to conduct world businesses.

1.5.3.3 Terrorism initiatives standard are still developing: Many terrorism prevention initiatives have been developed globally after the September 11th terrorist attacks. In the United States alone, “more than ten different kinds of initiatives were introduced to the public sectors just a few months after the terrorist attacks” (Sheu,C., Lee, L., and Niehoff, B., 2006). However, the creation of new initiatives and the changes to the old system have caused many problems in GSC. Meanwhile, due to the continuous destruction of terrorist attacks, terrorism initiatives are being modified constantly to make sure they are secure and compatible time after time.

1.5.4 Strategy

GSC is growing increasingly complex due to the high growth rate of international business. Additional initiatives between dissimilar supply chains only serve to make matters worse. However, the use of good strategies to manage highly complex systems may enable one to overcome many difficulties. For this thesis, the IDEF0 function modeling method is extremely useful. This model is able to define GSC processes precisely and the elements that are related to GSC can also be identified with certainty. The flexible design of the IDEF0 function modeling enables it to adapt to almost any type

of environment, as the modification of the IDEF0 function modeling can be done easily in order to suit different systems.

1.5.5 Objectives

The objectives that are stated in the road map are required to overcome the obstacles and also to achieve the desired state. For this thesis, the four objectives include:

1.5.5.1 Define GSC strategies, guidelines and processes: The understanding of GSC strategies, guidelines, processes in different industries as well as countries from various regions is vital. GSC is designed based on the characteristics of a particular industry. They are also premeditated based on a country's background and its geographical location. The understanding of the system environment is the key to developing a multi-relationship IDEF0 model. GSC guidelines can be very intricate and procedures can be duplicated. However, this information will be useful for future improvements and changes.

1.5.5.2 Identify GSC terrorism initiatives: The design of terrorism initiatives are usually performed by industry experts and government. The purposes of terrorism initiatives are to secure the flow of materials and formation, and improve the liaison of GSC with government. Terrorism initiatives set a standard for operation guidelines and regulations in various industries. Therefore, the research on terrorism initiatives in different countries is extremely important. Meanwhile, continuous research is needed due to continuous change of terrorism initiatives.

1.5.5.3 Modify the existing IDEF0 model for SCM and Mitigate SC Risk: The existing IDEF0 model for SCM and Mitigate SC Risk were created to enable one to manage a supply chain and mitigate SC risk. Part of the contents of the model is useful and can be used as a fundamental structure for the development of a terrorism resistant GSC IDEF0

model. Meanwhile, the design of the existing IDEF0 model also gives a clear view of the ordinary GSC structure.

1.5.5.4 Perform author-reader cycle review for IDEF0 model for a terrorist resistant GSC:

Author-reader cycle review will be performed by the industrial professionals. The professionals will review the IDEF0 model base on their industrial experience. The suggestions by the professionals will be discusses and reviewed by the author and the committees.

The combination of these objectives will be critical in developing an IDEF0 model for a terrorist resistant GSC. These objectives included all the necessary information to create GSC and IDEF0 models. By comparing the differences between industries GSC and countries' terrorism initiatives, it will be easier to design and create a standard template that will fit the industry in the best possible way. By revising the trading policies of different countries, this will minimize the barriers that hinder the development of an IDEF0 model. The reason behind this is that all border and customs agencies around the world are under the scrutiny of their respective governments.

1.6 Road map summary

A road map is a method that enables the author, reader as well as the end-user to understand the progress and the purpose of this thesis. Moreover, the addition of the SWOT analysis makes it easier to determine important factors related to the system. Although the road map is just a brief overview of the course of this thesis, it gives a very clear direction along which obstacles can be overcome in order to achieve the objectives by using the strategy mentioned. Therefore, these supporting contents are invaluable to the accomplishment of the goal of this thesis.

1.7 Thesis report organization

The next step for the thesis will be a literature review. A literature review will entail gathering additional information which is related to the thesis topic. A literature review will also assist the author in generating more ideas after reading facts about the achievements of others.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

In this day and age, especially after the new millennium, it is almost impossible to manage a country with a strategy of hundred percent self-supplying. The reason why it is such a daunting task is because the tendency of global businesses in connecting to every country on this planet involved in the world of manufacturing. This strategy, however, will be beneficial to each and every associate in the system.

The growth of global businesses is speedy after the 90s. Some small countries with small land areas have developed a unique global businesses structure. One of the most typical examples is the country Singapore. Although it is a small island, it is the only fully developed country in South East Asia. However, it could not survive if the supply of water and petroleum is suddenly cut off. The economy growth of Singapore is totally dependent on investments and strong partnerships from foreign countries. As a result, the global businesses structure of Singapore has created a strong Global Supply Chain (GSC).

Meanwhile, the discussion takes us to the other side of the situation, the largest populated country in the world, China. At present, how many countries on this planet could live on without using a “Made in China” product? The answer is perhaps none. The trend of current global manufacturing strategy has set the direction to the country with 1.3 billion people, China. Low cost production has attracted a lot of foreigners’ investments, such as Wal-Mart corporation. Principally, not only China, global businesses has created a lot of job opportunities at second and third world countries. Therefore, global businesses have become a catalyst of creating a strong GSC.

Two obvious facts that had been found from the research done recently are that the growth of global business is rapidly increasing and the level of dependency between each country is getting tighter (Accenture, 2007). Due to the quick expansion of global businesses, efficiency of managing a rapid growth GSC is becoming very challenging. The coordination between each party in GSC is getting more and more complex. As a result, modification of GSC needs to be done frequently in order to keep it running efficiently.

Astonishingly, September 11th, 2001 terrorist attack in the United States has totally changed the structure of GSC, meaning that GSC is not only at risk to natural destruction, but also vulnerable to the diversity of a terrorist attack, which could happen anywhere around the world. At present, GSC is facing huge challenges from the threat of terrorism because the impact of terrorist attack is unpredictable.

Basically, this section will introduce and define the possessions of developing terrorist resistant IDEF0 model of GSC. The contents include the understanding of how does terrorism affect GSC and the affected essentials inside GSC. In addition, this section also discusses how to deal with the aftermath of a terrorist attacks and the circumstances to operate under tightened government security. Last of all, this section covers the introduction of an IDEF0 model and explains connection of every element in an IDEF0 model.

2.2 Understanding Supply Chain (SC) and Supply Chain (GSC)

Initially, the understanding of Supply Chain (SC) and Global Supply Chain (GSC) are required before beginning to investigate deeper into this issue. According to Whitman, L., Malzahn, D. et al., (1999), “A supply chain is a web of autonomous enterprise collectively responsible for satisfying the customer by creating an extended

enterprise that conducts all phases of design, procurement, manufacturing, and distribution of products”. On the other hand, according to the Organization of Economic Co-operation and Development (OECD) (2002), Global Supply Chains are worldwide networks of suppliers, manufacturers, warehouses, distribution centers and retailers through which raw materials are acquired, transformed and delivered to customers.

From the definitions, the characteristics of SC and GSC are very similar. The most obvious difference is that SC is usually considered as a local chain of supply; and GSC could involve a bigger coverage, such as regional or international one, and it could also be involve with governments and international organizations. GSC network is covered all over the world and it functions with consistent organizations, resources, and processes that develop and deliver products to customers.

In the recent decades, many local SC had growth quickly and transformed into GSC. In general, many international businesses are growing rapidly from regional to worldwide. The location of suppliers, manufacturers and customers can be far apart and a single product could be built from different countries around the world. However, the quick growth of international businesses has also caused GSC is getting even more complex and very difficult to manage. Nevertheless, the development of new software and hardware has brought in new methods and technology and would successfully solve partial problem of GSC. For example, the implementation of SAP and Oracle has simplified the GSC operations. Moreover, the development of Radio Frequency Identification (RFID) has also improved the industries’ inventory management.

2.3 Understanding Supply Chain Management (SCM) and Supply Chain Models

From the moment that GSC is getting common, the research and development of Supply Chain Management (SCM) and Supply Chain Models had been highly performed.

The main objective of these developments is to create a better management method and models for the industries to manage, sustain, and foresee the future development of GSC.

According to Global Supply Chain Forum (GSCF) of Ohio State University (OSU), SCM is the integration of key business processes from end-user through original suppliers that provides products, services, and information that add value for customers and other stakeholders. From the research, Dr. Lambert (2008) proposed eight management processes that focus on managing the relationships in the GSC. These eight processes are 1) customer relationship; 2) supplier relationship; 3) customer service; 4) demand; 5) order fulfillment; 6) manufacturing flow; 7) product development and commercialization and 8) returns. Each of these entities is designed to perform cross-functional internally and externally. Figure 1 shows the relationship of a company with two tiers of customers and two tiers of suppliers. In a nutshell, the key of this research is to develop a SCM infrastructure that implements cross-functional and cross-firm GSC operations.

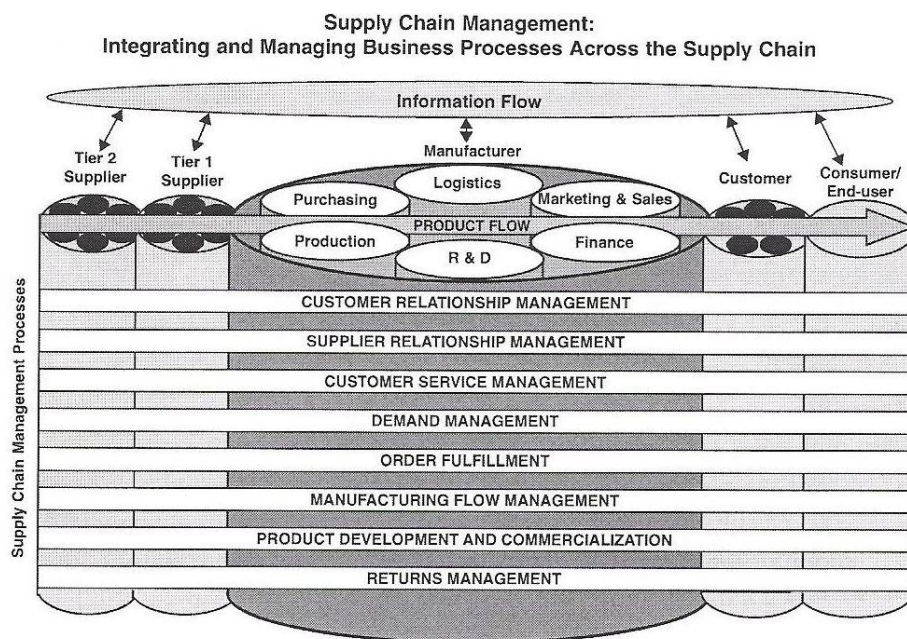


Figure 3: Supply Chain Management

Subsequently, the development of Supply Chain Models is another key practice to maintain close connection with the development of GSC. Many companies in different industries are using many types of models to improve the flow of supply chain and also develop different scenarios to get ready for future challenges. At present, one of the most common and trusted models is known as Supply-Chain Operations Reference-model (SCOR), which is developed and maintained by the Supply-Chain Council (SCC). “SCC is a global non-profit consortium whose methodology, diagnostic and benchmarking tools help nearly a thousand organizations make dramatic and rapid improvements in supply chain processes. SCC has established the supply chain world most widely accepted framework for evaluating and comparing supply chain activities and their performance” (SCOR, 2000). According to SCC, SCOR is defined as a process reference model that has been developed and endorsed by the Supply-Chain Council as the cross-industry standard diagnostic tool for supply-chain management. SCOR enables users to address, improve and communicate supply-chain management practices within and between all interested parties. Briefly, SCOR is a SCM tool and it is also a process reference model for supply-chain management, spanning from the supplier's supplier to the customer's customer.

The main reason why SCOR is so popular in the industry is because of the continuous research and development which had been performed by SCC to continually improve the SCOR system tools. SCC also educates and discusses SCOR & GSC issues with sponsors and clients. According to SCC’s research, three main functions of SCOR model are: 1) Guide the consolidation of internal supply chains; 2) Create standard processes and common information systems across business units; 3) Create a common scorecard by which customers can measure their performance and by which SCC

sponsors can measure suppliers' performance. The expected outcomes would be "significant cost reductions from eliminating duplicative assets; generates major cost savings, cycle-time and quality improvements; lead to major cross-organizational process improvements" (SCOR, 2000). Last but not least, both GSCF and SCOR provide upstream and downstream sides of GSC. The combination use of eight key techniques of GSCF and the SCOR of SCC would give a positive impact and provide continuous support to every international company in the USA.

2.4 The risks of GSC

What is risk? Risk is defined as "the probability of variance in an expected outcome" (Spekman and Davis, 2004). According to Spekman and Davis (2004), "as firms collaborate and combine forces to compete as extended enterprises against other integrated supply chains, risk is linked to the interdependence among supply chain partners". For example, if South East Asia (SEA) suffered a regional natural disaster, the GSC of rice will be affected immediately around other Asian countries. The reason is because SEA is one of the major hubs of rice plantation. Countries such as Thailand, Vietnam, the Philippines and Malaysia are major rice exporters. The supply of rice will be affected greatly if these countries face difficulties in exporting rice. This type of chain relationship can be seen in different industries. Therefore, GSC risk has been highly discussed and researched in the past two decades.

Before the September 11th terrorist attacks, GSC risks that concern many of the industries are the natural disasters, such as hurricanes, tsunamis and earthquakes; or regional diseases, such as Severe Acute Respiratory Syndrome (SARS), Avian Flu and Poultry Diseases. These occurrences had a direct impact on the flow of the local and region GSC. For instance, two major natural disasters that happened within the past four

years, such as Asian Tsunami which happened on December 26th 2004 at the India Ocean and Hurricane Katrina which happened on August 23rd 2005 at Atlantic Ocean had caused a massive devastation. “Asian Tsunami had killed more than two hundred thousand people in eleven countries. It also caused ten thousand billions economic lost” (Irene, Grossi et al., 2006). In addition, “Hurricane Katrina had killed eighteen hundred people and caused eighty billions economic lost” (Burton & Hicks, 2005). Just as sudden, another two massive natural disasters made another strike in May 2008. They were Sichuan Earthquake in China with 8.0 magnitudes, and the Cyclone Nargis in the Indian Ocean. Both natural disasters had killed more than two hundred thousand people and caused estimate thirty billions economic lost in Asia” (CNN, 2008). In addition, risks which are caused by human factors include Information Technology (IT) severe attacks, such as internet viruses and hackers and currently, political conflict between countries also interferes with the performance of GSC.

Subsequently, the present biggest treat of GSC is terrorism. A massive human tragedy, a series of terrorist attacks that occurred back in September 11th of 2001 in the United States of America (USA) has started the world terror of religious terrorism. Terrorism in the modern sense is defined as “violence or other harmful acts committed or threatened against civilians for political or other ideological goals” (Humphreys, 2006). As a whole, the devastation terrorism incurred around the world is getting worse since the 90s and a current count shows more than eighty terrorist attacks occurred in year 2007 alone around the world, which double of that from year 2006. The negative impact of terrorist attacks not only affected international businesses but also resulted in the murder of thousands of innocent civilians around the world.

The September 11th terrorist attacks in the USA shocked and dazed the entire world because USA was one of the world largest and safest countries on this planet. The retaliation towards terrorist regions was taken a few months later by the United States military. Six years later, the threat of terrorism has lessened somewhat but it is still not fully extinct, both on US soil and internationally. Although the United States had successfully thwarted nineteen terrorist attacks against America since September 11th terrorist attacks (Carafano, 2007), the world safety is still extremely vulnerable due to continuous terrorist attacks in different regions around the world.

After the tragedy, the world businesses are operating under a lot more risks. Two major impacts to the world business are that GSC is getting more vulnerable and complicated. The anti-terrorism initiatives introduced by respective governments had brought in additional barriers to the GSC. Problems such as longer lead time and additional policies now occur simultaneously. The regular processes are forced to be changed and the procedure needs to be reconfigured in order to be secure and fit the latest regulations. “Firms are vulnerable not only to attacks on their own assets, but also to attacks on their suppliers, customers, transportation providers, communication lines, and other elements in their eco-system” (Sheffi, 2001). It is true that there is no restriction on the terrorist attacks because anything could happen to any sector in the GSC and that particular attack could affect the GSC instantly. At the present time, terrorism activities have occurred around the world, such as Russia, UK, India, the Philippines, Indonesia, Iraq and Afghanistan.

According to Sheffi (2001), “Ford and Toyota manufacturers in the United States had suffered massive losses caused by the September 11th terrorist attacks because they operated in the Just In Time (JIT) inventory strategy, keeping material on hand for only a

few days or even few hours”. The advantage of JIT had helped a lot of firms in minimizing the inventory on hand in order to increase the sales margin. However, the JIT strategy has also created a number of potential risks and the September 11th tragedy is considered as the worst scenario for the JIT strategy. After the September 11th attacks, “the ten day shutdown of twenty-nine ports in the US is presumed to have cost the US economy one billion dollar daily” (Jutter, 2005). This research proved that a lot of international firms were affected very badly by the tragedy and would still continue to suffer the after impact.

The fact of the September 11th tragedy and academic research has proved that GSC has an indirect relationship with different kind of risks. Other than the threat of terrorism, few other common supply chain risks are the risks caused by Information Technology (IT), hackers, the corruption of government agency and the port security. Considering the unstable political influences between countries has also created additional political and religion issues. Essentially, the world is living under a lot of anxiety. No one knows when and where the next terrorist attack would occur and governments and think-tanks alike are constantly on the alert. The following paragraph will introduce the many types of strategy to secure the GSC under the threat of terrorism.

2.5 GSC strategies

Developing a secure and resilient GSC is considered necessary at this moment. The GSC not only has to be secure it has to be resilient in order to operate under unexpected circumstances. After the September 11th attacks, the GSC faced four major challenges, which are 1) preparing for another tragedy, 2) managing supply chains under increased uncertainty, 3) managing relationships with the government, and 4) organizing to meet the challenge (Sheffi, 2001). In order to overcome these challenges, a series of

hybrid strategies need to be considered. For example, the relationship between public and private sectors needs to be improved and the development of partnership between international firms and regional organizations needs to be taken into account.

“The risks of supply chain had been received a greater attention in research by academics and practitioners alike” (Spekman and Davis, 2004). Due to the high demand of GSC security solutions, many consultant groups and international firms had begun their own research and provide solutions to their individual clients’ GSC orientation. For instance, IBM has published a lot of journals which were related to GSC operations and security issues. These journals have provided new ideas and latent solutions. The researchers are providing and sharing new practices to improve the efficiency of GSC.

Subsequently, “effective supply chain risk management requires the identification and monetization of risk events, probability of occurrence, and the firm contingencies for alternative sources of supply” (Barry, 2004). In order to have an effective GSC risk management, a lot of real time case studies needs to be reviewed, the relation of facts and causes need to be comprehensible. One of the most complicated is operations improvement that always requires a lot of support from the many different sectors in international firms and also in the GSC. The following paragraphs will introduce the types of SCM strategies. The contents will discuss what and how it can be done.

2.5.1 Revenue Sharing

The main purpose of every business is to make profit and most of the firms are trying to use the minimum cost to keep expanding the business structure or improve the performance of the GSC. For that reason, the SCM has introduced a business strategy called revenue sharing to assist the business development.

The meaning of revenue sharing is “as for the compensation, the retailer must share his revenue with the supplier at a certain revenue-sharing rate, say r ($0 \leq r \leq 1$), where r represents the portion of the revenue to be kept by the retailer” (Qin and Yang, 2008). The objective of revenues sharing is to help the supply chain be more profitable while upholding the individual components' incentives. For example, the mail-in rebate system is a very common technique of revenue sharing. This practice has been successfully implemented by many electronic retailers, such as Best Buy and Circuit City. By a partnership with the manufacturers and retailers, business has increased profit for both the upstream and downstream firms in the GSC. Last but not least, revenue sharing has also minimized the risk of holding too much inventory due to variable demand or any other stochastic risks.

“Revenue sharing is a valuable instrument in vertically-separated industries when there is intra-brand competition among the downstream firms, demand is stochastic or variable, and downstream inventory is chosen before demand is realized” (Dana and Spier, 1999). According to the research, revenue sharing could also encourage inventory holding and soften downstream price competition and it applies to other industries as well. In other words, if revenue sharing is implemented wisely, the advantage is beneficial to each and every entity in the GSC. However, revenue sharing is always dependent on the performance of each entity. Hence, the success of GSC is not only dependant on upstream or downstream entity but the entire development and cooperation of GSC.

2.5.2 Dual Manufacturing

In general, dual manufacturing is a method of having two companies supplying the same unit. According to Sheffi (2001), “the concept of dual manufacturing is to

ignore the time value of money, possible penalties for not delivering and many other aspects of reality. It demonstrates, however, the value of purchasing the insurance”.

These days, a lot of companies are switching their manufacturing processes to Asia and Africa. Countries such as China, India and South East Asia region had been chose by foreigner investment due to a lower production cost. However, due to the activeness of terrorism, some countries in Asia still had been listed as high risk countries. By taking into account of a disruption happening in particular region, which would lead to transportation issues, GSC should search for another supplier locally or in other region to supply a small percentage of the same unit with higher production cost. By doing so, the GSC will become more resilient because the firm always has the backup of the supplier.

2.5.3 Inventory Management

Inventory control is considered a daily task in either a manufacturing environment or in a GSC. The inventory level needs to be kept consistently as a one part shortage would cause a series of impacts in the GSC. At present, the common types of inventory management methods are Just-In-Time (JIT), Vendor Managed Inventory (VMI) and risk pooling.

After the September 11th disaster, the transportation network, including land, sea and air of USA were locked down for ten days. A lot of international companies experienced inventory issues. A lot of manufacturing firms had to try to keep minimum inventory on hand because they are performing JIT, VMI and risk pooling inventory practices. For instance, Ford and Toyota had inventory issues because they operated under the JIT inventory method and on hand material will only last for a few days or even as few as several hours (Sheffi, 2001). As a result, Dr. Sheffi had recommended every

industry should have dual inventory arrangement, meaning that industries should “separate the normal business uncertainties from the risk associated with another possible terrorist attack by creating Strategic Emergency Stock (SES)” (Sheffi, 2001). In other words, SES should only be used during extreme disruption, such as terrorist attacks or any natural disasters. It should not be used to solve daily inventory variations.

Nevertheless, in order to create a practicable SES, firms are required to spend dollars and the SES is yet also considered as an inventory on hand. From another point of view, SES strategy can be seen as spending money to buy insurance so as to reduce the risk of uncertainty.

Subsequently, another common inventory management is known as Vendor Managed Inventory (VMI). VMI is defined as “the buyer of a product provides certain information to a supplier of that product and the supplier takes full responsibility for maintaining an agreed inventory of the material, usually at the buyer's consumption location” (Tempelmeier, 2006). The objectives of VMI are to reduce both the inventory in the GSC and shared risk. A successful example is Wal-Mart that had implemented VMI. In brief, the vendor own the products until sales take place at the retailer store.

In addition, with the aim of reducing the risk of supply chain, another extensive inventory technique was developed, which is known as inventory aggregation; also called risk pooling. This technique is an efficient method to reduce inventory carried in a supply chain. “The technique is originally practiced by insurance companies in order to create a protection to the insurance industry by pooling similar risks that underlies the concept of insurance” (American Academy of Actuaries, 2006). Later, the practice is applied to many other different industries, such as the manufacturing industry and retailer businesses. At present, risk pooling is an important concept in supply chain management.

Risk pooling suggests that “demand variability is reduced if one aggregates demand across locations because, as we aggregate demand across different locations, it becomes more likely that high demand from one customer will be offset by low demand from another. This reduction in variability allows a decrease in safety stock and therefore reduces average inventory” (Simchi-Levi, D. et al., 2003).

The key objective of risk pooling is to develop centralized distribution system. According to Simchi-Levi, D. et al. (2003), “risk pooling leads to a reduction in variability measured by either the standard deviation or the coefficient of variation. This means that the higher the coefficient of variation, the greater the benefit obtained from centralized systems; that is, the greater the benefit from risk pooling”. In addition to that, another two advantages of risk pooling are: 1) the performance of risk pooling will reflect the market demand of a particular region and it is an indication to let the firms to forecast the upcoming demand. 2) The technique will be very efficient when inventory and warehousing costs are high percentage of a supply chain. For example, Dell and Hewlett-Packard (HP) are the two huge firms in the USA which have a very successful risk pooling system. The ordering of each sale will be sent to the database center and re-sent out to the regional distribution center based on the customer’s location and requirements.

In order to have better performance of JIT, VMI and risk pooling; industries require better information sharing through the internet by using advance Information Technology (IT). The next topic will discuss the importance of information sharing.

2.5.4 Information Sharing

Since the internet has been introduced to the world, the usage of personal computers has also increased greatly. Unfortunately, computer viruses are also getting very common and this threatens the security of the internet. According to Computer

Economics' report (2008), the computer viruses and hackers have caused an average of ten to fifteen billions economic lost each year worldwide.

In the USA, President Clinton in an effort to solve this problem had issued industry leaders to form information sharing and analysis groups to protect the nation's infrastructure in 1998. "Three years later, Information Technology Information Sharing and Analysis Center (IT-ISAC) was founded in January, 2001 by nineteen well-known IT industry companies, such as Microsoft, AT&T, Oracle, IBM, EDS and others to operate as a major repository for security information" (IT-ISAC, 2006). The main objectives of this organization are to share information on the subject of security attacks and also to improve the collaboration between public and private sectors. The conception of this organization is to unite the IT industry and to develop the information sharing network. The approach of information sharing has enhanced the efficiency of information flow, process management, and security of GSC. Besides that, this method will also foster trust among the companies in the GSC. For example, the most common information sharing practice in the international business is known as Electronic Data Interchange (EDI). EDI is an important tool in the manufacturing industry because a lot of firms use EDI to manage JIT, VMI and risk pooling. This EDI has improved the communication and the operation efficiency in the GSC.

Last but not least, IT is becoming a compulsory tool in every industry and information sharing is an essential practice in the GSC. The implementation of IT and information sharing has also helped smooth relationships between not only companies, but also the increase collaboration between government and even regional organizations.

2.5.5 GSC partnership

In general, a partnership is defined as “a relationship between individuals or groups that is characterized by mutual cooperation and responsibility, as for the achievement of a specified goal and mutual benefit” (Dictionary, 2007). A stable relationship in GSC is a major key to success in an international business. By developing partnership strategy in the GSC, it will be beneficial to the entire GSC and also help create a more competitive international firm. On the other hand, a partnership is also an important input to develop trust between companies and it also helps facilitates a closer connection from the supplier’s suppliers to the customer’s customers.

In the current international business field, few common business partnerships are general partnerships, limited partnerships, joint ventures and strategic alliances. The main objectives of these partnerships’ conception are to develop trust among the firms, improve the communication amongst the GSCs and increase the profit of the business. After the 90s, many Western entrepreneurs had expanded the international business into the Asian countries. The first two choices are very obviously, China and India. This is because both the countries can provide the required manpower and at a much lower cost too. Not long after this development and also with the government’s support, a lot of these investments turned into joint ventures and the key strategic goal of joint ventures is the transfer of technology.

Subsequently, the next section will introduce two common partnership structures. These are the Public-Private Partnership (PPP) and Private-Private Partnership. The term public refers to governments and private refers to businesses of civil society. “PPP are medium-to long-term ventures in which there are key contractual or legal relationships between public and the participating private sector” (Brusewitz, 2004). PPP strategy has

been recognized in the United States as far back from the late 1970s. The US government publication – Commercial News USA had started a partnership with US exporters by advertising US products and services to international markets. Soon after, “Clinton Administration’s effort to reinvent government has been to stretch United States (US) tax dollars while improving service to taxpayers” (Holderman, 2004) and this particular improvement created a win-win scenario for both the private and public sectors.

At present, one of the most common PPP around the world is of the government financing infrastructure investments and development. Basically, it is another kind of competition among private companies. Private construction companies are trying their best to bid on contract to partnership with government. Based on current news aired on CNN, the USA federal government was shown to make an announcement on July 15th 2008 that the Federal Housing Administration (FHA) has decided to lend a hand to two major private mortgages in the USA, Fannie and Freddie. Later, on July 30th, President Bush signed a housing rescue law which allows FHA to insure up to three hundred billion in the hopes to save the ever declining housing market.

In the meantime, PPP strategy has been introduced and implemented into many different sectors and countries. This had turned out universal cooperation within the development of information sharing. PPP and Private-Private Partnership have become more vital aspect towards the rapid growth of GSC. While partnerships are a very high-quality business processes, this means that the development of each stage is very critical. The management requires extensive preservation. According to Michel C et al. (2002), “partnerships that failed are usually caused by the managers' inability to form and maintain successful relationships with their partners at an interpersonal level”. Nevertheless, partnerships approaches seem to be non-standard. Some partnerships fail to

keep to their promises and some began a partnership with a non-realistic planning or inadequate foundations. According to Turner and Wirth (2003), “there are three important and basic rules to be followed before developing a partnership”. The rules are: every party must have a clear problem; partnership approach is backed by a dependable plan and find for right people for this advancement. These three rules are only a fundamental guide. In order to implement a partnership, Turner and Wirth (2003) also introduced ten critical steps that need to be considered before starting a partnership approach for either PPP or Private-Private Partnership. The ten critical steps are:

- 1) Examine the potential: Usually partnerships approaches are protracted so the search of a potential partner is very decisive act;
- 2) Focus on the concrete: Other than common visions, values and missions; rules and activities need also be introduced in order to turn PPP to a reality;
- 3) Agree to a shared governance structure: Usually, the arrangement of power relations is vital because the success of a PPP strategy underlies the companies’ supremacy;
- 4) Plan the details: The settings of performance and management goals are important and as such a complete strategy for developing, maintaining, and completing it is required;
- 5) Flexibility: In order to be resilient, explicit exit regulations need to be set in order to protect partnerships members;
- 6) Identify catalytic leadership: Strong management leadership is the key to get the partnerships off the ground;
- 7) Establish an appropriate time frame: The development of partnerships usually take longer than expected as hidden problems will only show up during the evolvement period;
- 8) Trust, but verify: Trust is an indispensable part for PPP or Private-Private Partnership. “Trust is a necessary precondition, but it can also be reinforced through the process of partnering” (Turner & Wirth, 2003). For example, partnerships companies may appoint third party Audit Company to perform the evaluation for verification;
- 9) It is important to

acknowledge that the job is difficult: From research, partnerships take significant resources to initiate and manage. However, most importantly is that all parties must remain passionate and committed; 10) Keep records: Lastly, written agreement with legal authorization is the only to formalize the partnership and also a method to protect every member in the partnership.

Additionally, in the United States, there are two major PPP organizations, which are the National Council for Public- Private Partnerships (NCPPP) and Public-Private Partnerships (PPP) which are operated by the US Department of Transportation. Nevertheless, the development of PPP has presented business opportunities in areas at which the private sector was previously excluded. Meanwhile, the PPP strategy has also improved the relationship between public and private sectors.

2.5.6 International and Regional Organizations

The main intention of international and regional organizations is to develop a better relationship among governments and private sectors in the many different countries. The participation of international and regional organizations is beneficial for the rapid expansion of reliable global businesses. Advantages such as trade facilitation and GSC security strategic are the trendiest seen so far.

At present, the two most famous international organizations are the United Nations (UN) and World Trade Organization (WTO). Basically, UN focuses on developing inter-country relationship and preserving world peace; while WTO develops better global businesses by promoting global development and country openness. In addition to that, regional organizations play similar roles to that of UN and WTO too. Six major regional organizations which include almost every country in their respective region are the Organization of American States (OAS), which includes South Latin

Americas; the European Union (EU), the Council of Europe (COE), the Asia Cooperation Dialogue (ACD), the Pacific Islands Forum and the African Union (AU). Each of these organizations has similar missions, which is to promote healthy relationships amongst the members and also to help regional countries perform businesses with other regions' countries. After the September 11th tragedy, all of these international and regional organizations face new challenges. All the businesses processes need to be re-evaluated in order to advance the security system.

There are a lot of methods which can be used to enhance the stability of GSC. However, the design of strategy and implementation methods is vital. Besides that, the process such as participating in terrorism initiatives is another important matter because the assessments of the GSC need to be done and a lot of additional processes also need to be included.

2.5.7 Anti-terrorism Initiatives

In response to the September 11th terrorist attacks, the US government launched anti-terrorism initiatives few months after the tragedy in order to improve border security systems and facilities. "Although these initiatives are beneficial to trade security, the international trade community is concerned with their impact on trade efficiency and cost" (Sheu,C., Lee, L., and Niehoff, B., 2006). "The anti-terrorism initiatives will cost an additional \$151 billion annually for the US economy" (Bernasek, 2002; Damas, 2001), which is a costly sum. Although the implementation and maintenance cost is a huge one, it is worth it if the security of GSC can be enhanced into an anti-terrorist resistant one. Other than using anti-terrorism initiatives to protect the US mainland, the US government also expects companies to collaborate with foreign companies in participating in these initiatives in order to expand an extensive GSC security. However, due to the differences

in the varied culture and practices in different countries, there many obstacles to be overcome.

At present, the anti-terrorism initiatives in the US includes the Container Security Initiative (CSI), Free and Secure Trade (FAST), Smart and Secure Trade Lane (SST), Operation Safe Commerce (OSC), Partners in Protection (PIP), 24-Hour Rule and the Customs-Trade Partnership against Terrorism (C-TPAT). These initiatives were planned after the tragedy and it focuses on protecting the GSC and national imports and exports ports.

From the research, C-TPAT is recognized as a precondition assessment for every company who wish to participate in other anti-terrorism initiatives. The idea of C-TPAT is to develop wide range security coverage from the supplier's suppliers to customer's customer. Meanwhile, C-TPAT and other anti-terrorism initiatives involve foreign governments to ensure border security. In most cases, these "security initiatives cover four major points of security, which are source inspection, inbound inspection, in-transit process control, and prevention control" (Sheu,C., Lee, L., and Niehoff, B., 2006).

Source and inbound inspections are performed by Customs Department before exporting merchandize from supplier location and importing merchandize to customer location.

This stage usually takes the longest time due to the large amount of containers inspection and complicated inspection procedures. However, processing method and time can be

improved by participating in the 24-Hours Rule and Container Security Initiative (CSI).

At present, 24-Hour Rule and CSI are the two major initiatives that functions at foreign ports before loading goods on to ships or planes. Subsequently, during the delivering

period, Smart and Secure Trade Lane (SST) and Operation Safe Commerce (OSC) are accountable as two key process control initiatives. SST focuses on the deployment of

security of merchandise across global trade countries and OSC focuses on the collaboration of PPP among the global trade countries. Last of all, a prevention plan, C-TPAT is a PPP initiative to develop a better GSC and border security. There other security initiatives which are designed for C-TPAT members, which are the Free and Secure Trade (FAST) and Partners in Protection (PIP). These two initiatives help expedite the process of merchandizing. FAST mainly expedites truck movement and PIP is primarily operating at the US-Canada border.

2.5.8 Third Party Logistics (3PL)

It is important to understand what exactly the role of 3PL in a GSC is and how PPP and anti-terrorism initiatives work with 3PL. “Ninety percent of world trade is transported in containers on ocean ships” (Cuneo, 2003). “Roughly twenty million containers move through more than two hundred ports around the globe annually, and of those, six million containers enter US ports each year” (Sheu, C., Lee, L., and Niehoff, B., 2006). These statistics had informed the importance of 3PL selection and management as 3PL companies are portrayed as a source of potency to GSC in moving merchandise across the globe with faster and safer methods.

According to Rice and Tenney (2007), “too often companies define security and risk management in terms of only physical asset protection or guarding against unlikely disruptions, instead of recognizing that both are central in protecting the firm’s economic viability”. It is true that every international business transaction must pass through borders and customs via sea, land or air, all of which are operated by the government. Meanwhile, the government is also the only one that is able to cope with various disruptions and this is the reason that companies should develop PPP, a close 3PL

relationships and participate in anti-terrorism initiatives in order to raise the resilience of GSC.

2.6 Reference IDEF0 models

“Supply chain design is frequently performed from the perspective of a single supplier-customer relationship. However, as a supplier provides value to a different supply chain, it becomes increasingly difficult to optimize each supply chain.” (Sinha, P.R., Whitman, L.E. and Malzahn, D., 2004). Due to the different characteristics of industries and varying operations procedures, it is complicated to create a multi-purpose GSC model. However, a fundamental configuration could always be premeditated. The author’s IDEF0 model for a terrorist resistant GSC is developed by using two IDEF0 models as fundamental references. The referenced models are A0 activity Manage the supply chain and A0: Mitigate Supplier risks in an aerospace supply chain.

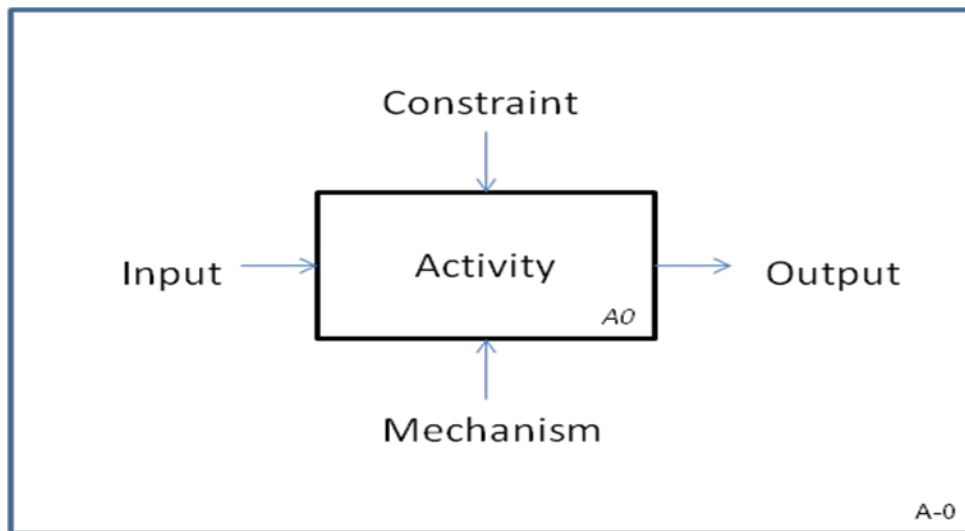


Figure 4: IDEF0 arrangement

Before introducing the model, figure 2 shows the basic IDEF0 model. Figure 4 is an A-0 diagram with an A0 activity. A-0 diagram is the top diagram of every IDEF0 model and the element in the box will always be an activity. The input will transform the

activity into an output and the transformation is administered by the constraint and the process is controlled through the mechanism. More information will be introduced in detail in Chapter 3: Method. The following sections will briefly introduce the contents of the IDEF0 models.

2.6.1 Reference IDEF0 model: Manage the supply chain

The topic of this IDEF0 model is *Manage the Supply Chain* and the partial IDEF0 model contents is based on the Enterprise Transformation Methodology written by Underdown, D.R. (1997). The authors of this IDE0 model are Chidambaram, S., Whitman, L.E., Cheraghi, S.H. (1999). The point of view is based on an enterprise engineer's perspective. And the primary objective is to present fundamental steps and practices to manage a supply chain with the intention of developing a world-class supply chain.

So, this brings us to the question of what is the definition of a world-class supply chain. According to Graham and Fraser (1996), "in order to reach a world-class and competitive phase, an array of unique attributes has been designed. These attributes are: 1) Developing relationships, which deliver results that produce solutions to its customers; 2) Providing products and services that often exceed customer requirements; 3) Giving quality and safety the highest priority; 4) Responding efficiently to sudden changes in market requirements; 5) Earning a return on investment which contributes to the success of all members of the supply chain; 6) Remaining the leader of the industry irrespective of time. These proactive actions assist the development and establishment of GSC in a precise method and with a shorter period of time". These six characteristics also facilitate the liaison between suppliers and customers.

Subsequently, figure 5 is an A0 activity of Manage the supply chain. With the aim of upgrading the supply chain to become a world-class level, the inputs for this IDEF0 model are supply chain initiatives, market requirements and existing culture and practices. These inputs will be the main functions to transform a supply chain into two outputs, which are ‘changed competent culture’ and ‘well managed supply chain’ (see figure 3). Meanwhile, the constraints of the transformation are organization policies, budget, supply chain partners capabilities and culture and environment. Lastly, the mechanisms are power change methods and tools and high level management.

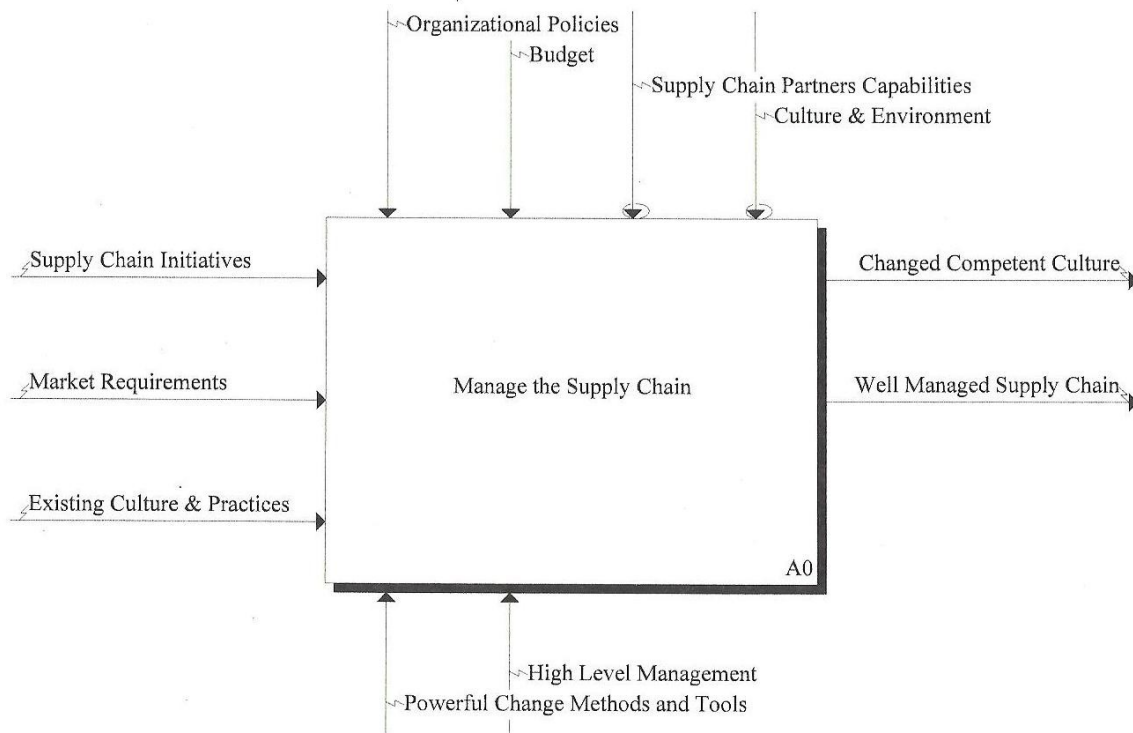


Figure 5: IDEF0 A-0 diagram, A0 activity

A0 activity will be developed into A1 to A5, five individual activities. Figure 6 displays the relationship between each activity, the connection of inputs and outputs, and the arrangement of constraints and mechanisms. The five activities are defining the scope of supply chain, changing culture, establishing customer integrated decision making,

developing supply chain wide technology strategy and adopting supply chain wide performance measures. Each of these activities will be split into another deeper level in order to define each activity more precisely. The content of these five activities has fulfilled the concept of a world-class supply chain. The improvement of management technique and the transformation of culture and practices are two important inputs because managing people and changing working culture are the most challenging and tedious part of every business.

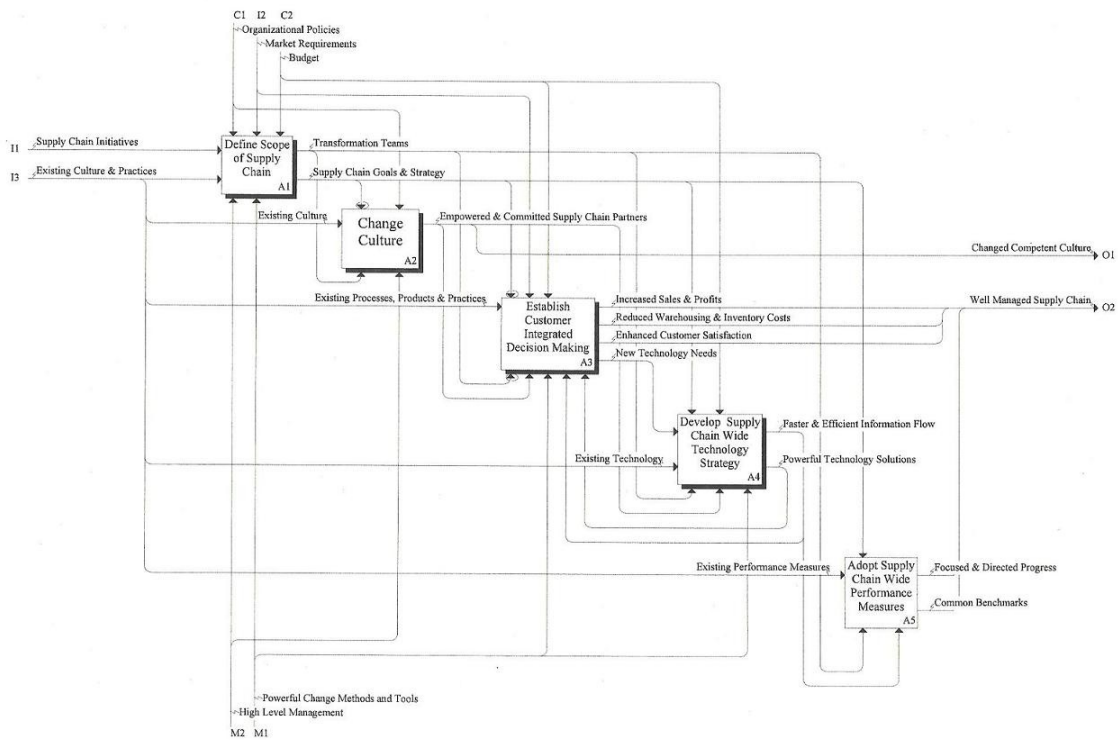


Figure 6: A0 diagram of Manage the supply chain

2.6.2 Reference IDEF0 model: Mitigate supplier risks

The second reference IDEF0 model is with an A0 activity of Mitigate supplier risks, which focuses on aerospace supply chain only. The authors of this IDEF0 model are Sinha, P.R., Whitman, L.E. and Malzahn, D. (2004). The objective of this research is to “develop a generic methodology for mitigating risks in the aerospace supply chain

with a view to consistency across supply chains” (Sinha, P.R., Whitman, L.E. and Malzahn, D., 2004). The management of a supply chain in an aerospace industry is always more tedious as compared to other manufacturing industries. Due to the September 11th tragedy, USA government has requested that the aerospace industry improve upon the security of the supply chain. However, the additional protection has caused the supply chain to be less efficient. The inconsistency of new security implementations and supply chain management has weakened the linkage between suppliers, manufacturer and customers.

This IDEF0 model presents a progression of steps which lead to mitigate supplier risks in the aerospace supply chain. To begin with, figure 7 shows the association of the activities. The inputs are existing risk awareness and process and the final output will be the risk mitigated process. The constraints are budget, knowledge, influential factors and policy and regulations. The mechanisms are four different types of resources; they are cross-functional team, skilled professionals, information technology and empowered people. Figure 5 also shows the five activities; identify risks, assess risks, plan and implement solutions, conduct failure modes and effect analysis and continuous improve.

In general, collecting and comparing data sets of samples is an important step to analyze the risk of a supply chain. However, different point of views or work processes would present dissimilar output. Therefore, the standardization of risk identification is needed. The research presents the basic opening of how to detect and manage the risks of supply chain in an aerospace industry.

Developing partnership strategies is the trend of global businesses, and 3) Participating in anti-terrorism initiatives is a must for current global businesses. 4) The reference models gave a good understanding of what GSC need. Last of all, the literature review has outlined potential and important entities of GSC. These entities are the knowledge required in developing an IDEF0 model for terrorist resistant GSC. Next, Chapter 3 will introduce IDEF0 modeling function.

CHAPTER 3

METHOD

3.1 Introduction

Back in the 1970s, ICAM Definition (IDEF) was known as a product of the Integrated Computer-Aided Manufacturing (ICAM) initiative. According to ‘What Is’ (2002), ICAM was an initiative managed by the US Air Force out of Wright Patterson AFB, Materials Laboratory and was part of their Technology Modernization effort, specifically the Computers in Manufacturing (CIM) initiative. Later in the 1980s, Institute of Electrical and Electronics Engineers (IEEE) standards renamed IDEF as Integrated Definition modeling methods.

As of now, there are sixteen types of IDEF modeling methods. The few widespread IDEF modeling methods are IDEF0 – Function Modeling, IDEF1 – Information Modeling, IDEF1X – Data Modeling, IDEF2 – Simulation Model Design, IDEF3 – Process Description Capture, and IDEF5 – Ontology Description Capture. In general, IDEF modeling method is used to regiment analyzing processes, such as confining as-is process models. According to Hanrahan, R.P. (1995), “IDEF modeling method facilitates an enterprise to develop a basis for process improvement project and builds groundwork in defining information necessities”.

3.2 IDEF0 Basics

Specifically for this thesis, IDEF0 function modeling method was selected to develop the decisions, actions and activities for terrorist resistant GSC. IDEF0 originated from the Structured Analysis and Design Technique (SADT), an entrenched graphical language. National Institute of Standards and Technology (NIST) released IDEF0 as a

standard for function modeling in Federal Information Processing Standards (FIPS) Publication 183 in December 1993. (KBSI, 2006).

The IDEF0 modeling method has slowly and steadily brought in additional information into the diagram structure by decomposing each node, with each node representing specific function or activity. Each activity is supported with a description. As a rule of thumb, A-0 diagram represents a minimal context of the model and the A0 node represents the function of the whole model. Subsequently, the A0 node is decomposed into lower details, with a minimum of three lower nodes (i.e. A1, A2, A3, ..., A6 which is also called as child diagram). The IDEF0 modeling method indicates each activity with the input, output, control and mechanism (ICOM). According to Hanrahan (1995), "IDEF0 modeling method helps the modeler portray a view of the processes with the inputs (I) and controls (C) covering the processes and the outputs (O) and mechanisms (M) acting on the processes".

3.3 IDEF0 model assessment

The development of the IDEF0 model for a terrorist resistant GSC can be broken into three sections. They are: 1) Perform literature review and reference IDEF0 models; 2) Perform reader-author cycle group discussion with professors and some others master students in the Industrial and Manufacturing Engineering Department (IMfgE) at Wichita State University (WSU), Wichita, Kansas, USA; 3) Perform author-reader cycle with two companies outside of the USA. The results of the research will be introduced in the next chapter: Results and Discussions.

CHAPTER 4

RESULTS AND DISCUSSIONS

4.1 Company reviews:

The IDEF0 model for terrorist resistant GSC has been given to two companies for review and this is a part of the author-review cycle. The next two paragraphs will discuss the review.

4.1.1 Assessment I: DiGi Telecommunications

DiGi Telecommunications is one of the leading mobile phone service providers in Malaysia. It began business back in 1995. As of now, Telenor ASA of Norway owns 61% of DiGi corporation's shares. DiGi Telecommunications became the first service provider to offer General Packet Radio Service (GPRS) - 2.5 generation and Enhanced GPRS (EGPRS) – 2.75 generation in Malaysia. The introduction of the prepaid mobile phone services has conquered the youth market since 1999, which was also made popular by this company. Now, “DiGi is providing a comprehensive range of affordable, convenient and easy to use wireless services to simplify and enrich the lives of its customers. DiGi has an established presence as a leader in voice and data prepaid services with a number of firsts that have set industry benchmarks for creativity and innovation” (DiGi, 2007).

The contact person, Ms. S.Y. Tay is the acting Head of Sales of East Malaysia Enterprise Business - DiGi Communications. She is responsible in managing and developing the sales and supply chain between DiGi and the distributor and retailer for the East Malaysia market. Ms. Tay graduated with a Mass Communication degree from Western Michigan University in the year 1996 and has ten years of industry sales

experience under her belt. She was a sales executive of Xerox Corporation of East Malaysia before she joined DiGi.

During the author-reader cycle, Ms. Tay provided some valuable recommendations. The first point is that while GSC companies are developing the SC team, regional committees must be created in order to monitor the performance of the GSC and also perform GSC assessment on a periodical basis. The selection of regional committees must be from all participating companies or any related organizations and they must be inclusive of various aspects, such as the knowledge of anti-terrorism initiatives and political knowledge. However, the success of developing and managing the terrorist resistant GSC is still dependent on the performance of each company's management and SC team.

Another important comment is regarding the point of view for A1. Ms. Tay suggested that the A1 activity might be tedious if it is defined based on individual companies' requirement. It could be more ideal if the definition is based on industrial requirements. The advice is useful if the model is designed for a particular industry. However, the IDEF0 model for terrorist resistant GSC is a generic method for any industry to begin the implementation of partnerships and anti-terrorism initiatives.

Subsequently, the output of A22 is customized and reclassified GSC processed and policies. Ms. Tay recommends that the processes and policies should be mentioned and discussed internally at an early stage while developing the SC team. This point also is a valid one because the SC team should prepare and discuss the characteristics and the needs of GSC before interacting with other companies' SC team. Besides that, Ms. Tay also made a comment on C2: "Regional organization and country regulations" in activity A3. She suggested that there the regulations should control every activity in A3. The

reason is because the evaluation of terrorism treats, selection of anti-terrorism initiatives and validation of 3PL relationship should be constrained by regional organization and country regulations. For more details, the written notes of the review are shown in the appendix section.

4.1.2 Assessment 2: Sanmina- SCI Corporation

“Headquartered in San Jose, California, Sanmina-SCI is a leading EMS provider focused on delivering complete end-to-end manufacturing capabilities and highly complex solutions to technology companies around the world” (Sanmina, 2007). In Kuching, a fast-growing city in Malaysia, Sanmina-SCI has a twelve year old Printed Circuit Board (PCB) manufacturing plant. The plant maintains a close and healthy relationship with Sanmina-SCI assembly plant at Singapore, Wuxi, China and other western countries, such as USA.

The contact person, Mr. Patrick Lim has twenty years of IT experience. He has worked for AT&T Singapore for ten years. Later, he continued his IT career at Sanmina-SCI as an IT Manager and now is the IT Director of Asia Pacific. Basically, he is responsible for matters of liaison between Sanmina-SCI Asia Pacific and the customers at Singapore and China with regards of solving Sanmina-SCI IT issues.

Mr. Lim provided precious recommendations regarding the IT security issues and how Asia American companies get certified with C-TPAT. While reviewing the IDEF0 model, he understands that IT security needs to be graded by IT and governments’ professionals. The areas include internal segments, such as companies, local partnerships and governments; external segment are companies and governments outside the countries. According to Mr. Lim, IT assessment is considered as an important input to maintain the effectiveness of IT tools and applications. However, it is monotonous to

perform IT assessment in a GSC environment if it is done individually. Therefore, he recommends that IT assessment team should be included in the SC team and the regional committees.

Subsequently, Mr. Lim also mentioned an important IT technology, which is known as Data Encryption Standard (DES). According to Tuchman (1997), “DES has been developed since 1970s by the US standards body National Bureau of Standards (NBS), later named National Institute of Standards and Technology (NIST) in order to encrypt unclassified, sensitive information. DES is defined as “the archetypal block cipher”. It is an algorithm that takes a fixed-length string of plaintext bits and transforms it through a series of complicated operations into another cipher text bit string of the same length. In the case of DES, the block size is 64 bits” (Tuchman, W., (1997). A lot of advanced technology manufacturing, such as Sanmina-SCI uses DES to protect their database and information flow. In addition, Mr. Lim also added that every company owned personal devices, such as cell phones with multimedia applications and personal laptops which allow them to access Wi-Fi during business trip are equipped with hard drive DES and email DES.

Last of all, Mr. Lim presented a sample of Supply Chain Security Self Audit, the Supply Chain Security (SCS) implementation procedure and the implementation of C-TPAT. These samples were very helpful because the samples describe and explain the implementation of C-TPAT which is done outside the USA.

4.2 Review: IDEF0 model for a terrorist resistant GSC

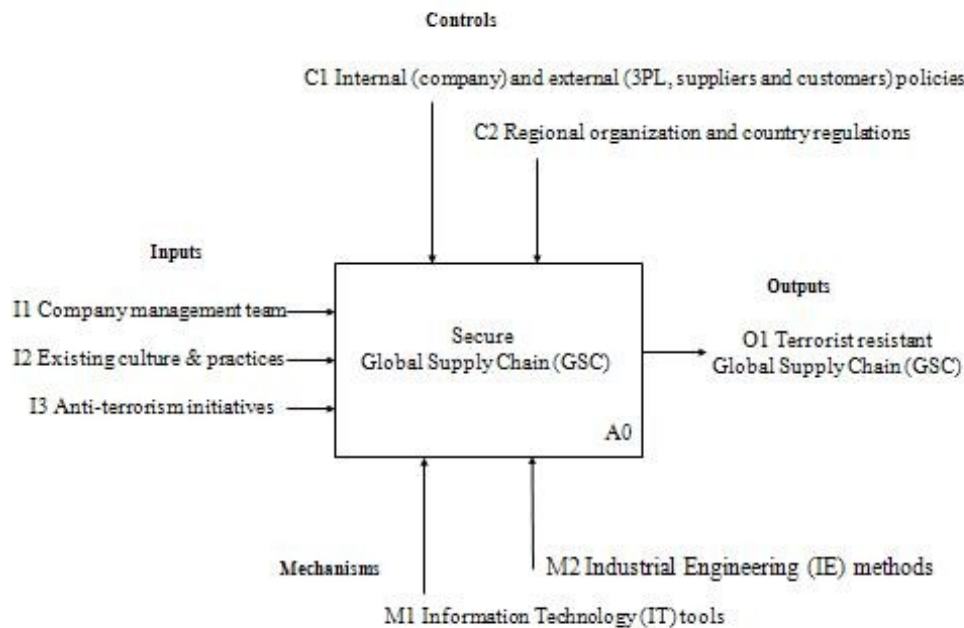
4.2.1 IDEF0 model

Other than the professional's reviews, the IDEF0 model for a terrorist resistant GSC has also been reviewed by Dr. Lawrence Whitman, Dr. Don Malzahn and WSU Enterprise Engineering group (WSUEEG). This team is considered as the reader of the IDEF0 model and has performed author-reader cycle for numerous times in order to keep configuring and updating the logic of the IDEF0 model.

In the GSC, the operation systems are seen as an interdependent whole. According to Dr. Russell Ackoff (1981), "if each part of a system considered separately, is made to operate as efficiently as possible, the system as a whole will not operate as efficiently as possible". This quote is the inspiration for the author to develop a generic IDEF0 model for a terrorist resistant GSC. Before beginning to collaborate with other companies or implement anti-terrorism initiatives, each company must have fulfilled the fundamental requirements of partnership and GSC management. The following section will introduce the IDEF0 model for a terrorist resistant GSC in detail.

4.2.2 A0 activity: Secure GSC

Figure 8: activity A0, which is also known as A-0 diagram is the top-level diagram of the IDEF0 model. The inputs are company management team, existing culture and practices, and anti-terrorism initiatives which are transformed by the activity "secure GSC" into a terrorist resistant GSC. This activity is constrained by internal policies, such as self company policies, and external policies, such as 3PL, suppliers and customers' policies while the two mechanisms are Information Technology (IT) tools and Industrial Engineering (IE) methods.



A-0

Figure 8: A0 activity Secure GSC

4.2.3 A1, A2 and A3 activities

Subsequently, A0 activity is decomposed into A1, A2, and A3; the three activities which are shown in figure 9. The I1, company management team is transformed by A1 “define scope of a secure SC for a company” into SC transformation team and partnership strategy. SC transformation team became the mechanism of A2 and A3 while partnership strategy became the constraint of A2. I2, existing culture and practices is transformed by A2 “develop a GSC partnership between companies (internal, suppliers and customers), 3PL, government and regional organization” into stable GSC partnership, which is also the constraint of A3. Lastly, I3, anti-terrorism initiatives is transformed by A3 “participate in anti-terrorism initiatives” into terrorist resistant GSC and altered culture and practices. Terrorist resistant GSC is the final outcome while altered culture and practices will be linked back as an input for A2 for further

modification and improvement. The next three sections will analyze the decomposition of A1, A2 and A3 activities.

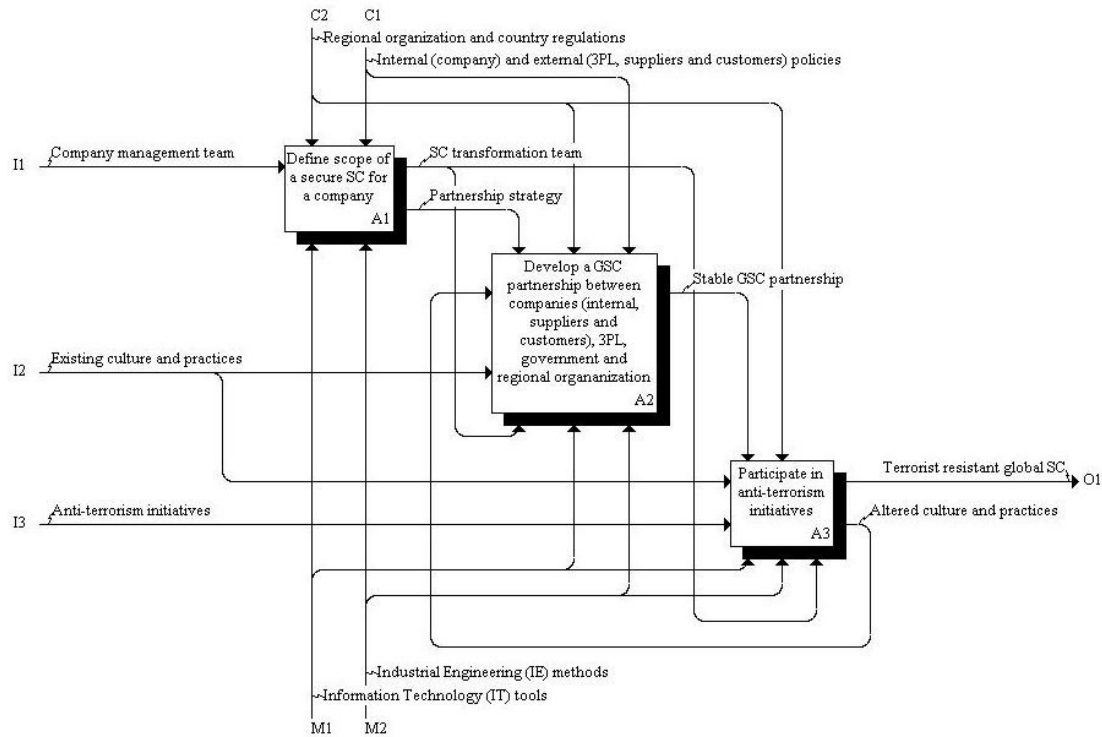


Figure 9: A1, A2, and A3 activities

4.2.3.1 A1 activity

Figure 10 presents the decomposition of A1 activity. A1 activity is decomposed into A11: establish SC team; A12: identify company SC information (intelligence) and problems; A13: analyze current situation and foresee possible improvement and A14: develop partnership strategy. The objective of these four activities is to develop a strong base for a company before beginning to implement GSC partnership and anti-terrorism initiatives. As a rule of thumb, the process to create a SC team is very critical because the SC team will be the administration of the whole design. The assortment of the SC database, analyzing current situations and foreseeing possible improvements need to be completed before beginning to plan for a partnership strategy.

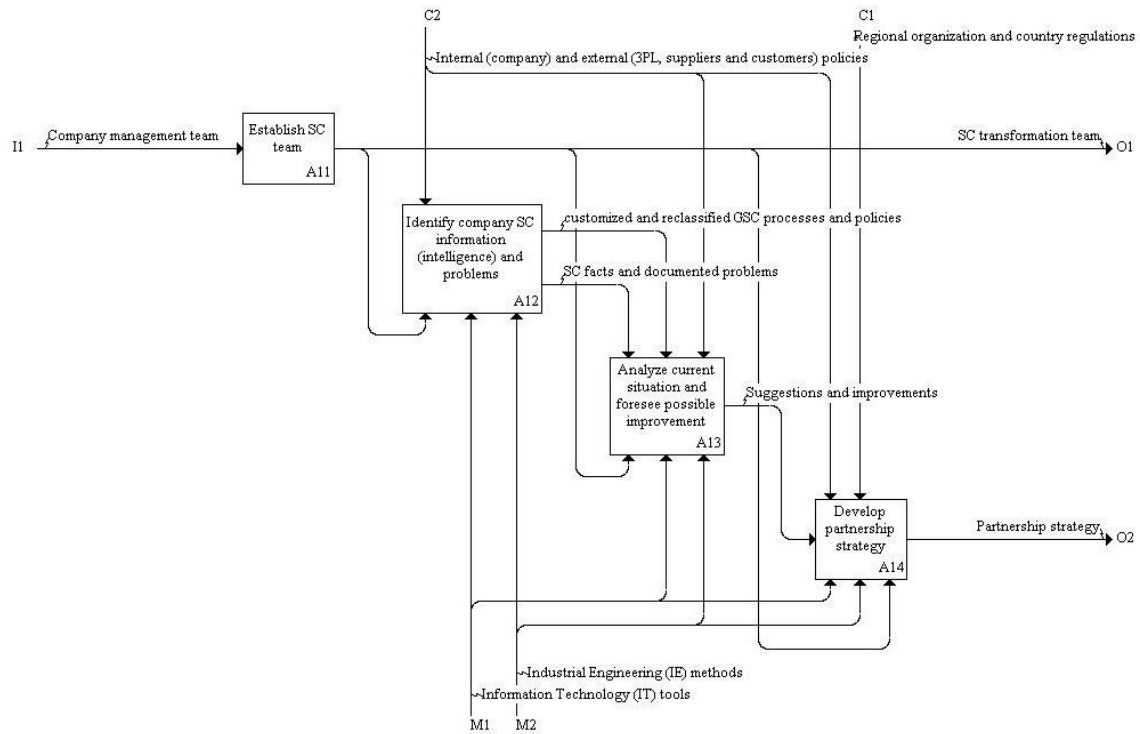


Figure 10: A11, A12, A13 and A14 activities

4.2.3.2 A2 activity

After planning well for internal issues, figure 11 presents the key activity to begin a trustful GSC relationship. The coordination with particular SC teams, development of trust between companies and the standardization of GSC processes and protected communication system are essential. After constructing a close GSC partnership, the verification of 3PL is required. The preservation of smooth information and products flow can only be demonstrated through a 3PL transportation system. In order to keep improving upon the GSC processes, the output of A24 “improved processes and policies” would become a cycle; directing the changes back to the previous activity for further

modification and improvement. The key output “Stable GSC partnership” will become the key constraint to guide the implementation of anti-terrorism initiatives in A3 activity.

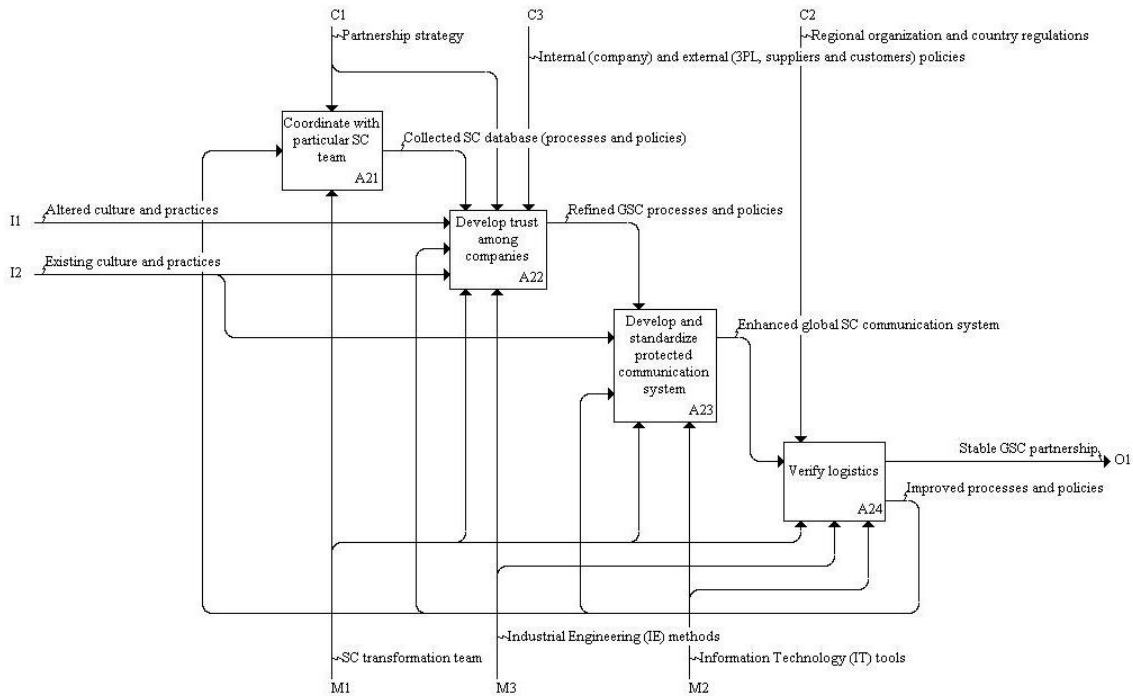


Figure 11: A21, A22, A23 and A24 activities

4.2.3.3 A3 activity

Figure 12 reveals the decomposition of A3 “participate in anti-terrorism initiatives”. A lot of anti-terrorism initiatives have been designed based on the characteristic of the region’s security and the development of the country. Meanwhile, the evaluation of terrorism threats in the GSC is needed so as to foresee each and every possible GSC risk. Subsequently, the determination of anti-terrorism initiatives will be based on the evaluation of terrorism threats. Lastly, the GSC with anti-terrorism initiatives will be validated through 3PL relationship. Through the validation, the final output is terrorist resistant GSC. Another two outputs from A34 will be linked back to

previous activities, which are altered culture and practices and modified processes and policies during situation changed.

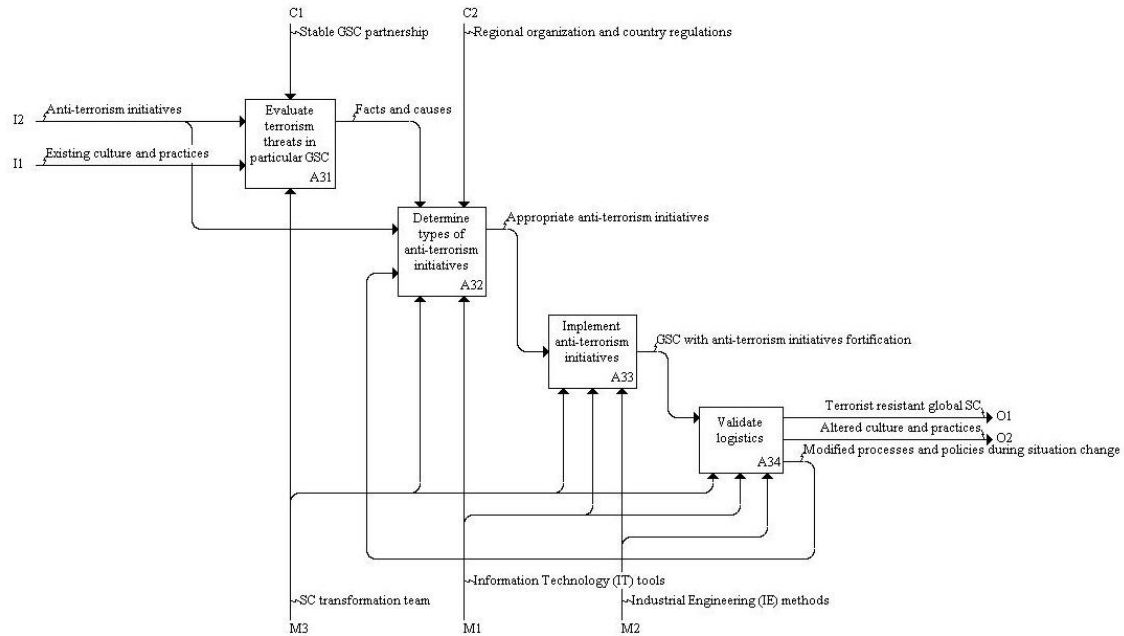


Figure 12: A31, A32, A33 and A34 activities

4.3 Conclusion

Due to the unsettled terrorism issues, GSC is required to be improved and sustained through various methods. The development of the generic operations for GSC will be the fundamental practices. In a nutshell, the basic practices are to minimize the failure of partnership. So, the implementation of anti-terrorism initiatives includes: 1) Solving internal issues and improve internal operations; 2) Advancing the understanding and trust between companies; and 3) Constructing a stronger partnership connection in GSC. Chapter 4 has analyzed the framework of IDEF0 model of a terrorist resistant GSC in detail. For a deeper understanding, the IDEF0 function modeling kit is presented in the appendix section, which includes IDEF0 diagrams, definitions and the glossary.

CHAPTER 5

SUMMARY AND FUTURE WORK

5.1 Summary

The idea to develop a terrorist resistant GSC is a massive project because there are too many constraints, such as conflict of interests and political issues between countries, religion and cultural issues. Also, geographical difficulties also need to be overcome. However, the process of incorporating a huge and complicated GSC can be simplified by using an enterprise model, such as the IDEF0 function modeling technique.

The IDEF0 model for a terrorist resistant GSC has shown a series of generic activities and these activities can be performed by any company from any industry. These activities could assist a company to be well prepared before stepping into the world of GSC or begin the implementation of anti-terrorism initiatives. Generally speaking, a successful GSC requires a mutually supporting community. Moreover, in order to have a thriving terrorist resistant GSC, the succession of partnership development and anti-terrorism initiatives implementation cannot be avoided.

5.2 Future Work

In order to have a superior and acceptable generic practice, a series of studies can still be done. For example, a deeper decomposition can be developed and a mixture of different IDEF0 models could let researchers to think outside the box. Meanwhile, possible future works which need to be completed is the interoperability of IDEF0 model with other applications. According to Vernadat (1996), “interoperability focuses on communication between applications and leads to a standard for different languages”. Moreover, interoperability would also increase the value of the model by reuse of the models (Panetto, Whitman, and Chatha, 2005). Last of all, extended research of

interoperability will improve the stabilization of terrorist resistant GSC with the main function of interoperability is sustaining and improving the efficiency of communication between different enterprise models.

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LIST OF REFERENCES

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APPENDICES

APPENDIX A

MODEL SUMMARY

Name: Develop an IDEF0 model for a terrorist resistant Global Supply Chain (GSC)

Description: This framework provides guiding principles for developing a terrorist-resistant Global Supply Chain (GSC). The major impact of this framework is in transforming Supply Chain events into a terrorist-resistant GSC. The benefits of the IDEF0 model are: 1) These activities can be performed by any company from any industry; 2) Assist a company to be well prepared before stepping into the world of GSC and begin the implementation of anti-terrorism initiatives

The one-box IDEF0 knot is the top level function and the designed structure has decomposed the A-0 IDEF0 knot into three sub-diagrams. The top level function is: Secure GSC. Subsequently, this function is further decomposed into three sub-functions, which are: Define scope of a secure SC for a company, develop a strong SC partnership between companies (internal, suppliers & customers), 3PL, government, and regional organization and participate in anti-terrorism initiatives.

IDEF0: “IDEF is known as Integrated Definition. IDEF0 (function modeling) is a method designed to model the decisions, actions, and activities of an organization or system. Effective IDEF0 models help to organize the analysis of a system and to promote good communication between the analyst and the customer. IDEF0 is useful in establishing the scope of an analysis, especially for a functional analysis. As a communication tool, IDEF0 enhances domain expert involvement and consensus decision-making through simplified graphical devices. As an analysis tool, IDEF0 assists the modeler in identifying what functions are performed, what is needed to perform those functions, what the current system does right, and what the current system does wrong. Thus, IDEF0 models are often created as one of the first tasks of a system development effort” (Knowledge Based Systems, Inc., 2006).

<http://www.idef.com/IDEF0.html>

Global Supply Chain (GSC): “Global Supply Chain refers to the distribution channel of a product, from its sourcing, to its delivery to the end consumer (also known as the value chain). The supply chain is typically comprised of multiple global companies who are increasingly coordinating activities via an extranet” (Learn that.com, 2006).

<http://www.learnthat.com/define/view.asp?id=339>

Purpose: To build a standard framework for developing a terrorist resistant Global Supply Chain (GSC) by using the IDEF0 modeling method.

Viewpoint: Company management – Supply Chain (SC) team

APPENDIX A (continued)

Context: (references)

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APPENDIX A (continued)

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APPENDIX A (continued)

Repository : Date: 1/17/2008

Used At:	Author: Bobby Tay	Date: 1/9/2008	Working	READER	DATE	Context
	Project:	Rev: 1	x			ARC Advisory Group (2002). Trade Security: A Wildcard in Supply Chain Management. Boston, MA: Gonzalez, A.
	Notes: 1 2 3 4 5 6 7 8 9 10	Time: 13:42:27	Draft			
			Recommended Publication			

Inputs

I1 Company management team
 I2 Existing culture & practices
 I3 Anti-terrorism initiatives

Controls

C1 Internal (company) and external (3PL, suppliers and customers) policies
 C2 Regional organization and country regulations

Mechanisms

M1 Information Technology (IT) tools
 M2 Industrial Engineering (IE) methods

Outputs

O1 Terrorist resistant Global Supply Chain (GSC)

Secure Global Supply Chain (GSC) A-0

A-0

APPENDIX A (continued)

“Secure Global Supply Chain (GSC)”

A0: Secure Global Supply Chain (GSC)

Description: The few main purposes of developing this IDEF0 model are to improve and standardize GSC processing methods, global security systems, and participate in anti-terrorism initiatives. Meanwhile, development of partnerships strategies is a trend in GSC. The types of partnerships include private-private, public-private, country-country, and country-region partnerships.

The partnerships in GSC include company itself, suppliers, customers, third party logistics (3PL), country governments and regional organizations. The activities involve changing the existing culture and practices of the GSC into a terrorist-resistant GSC that is familiar with existing anti-terrorism initiatives.

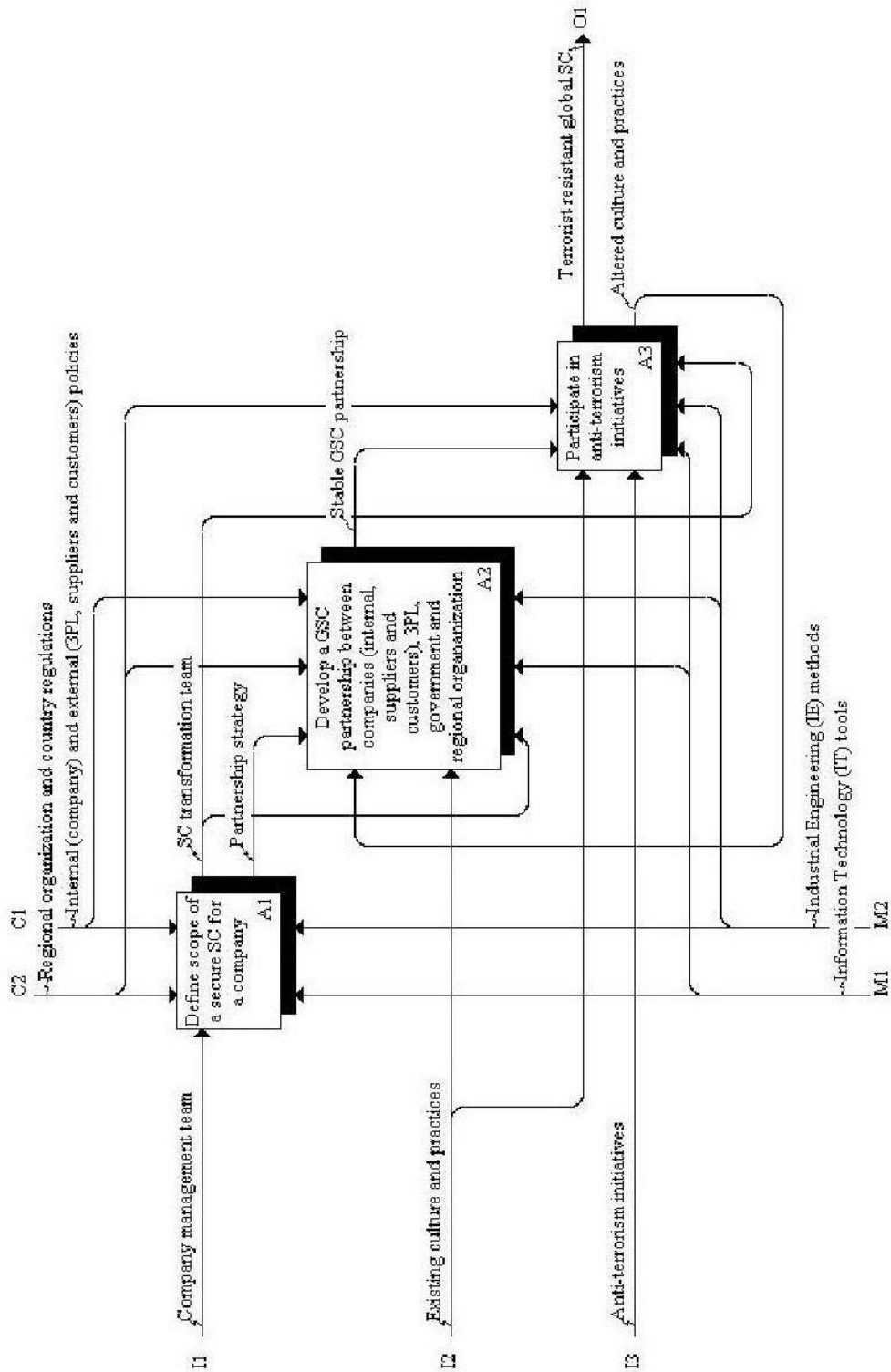
Lastly, in order to have a thriving terrorist resistant GSC, there must be a successful partnership development and anti-terrorism initiatives implementation

Transformation: Inputs of this activity are: Company management team, existing culture and practices and anti-terrorism initiatives. This activity transforms a secure GSC into a terrorist-resistant GSC. A GSC operates under many policies and regulations, such as internal (company) and external (3PL, suppliers and customers) policies and also regional organizations and country regulations. The mechanisms for this activity are information technology (IT) tools and Industrial Engineering (IE) methods which provide the necessary communication network support and technical and management methods.

Decomposition: This activity is further decomposed into the following three functions: Define scope of a secure SC for a company, develop a strong partnership between companies (internal, suppliers & customers), 3PL, government and regional organization, and participate in anti-terrorism initiatives.

APPENDIX A (continued)

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				Publication			



Node:	C2	Title:	A0: Secure Global Supply Chain (GSC)	Number:	Pg 2
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APPENDIX A (continued)

Activities in Diagram “Secure Global Supply Chain (GSC)”

A1: Define scope of a secure Supply Chain (SC) for a company

Description: This is a stage of internal self-assessment; a method to figure out what a company wants to be and how to achieve their objectives. The activities include developing a SC transformation team from the company management team. SC transformation team is also known as a cross functional team that would interact with every department in a company and is accountable to handle the company’s SC intelligence and analyze SC information for further changes and improvement. SC transformation team is also responsible to design and develop a long-term partnership strategy with 3PL, suppliers, customers, government and regional organization. For the moment, SC transformation team will also be involved as a mechanism in the next two activities in order to supervise the development of securing GSC. Meanwhile, the partnership strategy will act as a constraint to the next activity, which is to develop a strong partnership between companies (internal, suppliers, and customers), 3PL, government, and regional organization.

Transformation: This activity transforms a company management group into a SC transformation team by selecting potential and committed employees from the management team. Afterwards, the SC transformation team is responsible for the design of a partnership strategy with the GSC members. Furthermore, the policies from each and every SC members, regional organizations and country regulations are the key constraints while IT tools and IE methods are the mechanisms to support the development.

Decomposition: This activity is further decomposed into the following four functions: Establish SC team, identify company SC information (intelligence) and problems, analyze current situation and foresee potential improvement, and develop partnership strategy.

A2: Develop a GSC partnership between companies (internal, suppliers and customers), 3PL, government and regional organization

Description: The general definition of partnership is “in the commercial and legal parlance of most countries, a general partnership or simply a partnership, refers to an association of persons or an unincorporated company with the following major features: formed by two or more persons, the owners are all personally liable for any legal actions and debts the company may face, and created by agreement, proof of existence and estoppels” (DeMott, 2001).

There three major partnerships strategies in GSC are private-private partnerships, public-private partnerships (PPP) and country partnerships strategy (CPS). Usually, partnership strategy is planned and controlled by the company’s SC transformation team. The complication of designing a partnership strategy depends on the products and also on the size and the nature of the company. It is always advantageous to build a high-quality and

APPENDIX A (continued)

long-term partnership with suppliers and customers. As is common, a fine relationship with the government and regional organization are also considered key elements in developing a high-class GSC partnership. With the guidance of partnerships, GSC members would interact more and become more committed to the SC goals.

Transformation: This activity transforms company's existing culture and practices into stable GSC partnerships while under the constraints of partnerships strategies, companies' policies and also regional and country regulations. The mechanisms of this activity are IT tools and IE methods.

Decomposition: This activity is further decomposed into the following four functions: Coordinate with particular SC team, develop trust among companies, develop and standardize protected communication system, and verify 3PL relationship.

A3: Participate in anti-terrorism initiatives

Description: After the September 11th tragedy in the United States (US), the US governments had launched several anti-terrorism initiatives at US ports and boarders. The US government however, is doing their best to protect the US mainland and improve civilian safety while maintaining themselves as leaders in the world business.

The big challenge is that implementation of anti-terrorism initiatives are complex, potentially expensive and time-consuming to prepare and complete the implementation. However, the GSC experts have designed a primary initiative, the so called Customs-Trade Partnership Against Terrorism (C-TPAT) as a standard certification. C-TPAT was designed to provide a template on how to assure the integrity of conveyance loading, documentation, and sealing (ARC Advisory Group, 2002; Edmonson, 2004).

At the certification stage, C-TPAT applicants must perform a comprehensive self evaluation of their GSC using C-TPAT security guidelines. And then, US Customs would be able to make the certification decisions. Next, US Customs will make a site visit for the validation of certification. Once a company is certified, it becomes a C-TPAT partner and receives benefits such as reduced inspections, faster inspections and an assigned account manager to manage the relationship of PPP. Meanwhile, the certified company is also eligible to get certified in other initiatives, such as Container Security Initiative (CSI), 24-hour rule, Free and Secure Lane (FAST) and et cetera.

At this phase, the members in the GSC are outfitted with standard IT tools and secured communication system which are compatible with one another. Together with the well-built partnership structure and customized and modified global SC processes and policies, the company can now participate in anti-terrorism initiatives dependent on their business field without any hesitation.

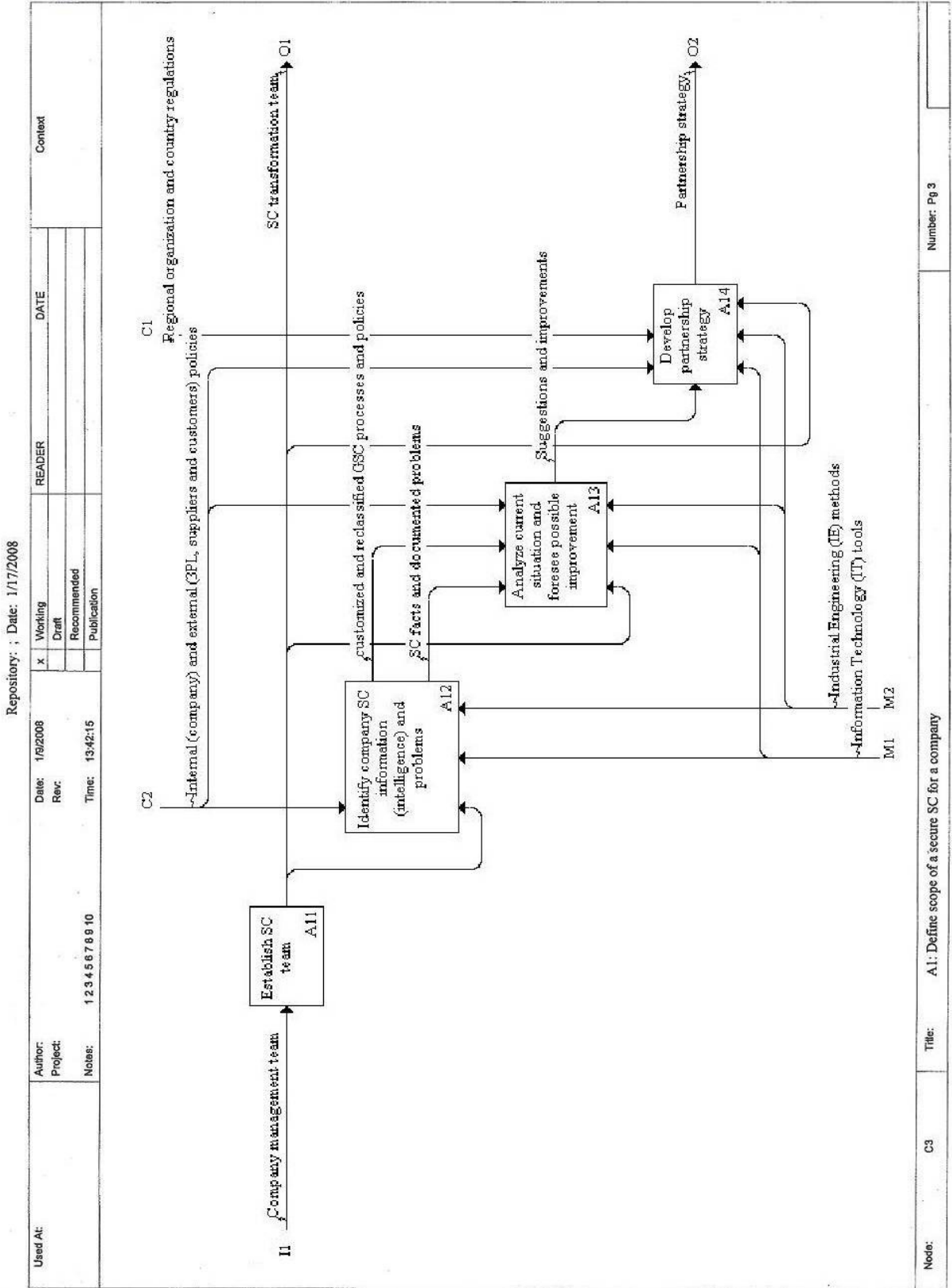
Transformation: This activity transforms anti-terrorism initiatives, existing culture and practices into a terrorist-resistant GSC by participating in anti-terrorism initiatives.

APPENDIX A (continued)

Meanwhile, this activity is constrained by GSC partnership structure, regional organization and country regulations. The mechanisms are IT tools, IE methods, and SC transformation team.

Decomposition: This activity is further decomposed into the following four functions: Evaluate terrorism threats in particular GSC, determine types of anti-terrorism initiatives, implement anti-terrorism initiatives, and validate 3PL relationship.

APPENDIX A (continued)



Number: Pg 3

Title: A1: Define scope of a secure SC for a company

C3

Needs:

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APPENDIX A (continued)

A1: Define scope of a secure Supply Chain (SC) for a company

A11: Establish SC team

The selection of the SC transformation team, which is also known as the cross functional team is vital because team spirit is an important factor. The right people are responsible to revolutionize and be in control of GSC operations. As a rule, SC transformation team should be selected from a company management team, and the team members include a president, vice president, chief executive officers, manager and supervisor from each department. The president and vice president are accountable in supervising the entire change of GSC. Chief executive officers, manager and supervisors are responsible to develop and modify the actual operations of GSC.

In addition, the selection of regional committees should also be created and selected when the SC transformation team is interacting with sister or partnership companies. The selection of regional committees must be from all participating companies or any related organizations. The main objective of regional committees is tightening the relationship between different SC transformation team in the system.

Meanwhile, due to the implementation of high technology security protection system, IT assessment team should also be included in the SC team. IT assessment team is considered as an important input to maintain the effectiveness of IT tools and applications. However, it is monotonous to perform IT assessment in a GSC environment if it is done individually. Therefore, IT assessment team should also be included in the regional committees.

Transformation: This activity transforms the company management team into SC transformation team.

A12: Identify company SC information (intelligence) and problems

At this phase, SC transformation team needs to gather and develop a complete SC database of that particular industry. For example, aircraft companies, such as Boeing, Airbus, Raytheon, Cessna and others have an Aerospace Supply Chain Database (ASCD) or Aviation Supply Chain Intelligence (AvSCI) that lists every major aircraft in production and analyses the relationship between the suppliers. It identifies where each supplier sits within the supply chain, the value of the contract with suppliers and customers (where in the public domain), the length of the contract and the location where the work takes place. (PMi Media, 2007)

Next, SC transformation team needs to classify SC information and problems from the existing sub-database, such as Supplier Relationship Manage (SRM), Warehouse Management System (WMS), Production and Supply Planning, Transportation Management System (TPS), International Trade Logistics (ITL) and Supply Chain Event Management.

APPENDIX A (continued)

Transformation: There are two outputs for this activity. The first output is SC facts and documented problems and the second output is customized and reclassified processes and policies. This activity is constrained by internal and external policies. The mechanisms are SC transformation team, IT tools and IT methods.

A13: Analyze current situation and foresee possible improvement

After SC problems have been classified, SC transformation team has to examine current circumstances in order to anticipate possible improvement on important issues. One of the common methods is the Six Sigma method – Define, measure, analyze, improve, and control (DMAIC).

Define: It is vital to define specific goals in accomplishing outcomes that are consistent with GSC demands and strategies. Basically, a developing road-map is required.

Measure: Accurate pre-measurements are required. Applicable data must be collected for future comparisons.

Analyze: Analysis is a technique to establish relationships of causality, such as problem, cause and effect.

Improve: Using types of IE methods to improve the processes, such as lean manufacturing techniques – 5S, SMED, and supply chain techniques – risk pooling and PPP strategy.

Control: Control is a process to avoid any variances. Usually, pilot team testing method is an evaluation method to examine the capability of the improvements. However, continued measurement and analysis must be performed to maintain the stability of a system.

Transformation: The output of this activity is suggestions and improvements. This activity is constrained by SC facts, documented problems, internal and external policies, and the mechanisms are SC transformation team, IT tools and IE methods.

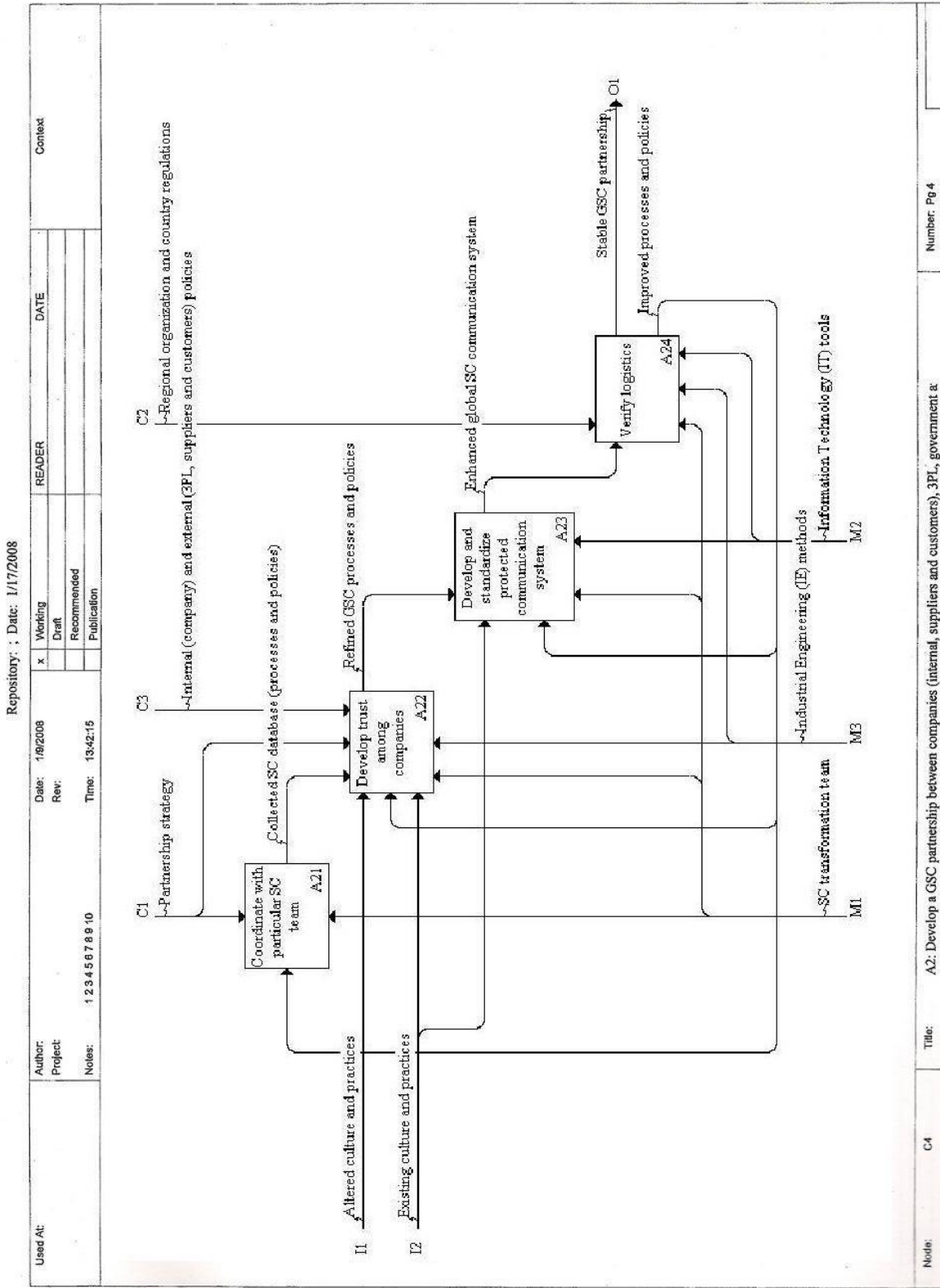
A14: Develop partnership strategy

Partnership is a liaison method to build a strong GSC. Partnership strategy is a combination of IT tools - SAP, IE methods – ERP, dual manufacturing, and business approaches – revenue sharing. Three types of partnership relationships are introduced in this IDEF0 model. They are private-private partnership, public-private partnership (PPP) and country partnerships strategy (CPS). SC transformation team needs to develop a long term private-private partnership with GSC companies. It is very important because partnership is a proactive technique in order to protect the growth of a business. In the later stage, the participation PPP and CPS will be helpful in improving GSC processes. Lastly, the most important fixation is that GSC must maintain a mutual beneficial relationship.

APPENDIX A (continued)

Transformation: This activity transforms suggestions and improvements into a partnership strategy. This activity is constrained by internal and external policies, and regional organization and country regulations. The mechanisms are IT tools, IE methods, and SC transformation team.

APPENDIX A (continued)



APPENDIX A (continued)

A2: Develop a GSC partnership between companies (internal, suppliers and customers), 3PL, government and regional organization.

A21: Coordinate with particular SC team

SC transformation team is required to synchronize with other companies' SC team at all time in order to be kept informed to all possible changes in GSC. The collaboration between SC teams is very important because they are accountable in managing and improving the competence level of GSC. Meanwhile, information sharing between GSC companies needs to be developed in this stage as to improve the efficiency of management.

Transformation: Firstly, the output of this activity is collected SC database (processes and policies). This activity is constrained by partnership strategy and the mechanism is SC transformation team. Meanwhile, improved processes and policies from A24 is also a return input for this activity.

A22: Develop trust among companies

Developing trust among companies is enforced for every global business. One way to develop trust across GSC is to implement Supply Chain Management (SCM). According to Lambert and Cooper (2000) managing a GSC requires continuous information flows. However, optimizing the product flows cannot be accomplished without implementing a process approach to the GSC.

By utilizing the information of A12 - identify company SC information (intelligence) and problems and A21 - coordinate with particular SC team, together with the eight key SC processes states by Lambert (2004): 1) Customer relationship management, 2) Customer service management, 3) Demand management 4) Order fulfillment 5) Manufacturing flow management 6 Supplier relationship management 7) Product development and commercialization and 8) Returns management are able to develop a strong trust among GSC companies. The main intention is to certify that every GSC companies are at the same level of management.

Transformation: This activity transforms existing culture and practices, and altered culture and practices from the returned information into customized and reclassified GSC processes and policies. The constraints are SC processes and policies and partnership strategy. The mechanism is SC transformation team.

A23: Develop and standardize protected communication system

In this age, the secure and smooth information flow in GSC is required for the support of a communication system, standardized hand-on processing methods and the collaboration of GSC companies.

APPENDIX A (continued)

For instance, internet services such as emails, websites and e-commerce; telecommunication services, such as fax and long distance conference calls are a necessity for every local and global organization. The installation of industry standards internet security suite, such as anti-virus, anti-spyware, anti-phishing and two-way firewall are required for every company's servers and personal computers. The promotion of high performance telecommunication devices is considered necessary too. The recording function is getting common for a long distance conference call as to protect two or more parties in making final decisions.

According to Cassidy (2003), each global trade transaction can involve up to twenty-five different parties. A typical cross-border transaction may involve filing thirty-five documents, communicating with twenty-five parties and complying with more than six hundred laws and five hundred trade agreements.

After the recent millennium, personal digital assistant (PDA) is well known tool for management team members. Features such as Wi-Fi, access to email accounts and document readers have improved workers' working efficiency and this creates extended working duration and a better environment. However, passwords protection for PDA and documents files needs to be placed at all times.

In addition, these high technology security protection systems need to be graded by IT and governments' professionals. Assessment such as Supply Chain Security Self Audit and the Supply Chain Security (SCS) implementation procedure need to be audited periodically.

Lastly, latest IT security technology, which is known as Data Encryption Standard (DES) is also encouraged to be implemented in the center database.

Transformation: This activity transforms existing culture and practices, thus improving processes and policies from the returned information into enhanced GSC communication system. The constraint is customized and reclassified GSC processes and policies and the mechanisms are SAC transformation team and IT tools and IT methods.

A24: Verify logistics

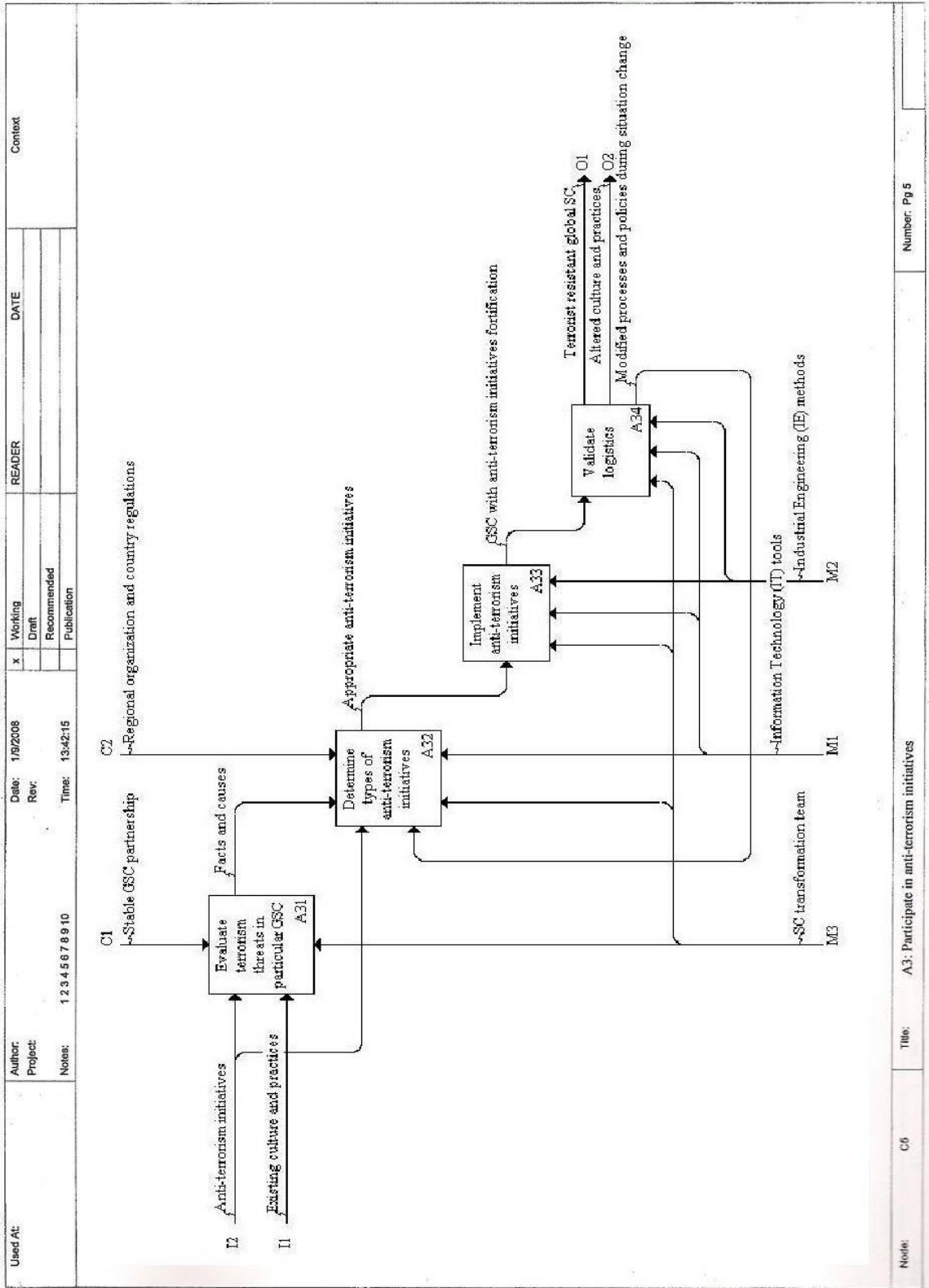
According to Hudson (2004), companies across the globe has spent anywhere from 40% to 50% of every logistics dollar on third party logistics (3PL) services. For this reason, 3PL companies play a vital role in GSC. The selection of 3PL provider is not as simple as comparing costs. It requires careful examination of a vendor's credentials, capabilities, business practices, technology and track record for safely storing, handling and distributing valuable pharmaceutical products (Marcum and Hudson, 2007).

By using on hand GSC information, existing communication system and standardized processing method, SC transformation team must verify logistics issues and develop partnership with selected 3PL provider.

APPENDIX A (continued)

Transformation: This activity transforms enhanced GSC communication system into stable GSC partnership and improved processes and policies. The constraint is regional and country regulations and the mechanisms are SC transformation team and IT tools and IE methods.

APPENDIX A (continued)



APPENDIX A (continued)

A3: Participate in anti-terrorism initiatives

A31: Evaluate terrorism threats in particular GSC

Currently, the threat of terrorism knows no borders. The evaluation of terrorism threats is vital for every GSC. In other words, companies need to know the weakest link in their GSC. SC transformation teams need to get organized for any possible terrorism threats that would affect the GSC operations by reviewing SC processes and evaluating the consequences of disasters on GSC operations. SC transformation team may make use of GSC information to prepare an anti-terrorism process handbook which gives a standard response to any terrorist attack.

Transformation: This activity transforms anti-terrorism initiatives and existing culture and practices into facts and causes. The constraint is stable GSC partnership and the mechanism is SC transformation team.

A32: Determine types of anti-terrorism initiatives

Anti-terrorism initiatives are designed and administered by respective the country's governments. It is important that the SC transformation team must understand the various types of terrorism initiatives and comply with anti-terrorism initiatives regulations before putting it into practice.

U.S. Customs and Border Protection (CBP) have developed anti-terrorism initiatives to protect the export and import operations by air, land and sea. Few common anti-terrorism initiatives are: Customs-Trade Partnership Against Terrorism (C-TPAT) for GSC partnership, Container Security Initiative (CSI) and 24-hour rule for outbound Customs inspection, Free and Secure Trade (FAST), Smart and Secure Trade Lane (SST) and Operation Safe Commerce (OSC) for source and inbound in transit control.

Transformation: This activity transforms anti-terrorism initiatives and returned data - modified processes and policies during situation change into appropriate anti-terrorism initiatives. The transformation is constrained by regional organization and country regulations.

A33: Implement anti-terrorism initiatives

The implementation of anti-terrorism initiatives begins with the assessment of the companies' GSC operations by using C-TPAT guidelines. C-TPAT certification is known as a prerequisite for other anti-terrorism initiatives.

C-TPAT requires a company to develop a plan in improving security throughout GSC. Signing Memorandum of Understanding (MOU) is a must, and the company must submit the plan within sixty days after signing the MOU. It takes another sixty days for CBP to review and make the certification decisions. Once certified, the company becomes a C-

APPENDIX A (continued)

TPAT member. However, the validation processes of GSC operations must be completed within three years.

Transformation: This activity transforms appropriate anti-terrorism initiatives into GSC with anti-terrorism fortification while under the constraint of regional organization and country regulations. The mechanisms are SC transformation team, IT tool, and IE methods.

A34: Validate logistics

SC transformation team has to validate 3PL relationship before placing anti-terrorism initiatives into practice. The synchronization of 3PL and anti-terrorism initiatives is fundamental. According to Sahay and Mohan (2006), the perception analysis validates the effectiveness of 3PL relationships would be significantly impacted by partnerships loyalty and company integrity. A successful long term 3PL relationship depends totally on these two variables.

Transformation: This activity transforms GSC with anti-terrorism initiatives fortification into terrorist resistant GSC, altered culture and practices and modified processes and policies during situation change. The mechanisms are SC transformation team, IT tools and IE methods.

APPENDIX B

GLOSSARY

Altered culture and practices: After going through different stages, a better set of altered culture and practices will be discovered. The improvement of processes and practices will be considered as a new technique and needs to be implemented back into the previous stage so as to develop an enhanced GSC.

Anti-terrorism initiatives: After the September 11th tragedy, anti-terrorism initiatives were introduced by the US governments towards the private sectors. These initiatives were designed to protect the US mainland while also improving collaboration between government and private sectors, called the Public-Private Partnership (PPP). Currently, the prerequisite to participate in the initiatives services is to be certified by the Customs-Trade Partnership Against Terrorism (C-TPAT). “C-TPAT is a joint government – business initiative to build cooperative relationships that strengthen Global Supply Chain (GSC) and boarder security.”

Appropriate anti-terrorism initiatives: Nowadays, most countries have created types of anti-terrorism initiatives so as to protect the borders and GSC. Companies in a GSC environment need to participate in a few anti-terrorism initiatives which are operated by different countries governments. Hence, the determination of appropriate anti-terrorism initiatives is required.

Collected GSC database (processes and policies): The collaboration between SC teams from different companies is vital. Both internal and external SC teams are required a set of GSC database in order to develop a mutual set of policies. Meanwhile, the consideration of GSC partner’s processing methods is necessary to improve the partnership procedure.

Company management team: A management team is portrayed as the spirit of a company. Whatever they do will definitely cause changes in a company. They are responsible for managing daily operations and vital decisions. In general, they are accountable in completing tasks and maintaining the value of a company. The team members include chief officers, managers and senior staffs from different departments. The collaboration between these different departments is also the key to success in managing a company.

Customized and reclassified GSC processes and policies: After developing the GSC database, GSC companies are expected to share and update GSC information together. This will be beneficial to each and every company and also increase the efficiency of GSC. For a long term progress, this method could also develop trust amongst GSC companies. The partnerships of GSC will build up a new set of customized and reclassified GSC processes and policies which will better fit companies in the GSC.

APPENDIX B (continued)

Enhanced GSC communication system: Nowadays, communication system is an important IT tool in managing global organizations. Conference call is the most common meeting method between supplier, manufacturer and customer, which are located in different regions. Advance IT tools are required to guard GSC operations and up-to-date security system is needed to protect the GSC database. At this time, internet communications, such as emails and e-commerce are considered the fastest way to manage a GSC.

Existing culture and practices: Current industry existing culture and practices are referred to patterns of human activities that are performed throughout a daily basis. Meanwhile, different working environment and industry requires different level of working attitude. Therefore, different requirements of culture and practices also create different level of understanding.

Existing culture and practices could be an obstacle that constraints SC daily operation. Consequently, the first thing that the SC team needs to take care of is performing internal self-evaluation in order to figure out areas which have lack of standards.

Facts and causes: The threats of terrorism are based on regions safety level, country political background, and religion. The evaluation of terrorism threats needs to be done and analysis of the facts and causes is the key to decide which anti-terrorism initiatives is suitable for the GSC.

Global Supply Chain: The only unique characteristic is that Global Supply Chain (GSC) is performing outsourcing strategy. It converts a part of the inbound production to offshore production. Due to the growth of world businesses, GSC is getting more common and many manufacturers do not produce a product all by themselves but they perform outsourcing in order to reduce product and manufacturing cost, which would lead to an increase of revenue.

Worldwide companies in different industries, such as Wal-Mart, Sony, Toyota and Boeing are performing outsourcing strategies and developing strong partnerships with offshore companies. The trend of this development has caused GSC to become a very important element in businesses of the world.

GSC with anti-terrorism initiatives fortification: The implementation of anti-terrorism initiatives is a long process. A company needs to have strong determination and the project needs to be lead by a SC team. A GSC with anti-terrorism initiatives fortification means every GSC processes and information transfers are under a high level of security protection. The PPP and CPS will be able to create GSC in becoming a stronghold.

Improved processes and policies: Before participating in anti-terrorism initiatives, GSC companies should verify processes and information with a third party logistics (3PL) company in order to make the last changes on processing methods or include additional

APPENDIX B (continued)

logistics policies. These improvements will increase the efficiency and security level of GSC.

Information Technology (IT) tools and Industrial Engineering (IE) methods: Information Technology (IT) is becoming a very important piece of local and global businesses. IT refers to both hardware and software. These days, IT also refers to a service in an industry. IT hardware product needs to be upgraded once in every few years in order to catch up with current IT software requirements. IT software, such as Microsoft Office and computer based information management software, such as Oracle and SAP are used by many global organizations. IT services, such as the internet and Third Generation (3G) network has enabled a lot of functions for global businesses and road warriors. IT had become an indispensable tool to manage a huge and complex business.

On the other hand, Industrial Engineering (IE) methods are also considered an important part, especially in a manufacturing environment. IE methods for management are separated into a few different categories. Common IE methods for Supply Chain Management are risk pooling, partnerships strategies, and supplier developments. IE methods for lean manufacturing are including Sort, Set In Order, Shine, Standardize and Sustain (5S), just-in-time (JIT), Single Minute Exchange Dice (SMED), level load, line balancing, Kanban, Kaizen and et cetera. Inventory types includes buffer, safety stock, work in process (WIP), made-to-order (MTO), assemble-to-order (ATO), retailer managed inventory (RMI), first in first out (FIFO) and et cetera. Meanwhile, common manufacturing management methods are material requirement planning (MRP), enterprise resource planning (ERP), bill of material (BOM), push and pull control production.

Internal (company) and external (3PL, suppliers and customers) policies: As a rule, policies are design to protect a company. However, when two or more companies become a business partner, the negotiation of policy issue is a vital step. The final result is to develop a set of mutual policy which could minimize the disagreement and maximize the profit for every member in a GSC.

From the view of a company, internal policy is a guiding principle or process which standardizes the daily procedure and maintains a consistent growth of a company. Meanwhile, external policy is represented by the companies in GSC, which includes suppliers, customers, and Third Party Logistics (3PL) companies.

Modified processes and policies during situation change: The last process for the entire development is to validate anti-terrorism initiatives with 3PL companies. One of the outcomes is the modified processes and policies during situation change. For example, if a tragedy happened in a GSC, 3PL companies should co-operate with GSC companies to make reasonable modifications in order to maintain a consistent GSC operation.

APPENDIX B (continued)

Partnership strategy: The first relationship which needs to be established is developing a partnership with the companies in the GSC. With the regulations and commitment, partnership strategy will give a protection to each company in the GSC.

In the last few decades, the rapid growth of international businesses has created a new scenario, which is the public-private partnership (PPP). PPP is defined as “a cooperative venture between the public and private sectors, built on the expertise of each partner that best meets clearly defined public needs through the appropriate allocation of resources, risks and rewards”(Canadian Council for PPP). PPP has improved the understanding between public and private sectors. The main purpose is to create new development opportunities and generate mutual benefits.

Subsequently, the next stage is to develop Country Partnership Strategy (CPS). CPS is a method to enhance global businesses. Good sympathetic relationships between countries of different cultures and background are needed so as to maintain a long term partnership. In addition, World Trade Organization (WTO) has also created and developed a lot of CPS among countries from different regions. With the conception of PPP and CPS, GSC will be able to operate under a more secure and resilient condition.

Regional organization and country regulations: These days, the two biggest international organizations that interact with world peace and global businesses are United Nations (UN) and World Trade Organization (WTO). The development of UN, WTO and others regional organizations have improved the collaboration between different countries with significantly different background in culture, religion and geography. By participating in a regional organization, it will benefit the exports and imports of a country. For example, free trade is one of the unique characteristics for some of a region’s organization. Meanwhile, there are regional organization agreements to follow in order to maintain a peaceful partnership.

Subsequently, country regulations can be another obstacle for developing an international business. Some of the country business regulations are designed to protect the small industries. It means that any similar industry from a foreign country would have difficulties competing or getting involved.

One good example is that the government of Malaysia has postponed many occasions opening the automotive industry to other South East Asian (SEA) countries because with the intent of protecting local automotive manufacturers.

SC facts and documented problems: Company internal processes and information assessment is a method to discover SC facts and problems. Assessment should be done in every department so as to determine potential and unsolved problems in a company. If possible, this internal assessment should be done by an audit company; so as to prevent internal employees would from covering up any information. Stable GSC partnership:

APPENDIX B (continued)

The guidance of SC transformation team and collaboration between partnerships companies are two important elements in building a strong GSC infrastructure. Stable GSC partnerships mean that every process development and decision making will bring mutual advantage to the entire GSC. Meanwhile, by employing IT tools and IE methods, and also the development of PPP and CPS would increase the elasticity of GSC.

SC transformation team: SC transformation team is considered a cross functional team. Therefore, the selection of a SC transformation team member is vital. First of all, SC team members should be selected from every department in a company. Secondly, each SC team member should be at least a supervisor or team leader with potential and he or she must be a committed employee. SC transformation team plays a role in connecting each department within a company and is also responsible to confer with partnership companies. Each and every SC transformation team members should have a strong understanding within their own department so that they are able to make possible changes.

Suggestions and improvements: Analyzing SC facts and documented problems should be done by the SC transformation team in order to congregate the best suggestions and improvements. The exchange of ideas and strategies amongst lead members from different departments is the best way to solve conflict in process between departments.

Supply Chain: “Supply Chain (SC) is a coordinated system of organizations, people, activities, information and resources involved in processing a product or service in physical or virtual manner from supplier to customer. SC activities transform raw materials or components into a finished product that is delivered to the end customer” (Nagurney, 2006).

“The three primary elements of any SC are suppliers, manufacturers and customers. SC is also may encompass with retailers and distributors along with service and support functions” (Lockamy and Smith, 1997).

Supply chain can also be defined into internal and external sections. Internal is compromise of activities within a company, from the process of receiving to the process of packaging. External SC is the relationships between companies in a SC.

Terrorist resistant GSC: After improving internal and external GSC operations and getting certified as a member of C-TPAT, GSC is considered to be terrorist resistant. Moreover, the introduction of partnerships strategies and Industrial Engineering (IE) methods has created a more resilient GSC.

APPENDIX C

AUTHOR-READER CYCLE REVIEW

Repository : Date: 1/17/2008

Used At:	Author: Bobby Toy	Date: 1/17/2008	Working	READER	Context
Project:	12345678910	Rev: 1	<input checked="" type="checkbox"/> Draft		ARC Advisory Group (2002), Trade Security: A Handbook in Supply Chain Management. Boston, MA: Gonzalez, A.
Notes:		Time: 13:42:27	<input type="checkbox"/> Recommended		
			<input type="checkbox"/> Publication		

must be set up

① Regional Committee, to ~~monitor~~ establish, monitor and invite check the secured GSC on periodic basis

② Anti-Terrorism initiatives - further elaboration needed.

③ Secured Global Supply Chain must include the rules and regulation of all participating nation members, Anti-terrorism initiatives

④ Secured Global Supply Chain must also committee team must consists of the representatives from all participating nation members must be inclusive of various aspects (defense, political of views, etc)

⑤ Company must team is more needed in complying the process.

⑥ The model is good as it considers the soft part of the regional practice - existing cultures are practices.

⑦ IT & IS methods play extremely important roles in Secure GSC categories are

⑧ Details of Secure GSC must also should be considered.

⑨ Information Technology (IT) tools and Industrial Engineering (IE) methods

⑩ Internal (company) and external (3PL, suppliers and customers) policies

⑪ Regional organization and country regulations

⑫ Terrorist resistant global SC

Secure Global Supply Chain (GSC)

Company management team

Existing culture and practices

Anti-terrorism initiatives

Information Technology (IT) tools and Industrial Engineering (IE) methods

Internal (company) and external (3PL, suppliers and customers) policies

Regional organization and country regulations

Terrorist resistant global SC

Secure Global Supply Chain (GSC)

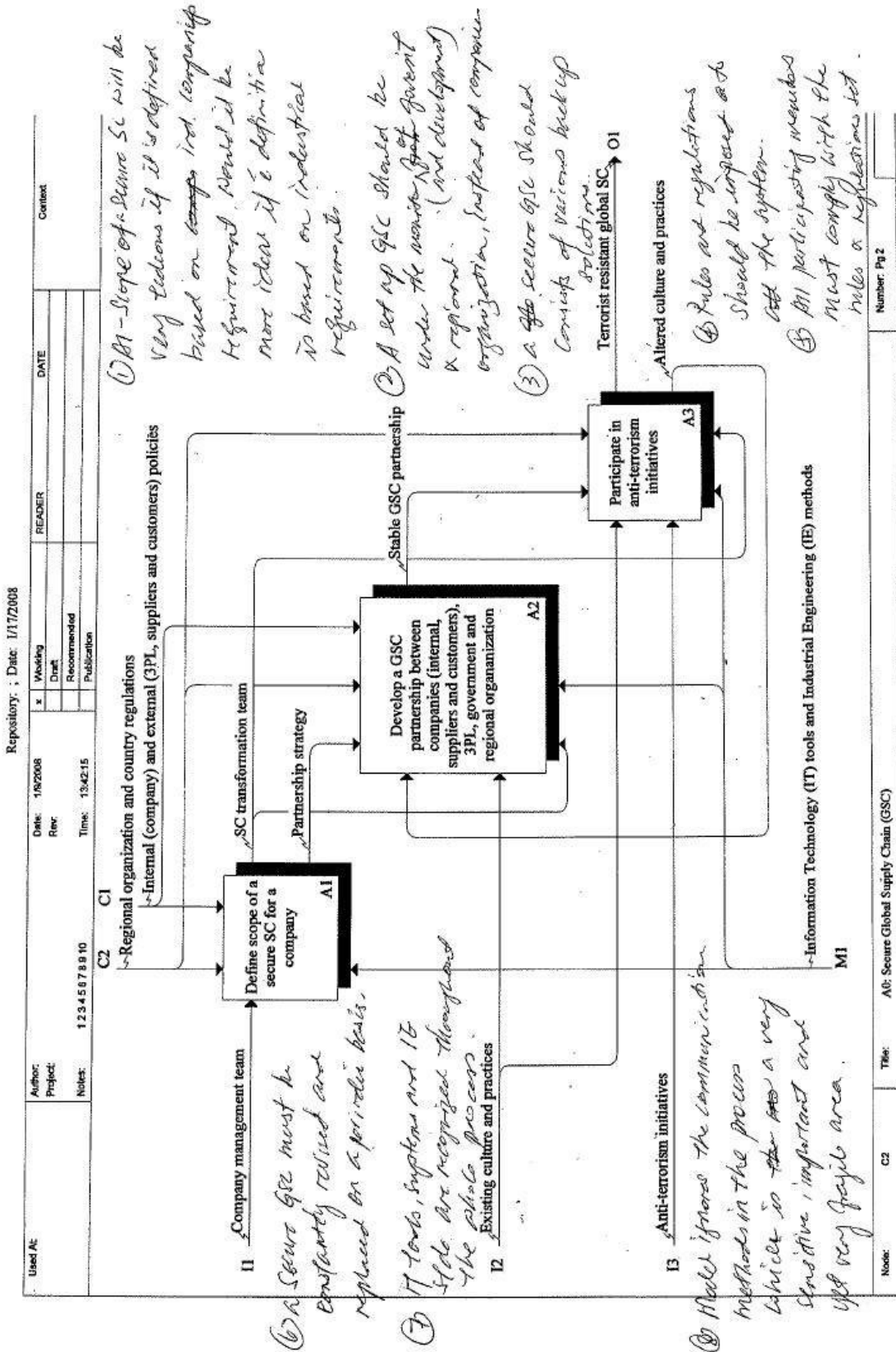
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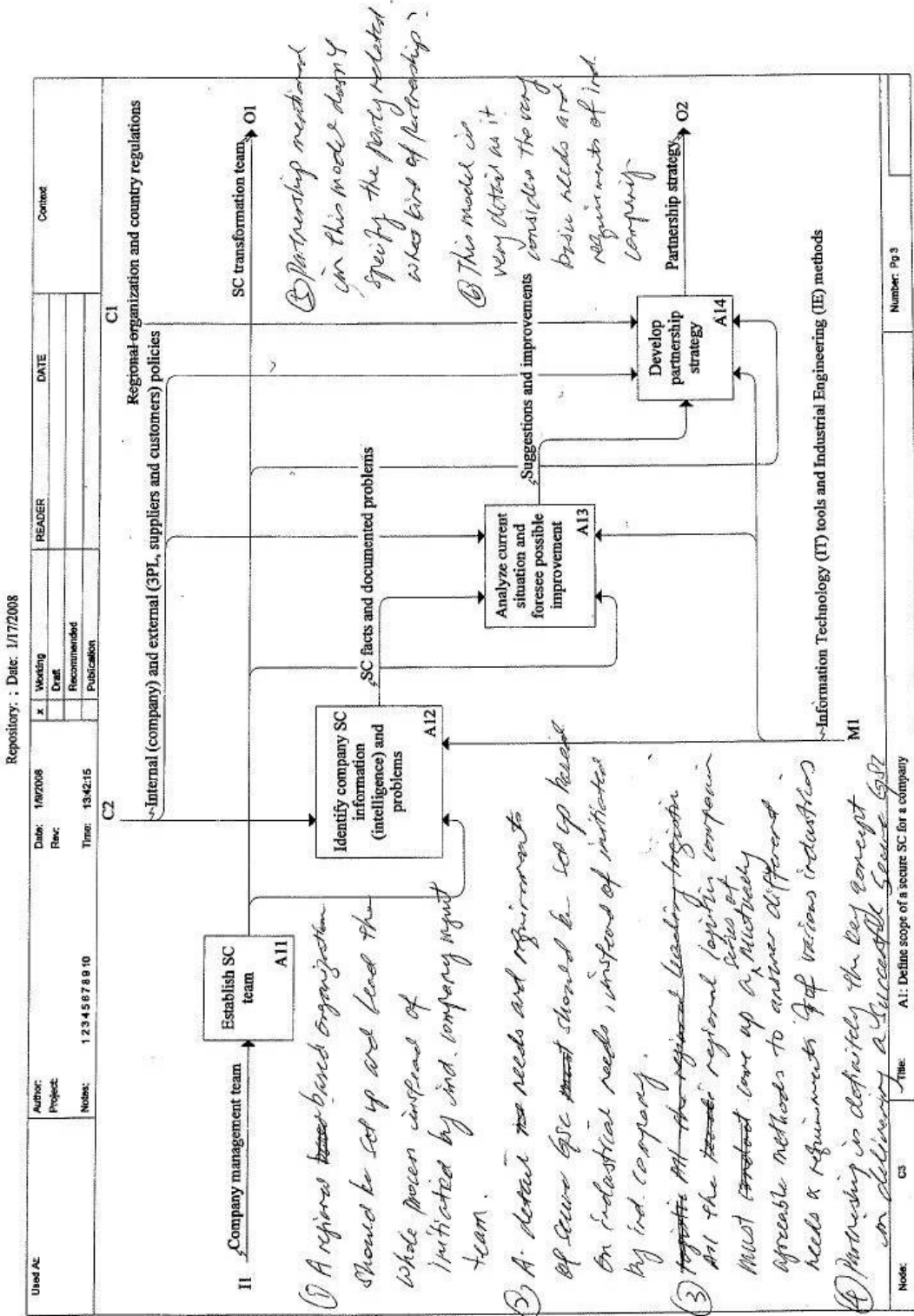
January 17th 2008 - Thesis proposal

Node: CI Title: Terrorist Resistant Global Supply Chain (GSC)

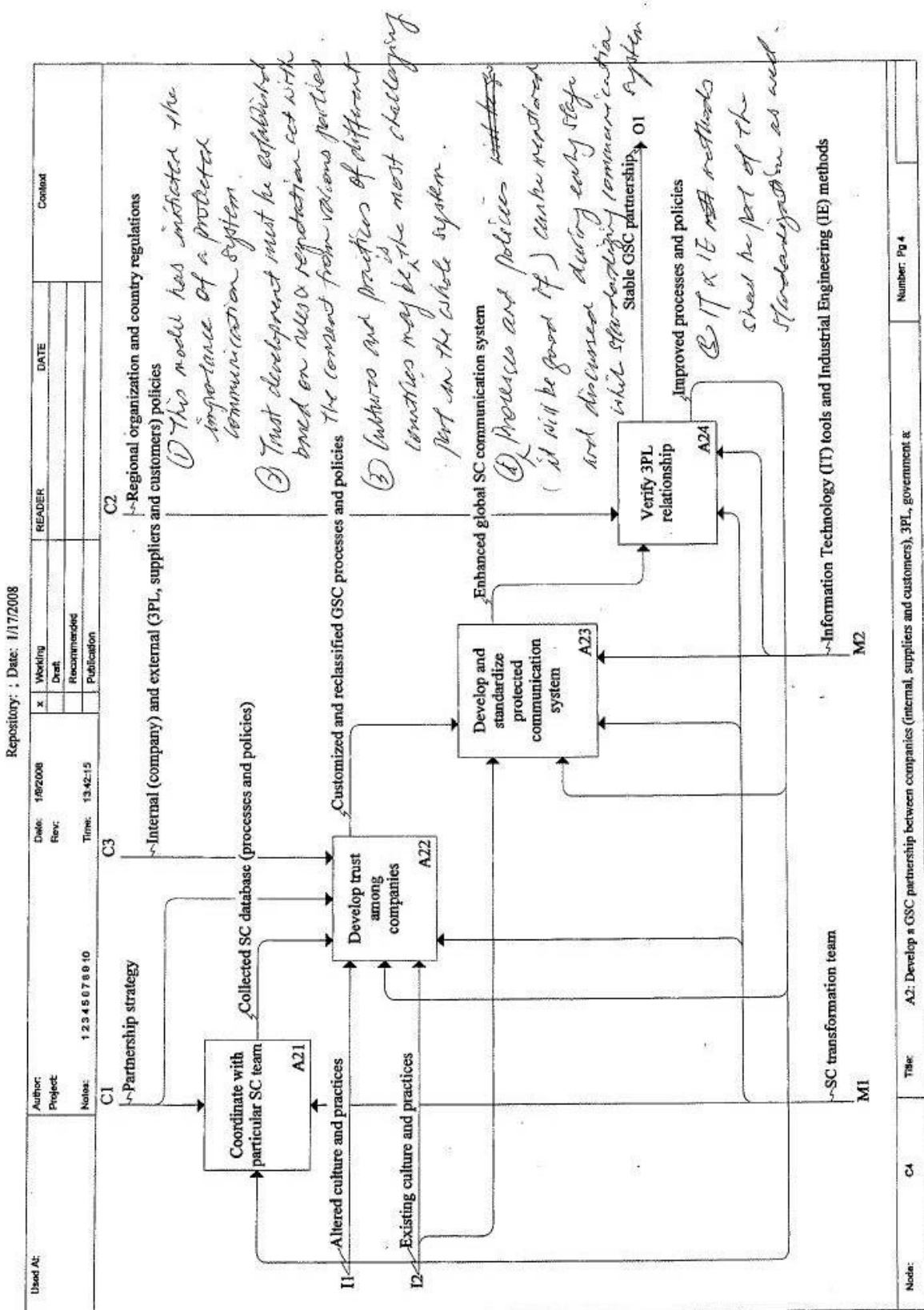
APPENDIX C (continued)



APPENDIX C (continued)



APPENDIX C (continued)



APPENDIX C (continued)

