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反武器擴散:資料採礦技術於我國戰略性高科技貨品出口管制之應用

Counter Proliferation: The Application of Data Mining Technologies in Taiwan Strategic High-Tech Commodities Export Control Management

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Chien-Kai Chiou

Abstract

Counter Proliferation: The Application of Data Mining Technologies in Taiwan Strategic High-Tech Commodities Export Control Management.

By

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WMD (weapons of mass destruction) proliferation and nuclear terrorism are the gravest dangers that the world faces. The international society established counter proliferation regimes and export control systems to prevent the proliferators from acquiring WMD and the related commodities that can be used in producing the weapons. However, there are limitations in export control systems. The trade security and facilitation should be both considered, while the proliferators attempt to establish procurement networks to circumvent export control systems and globalization has introduced challenges from the emergence of increasing number of global corporations and increasing volume of dual-use trade. By using the data mining tool of link analysis, the thesis attempts to develop a methodology to increase the coerciveness and accuracy of detecting problematic shipments from ordinary export activities in order to improve the export control management. From the research, it suggests that data mining is a feasible solution to improve the effectiveness and efficiency of export control. It can be used for discovering entities with not only explicit but also implicit proliferation concerns from a large quantity of datasets and increase the cost and difficulties of circumventing export control so that the proliferation activities are to be contained or hindered. Based on the findings, the thesis established an export control management model with data-mining solutions.

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1. Introduction

The international society faces an important issue in counter proliferation: how to improve export control system in order to ensure trade security and sustain economic development simultaneously. Many are concerned about countries such as North Korea and Iran, which attempt to acquire or develop WMD (weapons of mass destruction), especially nuclear weapons. Even more are concerned about the risk of those countries supplying nuclear weapons and technology to radical states or terrorist groups. Therefore, the international society has developed export control mechanism to prevent critical material, equipment, and technology being shipped to restricted area for developing WMD.

However, many of the goods in export control are dual-use in both military and civilian use. When it comes to civilian use, most goods are for legitimate business activities, which need to be promoted and facilitated, while only a small portion of shipments are violating export control laws to transfer controlled commodities to proliferators. Therefore, there is a need to not only address security concerns but also maintain the efficiency of ordinary business activities. In the prospective of management, it is worth of developing methodologies by using data mining technology to distinguish problematic deals from normal ones in order to foil problematic shipments without interrupting normal export activities.

1.1. Why is Export Control Important?

During Cold War, the major strategy to address nuclear threat was deterrence, by which the super powers declared mutually assured destruction to deter the opponents from launching nuclear attacks. The deterrence against state rivals was proved to be highly effective according to the experience during the Cold War, but it was not expected that nuclear weapons would be proliferated to countries, such as North Korea and Iran. The September 11th attacks aroused the fear of nuclear terrorism. Deterrence strategy is effective to state actors because states have territories, which would be the target of retaliation. However, terrorist organizations do not have permanent territories, so the confidence in deterrence strategy is obviously lowered when the opponents are non-state actors. Therefore, the international community started to emphasize the dissuasion strategy, which is to dissuade adversary from expanding, improving or transferring WMD. The focus of dissuasion is to discourage the proliferators developing WMD before they can possess the

weapons. Export control, which is an important tool of counter proliferation, is designed to prevent the proliferators from acquiring and transferring the weapons at the early stage of WMD development. For fulfilling the gap of deterrence strategy to non-state actors, export control is an essential tool to ensure international security.

In the globalization era, no country can avoid the catastrophic impact if there is a nuclear attack. The UN Security Council has issued resolutions against WMD proliferation. Countries including US, Japan, and European Countries have legislations and sanction lists against proliferators. International regimes, such as Wassenaar Arrangement, Nuclear Suppliers Group, Australia Group, and Missile Technology Control Regime, regulates international export control norms and the controlled items for conventional, nuclear, biological, and chemical weapons and missiles as for weapon platforms. The members of these international regimes include thirty some major industrial countries, such as Australia, Canada, France, Germany, Italy, Japan, Korea, Russia, UK, and US. The advanced countries are highly interested in implementing export control systems for WMD counter-proliferation.[1]

1.2. Taiwan's Obligations on International Export Control

Many people might think export control is solely to control the weapons. However, the international controls on the weapons are so strict that the proliferators are hardly able to acquire the final product of weapons; instead, the proliferators acquire the technologies (know-how), raw material, equipment, and sub-components, to build the weapons in their territories. These required commodities are mainly dual-use, for example, computers and machine tools, which have both military and civilian applications. Most of the sensitive commodities used to be produced by companies in advanced industrial countries, but Taiwan industries are able to produce these dual-use commodities after decades of industrial development. Therefore, the international community expects Taiwan to establish export control systems to meet the international norms. Although Taiwan is not the member of UN and the international counter-proliferation regimes, Taiwan followed international norms and

[1] 虞孝成, 徐振榮, 張世其"出口管制制度之探討," *科技發展政策報導*, no. SR9012 (Dec, 2001), 942-945.

implemented Strategic High-Tech Commodities (SHTC) export control mechanism in 1995 to fulfill the obligations as a member of the international community.[2]

Export control is essential to industrial development. Taiwan economy highly relies on the trade of exports, so the importance of export control is usually mistakenly neglected. However, Taiwan high-tech industries rely on the supply of technologies, material, and equipment from advanced countries. If Taiwan does not meet the requirement of export control systems, the international community, for example, US, Japan, and EU, might prohibit exports of high-tech commodities and technologies to Taiwan, which would be a severe impact on Taiwan industrial development.[3]

In addition, the entities which violate international sanctions might be added to sanction lists and cannot conduct any business with countries obliged by the international export control regimes. The reputation of global companies is essential for sustaining business development. Most companies are willing to take responsibilities to obey export control regulations to maintain their reputation. Some corporations establish internal control programs to review their exports in order to prevent from violating any international sanctions. To meet the international requirement of export control is beneficial not only to the country as a whole but also to the industries individually.

1.3. The Need to Improve Export Control Management

Current export control management mainly focuses on screening the entities on the black lists, to which are prohibited to export sensitive items. But the proliferators usually use legitimate businesses which are not yet on the blacklists to circumvent export control. Government authorities have to scrutinize the exports to restricted area or transshipment locations in order to verify the proliferation concern. Nevertheless, the problematic shipments account for a tiny portion of the total export activities. As a result, the exporters frequently complain that export controls delay the shipments and raise the costs of exports.

In Taiwan, there are more than 10,000 licensing applications of SHTC exports yearly, so the licensing agency is hard to conduct a comprehensive regulation and control; instead, it focuses on specific cases by risk management. As to the SHTC exports which intentionally or unintentionally avoid applying for permits, the licensing agency would not be able to discern

[2] Ibid, 948.
[3] Ibid, 941.

the real number of violations. In addition, there are about 7.8 million containers and 19 million customs declaration cases yearly, so the Customs can only randomly inspect five percent of the total shipments by risk management and few export violators can be detected. Therefore, the system tends to let exporters to take chance to export goods without licensing.[4]

1.4. US Example to Reform Export Control Mechanism

Because the US export control system is rooted in the Cold War, so US is undergoing an export control reform initiative to update to address the threats today and changing economic and technological landscape. The US reform is an adequate example for the improvement of Taiwan export control system. It is assessed that the current US export control system is overly complicated, contains too many redundancies, and tries to protect too much. The fact sheet on the US President's Export Control Reform Initiative described that the current system is based on two different control lists administered by two different departments, three different primary licensing agencies, a multitude of enforcement agencies with overlapping and duplicative authorities, and a number of separate information technology systems, or agencies with no IT system at all that issues licenses. The fragmented system, combined with the extensive list of controlled items which resulted in almost 130,000 licenses in 2009 in US, dilutes the ability to adequately control and protect those key items and technologies that must be protected for national security. The goal of the US reform is "to build high walls around a smaller yard" by focusing enforcement efforts on the key items and targets. The reform plans to transform US export control to a:

- Single Control List,
- Single Primary Enforcement Coordination Agency,
- Single Information Technology System, and
- Single Licensing Agency.[5]

[4] Kwo Shing Lai, "The Concept of Cooperative State and its Impact on the Regulations for Trade administration－a Focused Examination on Control Over High-Technology Commodities in Taiwan" (Master thesis, National Chengchi University, Taiwan), http://nccur.lib.nccu.edu.tw/handle/140.119/37129 (accessed Dec 12, 2012), 100.

[5] *Fact Sheet on the President's Export Control Reform Initiative* (USA: The White House, Office of the Press Secretary, April 20, 2010)

1.5. The Proposed Management Model for Taiwan Export Control

Current Taiwan export control system has already adopted a single control list and a single licensing agency but not yet establish a single information technology system. Taiwan export control system may adopt the concept of US reform to establish a single IT system by incorporating databases of the customs records, licensing records for both licensing and enforcement in order to improve export control management. The thesis attempts to combine the integrated IT system with data mining technologies in order to discover the problematic shipments and the patterns used by proliferation networks. While the system is able to identify the problematic items and entities more accurately and efficiently, the licensing authority would be able to relax the control on ordinary trade activities. By the reform discussed above, the export control management would be transformed to a comprehensive and targeting-oriented process, which would be more efficient and practical.

Current export control management relies on screening end-users to determine if they are on the blacklists. However, the proliferators would find other legitimate companies to hide the real end-users, while the licensing authorities depend on internal knowledge to assess the risk. If there is no intelligence tip-off, it is extremely difficult for the authorities to screen problematic exports from the large amount of export activities. Therefore, to fill the gaps in export control, the thesis attempts to establish a methodology to discover WMD procurement activities, which the proliferators use legitimate entities to cover. The methodology will be able to improve export control management in several ways:

- to increase effectiveness in detecting risks,
- to increase efficiency in licensing process,
- to strengthen credibility of the export control mechanism to deter violations,
- to raise the difficulties and costs for the proliferators to circumvent export control, and
- to shorten the time needed to issue export permits.

1.6. Literature Review

1.6.1. Export Controls in Public and Private Sectors

Currently, the major methodologies adopted by countries, such as US and Germany etc., are focusing on ICP (Internal Compliance Program) and end-user screening.

In the public sector, the ExportCont.org introduces in the Overview of the U.S. Export Control System that preventive enforcement should include established procedures related to export license applications (i.e. screening the proposed item, quantity, end-use and all parties involved in the transaction for any potential export) and compliance mechanisms (i.e. working in partnership with industry to educate them on how and why to monitor and control their own export activity).[6]

Georg Pietsch, Director General of Germany Federal Office of Economics and Export Controls, emphasizes that the end-user screening of export control should ensure a differentiated approach, especially with regard to:

- be able to properly evaluate each individual case,
- the different sensitivity levels of consignee states concerned,
- the reliability of the persons involved in the transactions,
- and the principle that sensitive cases need more efforts than cases of less sensitivity.[7]

In addition, Pietsch explains the criteria of plausible licensing check are:

- technical aspects,
- internal knowledge and other information of the authority,
- submitted documents and papers,

[6] ExportControl.org, "Overview of the U.S. Export Control System," ExportControl.org, http://exportcontrol.org/links/2081c.aspx (accessed Nov, 12, 2011).

[7] Georg Pietsch, "End use End-User-Screening" (Seventh Annual International Export Control Conference, Stockholm, Federal Office of Economics and Export Control (BAFA) Germany, 20-22 Sep, 2005, 2005)., 1.

- reliability of the persons involved in the transaction (exporter, consignee, end-user and other persons involved),
- risk analysis.[8]

Pietsch further elaborates that in German the backbone of risk analysis is a database with information about applicants, countries of concern, purchase, consignee, end-user and military or civil projects. The purpose of the end-user screening is to support decisions, to discover front-or mailbox-companies, procurement networks and other sensitive projects, overall to minimize the risk to diversion to proliferation end-use.[9]

In the private sector, there are compliance programs developed by IT or consultant companies. For example, the eCustoms–MSR Inc. provides Visual Compliance to assist customers to conduct comprehensive denied party screening for export shipments. Visual Compliance provides documentation and on-line tools to help avoiding non-compliance with U.S. Export Control Regulations. The Visual Compliance software solutions system performs Restricted Party Screening against all relevant U.S. Government lists, including Specially Designated Nationals and Blocked Persons (SDN).[10] NextLabs, IBM, and SAP AG also developed an information export control solution to extend the export compliance capability of the SAP GRC Global Trade Services application. The solution manages the handling and export of technical information that is subject to International Traffic in Arms Regulations (ITAR), Export Administration Regulations (EAR), or other U.S. federal regulations.[11]

Basically, current export-control screening methodologies both in the public and private sectors are focusing on screening the entities which are already on the black lists. For the entities which are not on the black lists but used by the proliferators as conduits, governments usually rely on internal knowledge and other information of the authority. However, the internal knowledge is not likely to cover all the applications since there are usually thousands of applications in a year. In addition, it is difficult to discover implicit

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[8] Ibid, 3.
[9] Ibid, 6.
[10] eCustoms, "Visual Compliance – Export Control Compliance, Comprehensive Denied Party Screening, Controlled Goods Classification, Export License Determination and U.S. Munitions List Classification for Your Export Shipments," eCustoms – MSR Inc., http://www.ecustoms.com/vc/vc.cfm (accessed Nov, 15, 2011).
[11] Lawrence Dietz, "IBM, SAP, and NextLabs Collaborative Effort Yields Export Control Solution," Sageza Group, Inc., IT Analysis Communications Ltd., http://www.it-director.com/business/content.php?cid=9482 (accessed Nov 15, 2011).

violation by human screening. Therefore, it is worth researching in using data mining technologies to develop a methodology to discover implicit signs indicating potential violations to improve and supplement the end-user screening process.

1.6.2. Categories of Data Mining Technologies

Richard J. Roiger and Michael W. Greatz define data mining as a process of acquiring knowledge by using computer technology to analyze information from databases. They note that the goal of data mining is to discover trend and patterns from data.[12]

For using data mining tools to solve real-world problems, Christopher Westphal and Teresa Blaxton noted in *Data Mining Solutions,* "When you begin a data mining engagement you have to make a series of decisions concerning such issues as how to integrate data from separate sources, what types of models to implement, what display paradigms to use, and which tools to choose for the application environment ".[13] There are a variety of commercial tools for data mining application. How can we choose appropriate data mining tools for handling export control issues?

Christopher Westphal and Teresa Blaxton introduce data mining systems in three paradigms of link analysis, landscape display, and quantitative analysis. They provide descriptions of some link analysis tools including NETMAP, Analyst's Notebook, Imagix 4D, Daisy, and others. They also discuss several tools that use landscape visualization, including Mineset 2.0, Metaphor Mixer, In3D, and others. Regarding quantitative analysis, they introduce tools of Clementine, Enterprise Miner, Diamond, and CrossGraphs. In addition, they also provide discussion of future trend in data mining technology, such as web visualizer, free text visualizers, full scope systems.[14]

In another way, Shia Ben-Chang categorizes data mining tools into case-based reasoning, data visualization, fuzzy query and analysis, knowledge discovery, and

[12] Richard J. Roiger and Michael W. Geatz, *Data Mining: A Tutorial-Based Primer*, trans. 曾新穆 and 李建億, 初版四刷 ed. (台北市: 台灣培生教育出版股份有限公司, 2006), 393, 4.
[13] Christopher Westphal and Teresa Blaxton, *Data Mining Solutions: Methods and Tools for Solving Real-World Problems*, Vol. 1 (USA: Wiley Computer Publishing, 1998), 617, 441.
[14] Ibid, 198.

neural networks.[15] Data mining also can be categorized into six fields, including database systems, machine learning, statistical and data analysis methods, visualization, mathematical programming, and high performance computing. The major functions of data mining include classification, estimation, prediction, affinity grouping, and clustering.[16]

There are a wide variety of applications by using data mining, including pharmaceutical research, telecommunications, banking, retail sales and marketing, stock market analysis, and money laundering investigations.[17] Data mining can also be used in customer profiling to predict potential customers, understanding customer behavior to decide logistic flow, or customer relations to maintain current customers. Recently, telephone, credit card, insurance, and government agencies are highly interested in fraud detection for decreasing loss. In addition, data mining can help us on detecting signals of customers with bad credit records, and we can use the signals to screen customers with high risks.[18]

1.6.3. Gaps of Current Methods

However, there is rarely discussions on data mining applications in export control. Most data mining applications are designed to find patterns from large source databases by integrating statistical method into data mining. In export control, the number of violating cases is usually not enough to generate a model for predicting proliferation patterns. The thesis will try to develop a way different from statistical method to solve export control issues.

Some of the current applications have similarities to the management in export control, for example, money laundering investigation, fraud detection, screening bad-credit customers, and criminal investigation. Those applications are focusing on detecting problematic individuals from a whole or following leads to find the targets.

For developing the methodologies to deal with export control issues, there are some research puzzles that we need to solve as follows.

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[15] 謝邦昌 and others, *資料採礦與商業智慧SQL Server 2005: Data Mining & Business Intelligence with SQL Server 2005* (Taiwan Taipei: 中華資料採礦協會, 2005), 381.

[16] 韋端 and others, *Data Mining 概述: 以 Clementine 7.0 為例*, 初版一刷, 2003), 885.Ibid.

[17] Westphal and Blaxton, *Data Mining Solutions: Methods and Tools for Solving Real-World Problems*, 617, 442.

[18] 韋 and others, *Data Mining 概述: 以 Clementine 7.0 為例*, 885.

- What is the essence and logic of the problems in export control?
- What are the difference between the application in export control and other fields?
- Besides of statistical methods, if using link analysis, which is used widely in investigation, is a proper way to build an effective data mining solution for export control?

By evaluating current application of data mining tools in various fields, the thesis will try to integrate investigation logic into data mining methodologies to develop proper solutions for improving export control management. The research will hopefully fulfill the gaps which have not yet been addressed in previous research, including using the data mining applications in export control, and enhance the research in using investigation method in data mining solutions.

1.7. The Utility of the Research

The subject is important and worth studying because nuclear terrorism has already been identified as perhaps the gravest danger and most critical concern after Sep 11, 2001. As U.S. President Obama Barak noted in his 13 April, 2010 speech at the Nuclear Security Summit in Washington, D.C.:

> Two decades after the end of the Cold War, we face a cruel irony of history -- the risk of a nuclear confrontation between nations has gone down, but the risk of nuclear attack has gone up. Nuclear materials that could be sold or stolen and fashioned into a nuclear weapon exist in dozens of nations. Just the smallest amount of plutonium -- about the size of an apple -- could kill and injure hundreds of thousands of innocent people. Terrorist networks such as al Qaeda have tried to acquire the material for a nuclear weapon, and if they ever succeeded, they would surely use it. Were they to do so, it would be a catastrophe for the world -- causing extraordinary loss of life, and striking a major blow to global peace and stability. In short, it is increasingly clear that the danger of nuclear terrorism is one of the greatest threats to global security -- to our collective security.[19]

Al Qaeda has demonstrated intent to acquire nuclear weapons to attack the United States and its allies. Osama bin Laden had declared that the acquisition of nuclear weapons is

[19] Barak Obama, *Obama's Speech at the Nuclear Security Summit* (USA: Council on Foreign Relations, April 2010)

a religious duty. Responding to a question regarding the issue of using WMD, Bin Laden stated in a 1998 interview that:

> To seek to possess the weapons that would counter those of the infidels is a religious duty. . . . It would be a sin for Muslims not to try to possess the weapons that would prevent the infidels from inflicting harm on Muslims. But how we would use these weapons if we possess them is up to us.[20]

Bin Laden tried to buy uranium during the mid-1990s when he was in Sudan. After September 11th, Bin Laden met with Pakistani nuclear scientists to discuss weapons issues.[21] Since the late 1990s, there have been allegations that al Qaeda was trying to purchase nuclear weapons, nuclear weapons materials, and nuclear technologies. Some reports have claimed the successful purchase or production of NBC/R (nuclear, biological, chemical, or radiological) weaponry based on intelligence agency assessments.[22] According to the materials seized and activities uncovered in U.S.-led military action against al Qaeda, al Qaeda conducted research and experiments on nuclear weapons. Officials found more confirmation from the interrogation of al Qaeda detainees as well as from trial testimony of arrested al Qaeda personnel.[23](Dunn, National Defense University, and Center for the Study of Weapons of Mass Destruction 2005)

But why has there not been an al Qaeda nuclear attack? The answer could be lack of materials and limited expertise to manufacture a nuclear device and/or purchase a weapon.[24] Therefore, it is essential to evaluate the potential sources of nuclear materials and expertise that terrorist groups could collect. Professor Graham Allison, a nuclear terrorism expert at Harvard University, warns that North Korea could be close to selling a nuclear bomb to al Qaeda. "North Korea currently sells anything that anyone will pay for," said Allison. Allison points out that despite all the problems with Iran (this year), North Korea has continued to sell weapons to that country. "North Korea succeeded in selling them 18 missiles," he said. "So if they sold these missiles, why wouldn't they sell these things for a bomb?" [25]

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[20] Rahimullah Yusufzai, "Conversation with Terror," *Time* (January 11, 1999), 38-39.
[21] Steve Coll, "The Unthinkable: Can the United States be made Safe from Nuclear Terrorism?" *The New Yorker* (March 12, 2007), 3.
[22] Lewis A. Dunn, National Defense University and Center for the Study of Weapons of Mass Destruction, *Can Al Qaeda be Deterred from using Nuclear Weapons?* (Washington, D.C: Center for the Study of Weapons of Mass Destruction, National Defense University, 2005), 27, 4.
[23] Ibid, 5.
[24] Ibid, 6.
[25] Brianand Ross and Dana Hughes, "'Missiles 'R' Us,' but would North Korea Sell their Nukes?" *ABC News* (July 28, 2006).

Therefore, the international community all agree that the supplying WMD and relative materials and equipment should be denied.

However, export controls on munitions items and nuclear equipment are highly identifiable and less controversial, but export control on dual-use technologies and commodities, which may have both commercial and military application, have more disputes.[26] For example, computers and machine tools used in nuclear program can be also used in automobile or other civilian industries. The export control system has to prevent the dual-use commodities from being exported to designated entities without causing impact on ordinary trade activities. In its 1987 study, the U.S. National Academy of Sciences found that "licensing delays and uncertainties remain a problem for a significant percentage of export transactions…shipping delays impose immediate financial of exporters as well as a longer-term cost in customer confidence."[27] Taiwan export control mechanism also has been encountering this paradox in the past years. Therefore, it is essential to find a way to improve current system in order to distinguish problematic shipments from legitimate ones so that we can minimize interference in ordinary trade activities.

Since the development of information technologies, data mining technologies have been applied to varieties of fields, including telecommunication services, banking, retail, financial market, money laundering investigation, and medical research. From evaluating the successful applications of data mining, we can hopefully find a solution. Therefore, it is worth analyzing the applications of data mining technologies to improve the effectiveness and efficiency of export control management.

1.8. Purpose of Research

The thesis will discover the operation and black market of proliferation network and discuss the limitations of export control system. Based on the findings, the thesis will review and evaluate current data mining tools and select appropriate tool(s) to use in export control process. By implementing the selected data mining tools, the thesis attempts to establish methodologies to improve export control mechanism.

[26] John Heinz, *U.S. Strategic Trade: An Export Control System for the 1990s* (USA: Westview Press, 1991), 170, 9.
[27] Ibid, 26.

1.9. Research Questions

For analyzing the situation and achieving a solution, this thesis will discuss the following questions.

- What is the status of WMD proliferation, taking nuclear weapon as an example?
- Having the serious concern of supplying WMD to failing states and non-state actors, who will be the potential proliferators and buyers of WMD?
- How do the proliferation network and procurement black market operate?
- How does the export control mechanism work in major countries and in Taiwan?
- What are the limitations of export control?
- What is data mining? What can data mining technologies provide to improve the management of export control?
- What are the currently available data mining tools and their applications?
- Regarding the nature of export control, which data mining tools are suitable for providing a solution in improving export control?
- How can we use the data mining tools to establish methodologies and/or models in the management of export control?

1.10. Overview

This paper is structured in the following way. The first section of the article is an estimate of proliferation network, addressing the potential sources of nuclear terrorism and the network of nuclear black market. This is followed by a review of global counter proliferation strategies, addressing the background of export control. The third section evaluates Taiwan export control system to find the limitation and downside that need to be improved. The forth section is to evaluate current data mining tools and select proper one(s) for implementing in export control management. The fifth section discusses the results and findings, addressing possible solutions. The last section gives recommendations for future research.

Before the discussion of data mining technologies, we need to estimate the situation of WMD proliferation and export control system.

2. The Proliferation Network

2.1. The Nuclear Proliferation Network: Potential Sources of Nuclear Terrorism

Nuclear terrorism is a gravest danger that the world faces now. North Korea and Iran are on the top of list of nuclear proliferation. The North Korea nuclear programs are originally from the Soviet Union and Pakistan. Starting in the mid-1980s, the Pakistani nuclear smuggling network exported know-how on uranium enrichment centrifuge technology and weapons design, and to North Korea, Iran, and Libya.[28] North Korea assisted Syria with a nuclear power plant,[29] and it also reportedly supplied exported nuclear material to Libya.[30] There is a growing concern that North Korea will transfer nuclear weapons to other states, such as Myanmar,[31] which can have an impact on regional security and increase the risk of nuclear terrorism.

Figure 1 shows the proliferation network. In order to evaluate the threat of nuclear proliferation, we need to review the status of Russia, Pakistan, Libya, Iran, North Korea and the related proliferation networks.

[28] Bruno Tertrais, "Pakistan's Nuclear Exports: Was there a State Strategy?" *Paper Prepared for the Nonproliferation Policy Education Center* (20 July, 2006).
[29] Henry Sokolski, "From Pyongyang with Love," *Far Eastern Economic Review* (April, 2008).
[30] Glenn Kessler, "North Korea may have Sent Libya Nuclear Material, U.S. Tells Allies," *Washington Post* (February 2, 2005, 2005), http://www.washingtonpost.com/wp-dyn/articles/A55947-2005Feb2.html.
[31] Norman Robespierre, "Nuclear Bond for North Korea and Myanmar," *Asia Times Online* (Oct 4, 2008), http://www.atimes.com/atimes/Southeast_Asia/JJ04Ae01.html.

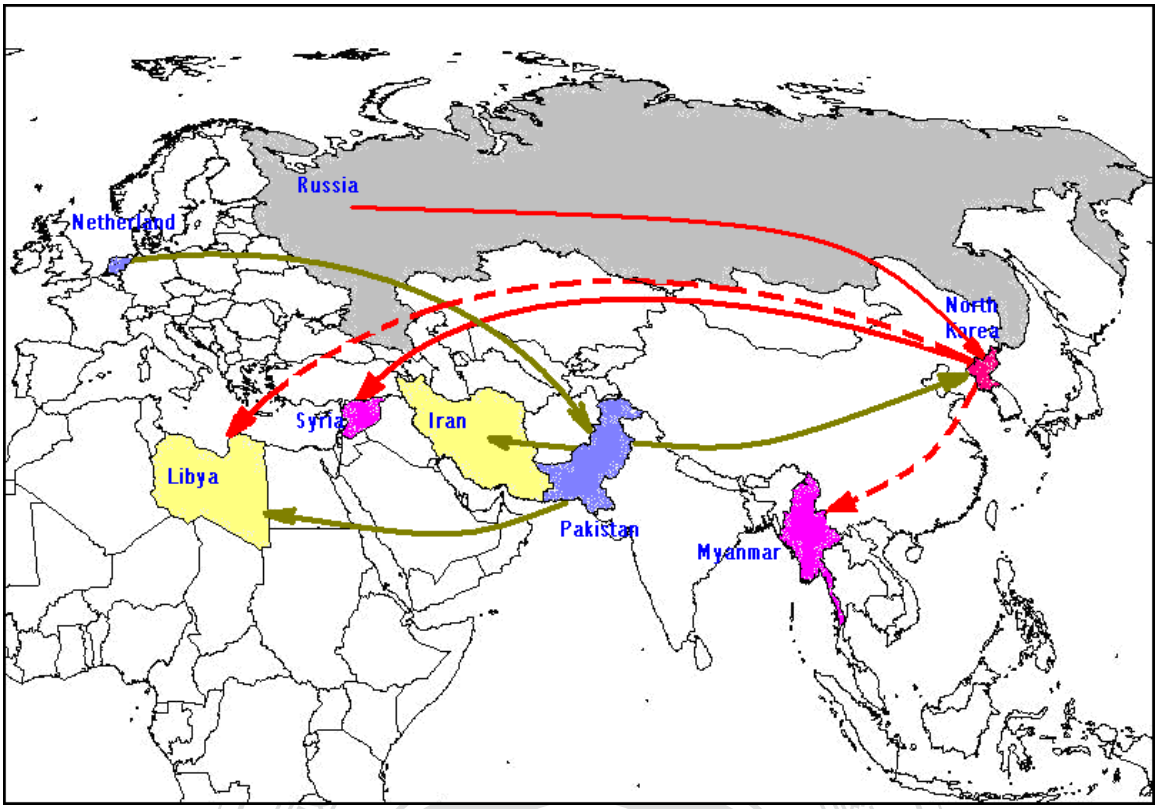

Figure 1 Nuclear Proliferation Network

2.1.1. Russia

There has been great concern that the security of Russia's nuclear complex since the collapse of the Soviet Union made the possible theft or unauthorized use of a Russian nuclear weapon a real threat.[32] There are rumors about the penetration of organized crime into the Russian nuclear forces, and about "suitcase bombs," which are said to have been built for the KGB in the late 1970s and 1980s, and then lost into the black market following the Soviet breakup. However, the existence of suitcase bombs has never been proved, and there has never been a single verified case of theft of nuclear weapon.[33]

The United States and Russia together possess about 95 percent of the world's nuclear material. This fact has led the United States to work closely with Russia to make sure that all of this material is safe from theft and that Russia's former WMD scientists find employment

[32] Joseph Cirincione, Jon B. Wolfsthal and Miriam Rajkumar, *Deadly Arsenals : Nuclear, Biological, and Chemical Threats*, 2nd ed. (Washington, D.C: Carnegie Endowment for International Peace, 2005), 490, http://www.loc.gov/catdir/toc/ecip0512/2005012915.html; Materials specified: Table of contents http://www.loc.gov/catdir/toc/ecip0512/2005012915.html., 130.

[33] William Langewiesche, "How to Get a Nuclear Bomb," *The Atlantic Online* (December, 2006), 4.

outside of the nuclear military complex.[34] U.S.-funded programs have helped to secure the transport of Russia nuclear war heads and to develop a modern warhead accounting system.[35] Now Russia is cooperating with the U.S. to address common security threats; nevertheless, the U.S. is dedicated in promoting cooperating with Russia in helping other states improve their nuclear security and safety.[36]

2.1.2. Pakistan

In the end of 2005, Pakistan may have produced between 1,110 and 1,440 kilograms of weapons-grade uranium, enough to produce between 50 and 110 nuclear weapons.[37] The serious issue is that the Pakistan nuclear programs have been proliferated to Libya, North Korea and Iran.

Pakistan decided to acquire nuclear weapons due to competition with India. In the 1970s, Dr. A.Q. Khan stole enrichment technology from his workplace, URENCO, in the Netherlands to offer his services to his home country, Pakistan. A.Q. Khan has been described by the Pakistanis as 'the father of the Pakistani bomb.' Khan's mission was to provide Pakistan with capability to produce the enriched uranium required for an atomic bomb, for which Pakistani governments gave A.Q. Khan some extend of authority and autonomy.[38]

In January 2004, U.S. agents intercepted a German ship named the BBC China carrying parts for a Libyan nuclear-weapons-production program. Libya had named the Khan Research Laboratories of Pakistan as the supplier of the nuclear-weapons program. According to William Langewiesche, a national correspondent for *the Atlantic*, at about the same time, the Pakistani-run network had provided information and nuclear-weapons

[34] Bob Graham and others, *World at Risk [Electronic Resource]: The Report of the Commission on the Prevention of WMD Proliferation and Terrorism* (New York: Vintage Books, 2008), xxi.
[35] Cirincione, Wolfsthal and Rajkumar, *Deadly Arsenals: Nuclear, Biological, and Chemical Threats*, 490, 131.
[36] Graham and others, *World at Risk [Electronic Resource]: The Report of the Commission on the Prevention of WMD Proliferation and Terrorism*, xxi.
[37] Cirincione, Wolfsthal and Rajkumar, *Deadly Arsenals: Nuclear, Biological, and Chemical Threats*, 490, 239.
[38] William Langewiesche, "The Wrath of Khan," *The Atlantic Online* (November, 2005).

components to Iran and North Korea, and had begun negotiations with a fourth country, perhaps Syria or Saudi Arabia.[39]

In a written confession in 2004, Khan admitted to supplying North Korea with about 24 centrifuge machines together with sets of drawings, sketches, technical data and depleted uranium hexafluoride (UF6) gas. Khan also reportedly provided a 'shopping list' to the North Koreans, which enabled Pyongyang to purchase additional components directly from other foreign suppliers.[40] Successive Pakistani governments have insisted that their country's ballistic missile cooperation with North Korea was based on a cash payment, and that there was no official nuclear-for-missile technology exchange. Khan may have acted largely on his own volition, for profit. The broad cooperation between Pyongyang and Islamabad, however, is significant reason to suspect state complicity, at least in terms of having knowledge of and thereby implicitly condoning the centrifuge deal.[41]

Whatever reasons led Pakistani leaders to ignore, and in some cases possibly assist Khan's nuclear-related sales, the terrorist attacks on New York and Washington on 11 September 2001 dramatically changed the dynamic, forcing President Musharraf to ensure that his country was not on the wrong side of the United States. A robust control system is now in place to protect Pakistan's nuclear assets from diversion, theft and accidental misuse.[42] Pakistan passed new export-control legislation in 2004. The new law prohibits the diversion of controlled goods and technologies. The act also calls for the creation of an oversight board to administer export control regulations, enforcement of the act, and licensing for export and re-export of nuclear-related technology.[43]

2.1.3. Libya

After almost thirty years of trying to acquire nuclear weapons capabilities, Libya announced that it was abandoning its clandestine nuclear program on December 19, 2003. Libya's major nuclear facilities include a 10-megawatt light-water research reactor, supplied

[39] Ibid, 1.
[40] John Chipman, "Nuclear Black Market: Pakistan, A.Q. Khan and the Rise of Proliferation Networks," *The International Institute for Strategic Studies, London, Strategic Dossier* (2 May, 2007), 2.
[41] Ibid, 2.
[42] Ibid, 3.
[43] Cirincione, Wolfsthal and Rajkumar, *Deadly Arsenals: Nuclear, Biological, and Chemical Threats*, 490, 249-250.

by the Soviet Union in 1975, and a critical assembly. In 2003, Libya allowed international officials to inspect previously undisclosed nuclear sites and to remove key components of its nuclear weapons program.[44] In September 2004, after removing related nuclear equipment and highly enriched uranium and implementing verification mechanisms, President Bush lifted most remaining U.S. sanctions on Libya as a response.

Libya acquired centrifuge through various sources, including the A.Q. Khan network. The Khan network's business with Libya involved nuclear specialists, middlemen, and supplier companies from three continents. Libya wanted the Khan network to provide the entire enrichment process from start to finish. By the time of the Libya deal, the network had become a globalized supply chain.[45] Libya has developed a gas-centrifuge-based uranium enrichment facility. Libya also provided the IAEA (International Atomic Energy Agency) with documents related to the design and fabrication of a nuclear explosive device that were provided by the A.Q. Khan network. Libyan officials have told investigators that they bought the blueprints from dealers who are part of that network, apparently for more than $50 million.[46]

2.1.4. Iran

Iran has acquired considerable uranium-enrichment capabilities through the black market network run by A.Q. Khan. Pakistani centrifuges were shipped to Iran through a company located in Dubai in the United Arab Emirates, called the SMB Group. Khan's group also supplied Iran with used centrifuge components and designs. Again, Pakistan's government claims this was an unauthorized transfer of technology and expertise carried out by Khan and his associates.[47]

Iran also has made significant progress in its missile capabilities. Iran benefited from its collaboration with North Korea, having obtained both missiles and missile production capabilities form Pyongyang. Iran's continued links to terror groups, in combination with its

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[44] Ibid., 317.
[45] Chipman, *Nuclear Black Market: Pakistan, A.Q. Khan and the Rise of Proliferation Networks*, 2.
[46] Cirincione, Wolfsthal and Rajkumar, *Deadly Arsenals: Nuclear, Biological, and Chemical Threats*, 490, 323.
[47] Barry R. Schneider and Jim A. Davis, *Avoiding the Abyss : Progress, Shortfalls, and the Way Ahead in Combating the WMD Threat* (Westport, Conn: Praeger Security International, 2006), 430, http://www.loc.gov/catdir/toc/ecip069/2006006637.html; Materials specified: Table of contents http://www.loc.gov/catdir/toc/ecip069/2006006637.html., 28.

weapons of mass destruction programs, place that country in the center of U.S. regional concerns.

2.1.5. North Korea

North Korea poses two kinds of threat. One is from the missiles they could launch. The other is the nuclear bomb or technology they might sell to terrorists or radical regimes.

In 1961, North Korea began construction of a nuclear energy research complex. The Soviet Union provided a small research reactor at the site in 1965, and Pyongyang subsequently expanded the complex and built a number of new facilities, including a large plutonium reprocessing plant. In the mid-1990s, North Korea had produced one, possibly two, nuclear weapons. In mid-2002, U.S. intelligence discovered that North Korea had been receiving materials from Pakistan for a uranium enrichment facility.[48] North Korea's nuclear test of October 9, 2006, ended any doubt as to whether Pyongyang has developed nuclear weapons.

North Korea might have exported uranium hexafluoride, which can be enriched into weapons-grade nuclear material, to Libya in 2005.[49] North Korea also assisted Syria with a nuclear power plant on the Euphrates before Israel bombs destroyed it in September 2007. The Syrian power plant appeared to be a near-replica of North Korea's Yongbyon reactor.[50]

North Korea and Myanmar resumed diplomatic relations in 2007. In April 2008, Japan's public broadcaster NHK reported that Myanmar has been importing multiple-launch rockets from North Korea.[51] In Oct 2008, Asia Times Online reported that a number of high-level contacts between North Korea and Myanmar raised new concerns that North Korea might transfer nuclear-weapon capabilities to Myanmar.[52] According to Liana Sun Wyler, Analyst of CRS Report for Congress, observers claim that "Western intelligence officials have suspected for several years that the regime (Myanmar) has had an interest in

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[48] Cirincione, Wolfsthal and Rajkumar, *Deadly Arsenals: Nuclear, Biological, and Chemical Threats*, 490, 284-288.
[49] Kessler, *North Korea may have Sent Libya Nuclear Material, U.S. Tells Allies*
[50] Sokolski, *From Pyongyang with Love*.
[51] Liana Sun Wyler, Library of Congress and Congressional Research Service, *Burma and Transnational Crime* (Washington, D.C: Congressional Research Service, Library of Congress, 2007), http://bosun.nps.edu/uhtbin/hyperion-image.exe/CRS-RL34225.pdf; http://bosun.nps.edu/uhtbin/hyperion-image.exe/CRS-RL34225.pdf Note: (100 KB)., 12.
[52] Robespierre, *Nuclear Bond for North Korea and Myanmar*

following the model of North Korea and achieving military autarky by developing ballistic missiles and nuclear weapons."[53]

Pyongyang has produced short-range, medium-range and long-range missiles, and deployed about 175-200 long-range missiles. North Korea tested a long-range missile with a range of 4-6,000 km in 2006. The Paektusan-2 potentially has inter-continental range, but it failed after about 40 seconds of flight. It poses a direct threat to the continental U.S. In missile sales, North Korea has exported missiles, missile components, and technology to Egypt, Iran, Libya, Pakistan, Syria, and Yemen.[54]

Since 1980s, The U.S. Government considers North Korea as a Rogue state, which is threatening to the world's peace. In 2005, United States Secretary of State Condoleezza Rice described the governments of North Korea together with Belarus, Myanmar, Cuba, Iran, and Zimbabwe as outposts of tyranny.[55] In his State of the Union Address on January 29, 2002 , President Bush labeled North Korea, Iran, and Iraq "axis of evil" and accused them of helping terrorism and seeking weapons of mass destruction.[56] October 2002, the Central Intelligence Agency (CIA) concluded that Pyongyang was pursuing a uranium enrichment program.[57]

Potential sources for terrorist organizations to acquire nuclear weapons are summarized in figure 2.

[53] Wyler, Library of Congress and Congressional Research Service, *Burma and Transnational Crime*, 13.
[54] Cirincione, Wolfsthal and Rajkumar, *Deadly Arsenals: Nuclear, Biological, and Chemical Threats*, 490, 289-290.
[55] Condoleezza Rice, "Opening Statement in Senate Foreign Relations Committee," (January 18, 2005), 4.
[56] George W. Bush, "Presidential Determination on Major Drug Transit Or Major Illicit Drug Producing Countries for Fiscal Year 2007," *Presidential Determination* 71, no. 189 (September 29, 2006).
[57] Carin Zissis and Jayshree Bajoria, "The Six-Party Talks on North Korea's Nuclear Program," (2008); Ibid, 1.

Russia	Rumors about "suitcase bombs. Russia is cooperating with the U.S. to address common security threat.
Pakistan	Pakistan nuclear programs have been proliferated to Libya, North Korea and Iran.
Libya	Libya stopped and dismantled its nuclear weapons programs in 2003.
Iran	Iran has uranium enrichment programs and missile capabilities, but has not produced nuclear bombs as of Nov 2011.
North Korea	North Korea has plutonium and uranium enrichment programs, nuclear bombs, and missiles.

Figure 2 Potential Sources for Terrorist Organizations to Acquire Nuclear Weapons Summarized

2.2. Nuclear Black Market

On 5 March 1970, the Soviet Union and the United States, instituted the Nuclear Non-Proliferation Treaty to thwart nuclear proliferation. At that time, however, no one thought that proliferation could come from Arab countries, Africa, and South America. The treaty was aimed at dissuading the developed countries, such as Western Germany and Japan, from acquiring nuclear weapons, and it worked because they accepted the United States and Soviet nuclear umbrellas.[58] Now, the threats come from countries which might not accept the nuclear umbrellas and lack the willingness and abilities to control nuclear proliferation. India and Israel, which own nuclear weapons capability, have declined to sign the treaty; however, the two states, at least, have the willingness and abilities to secure their nuclear complexes.[59]

Although Pakistan has ensured that it will not be on the wrong side of the United States regarding counterterrorism, A.Q. Khan has supplied nuclear technologies to North Korea and Iran and increased risk of nuclear terrorism. There are concerns of further proliferating to other countries, which could complicate the possibility of nuclear proliferation to terrorists.

Some nuclear black market activity has been well documented by various sources, including the International Atomic Energy Agency and the press. Naturally, much of the open-source information concerning such clandestine activity is fragmentary or ambiguous.

[58] Langewiesche, *How to Get a Nuclear Bomb*, 2.
[59] Cirincione, Wolfsthal and Rajkumar, *Deadly Arsenals: Nuclear, Biological, and Chemical Threats*, 490, 221, 259.

In addition, some countries are reluctant to share information on illicit activities within their borders or involving their citizens. Therefore, information is too fragmentary to make a firm judgment.[60]

In order to circumvent increased controls on nuclear technology, the Khan network developed means to import necessary materials. Khan's techniques were replicated by other states, such as Iraq, Iran, and North Korea. These countries have engaged the private sector in nuclear technology to further a military program and relied on similar methods of black market procurement, including systematically using the country's foreign embassies, paying a premium over the market price, using multiple connections and buyers to search for a given item, using front companies, falsifying end users, and altering product specifications so they would appear to operate below the international guidelines. Iraq, Pakistan and Iran all made extensive use of free ports, some of which have since tightened controls, while others still have a long way to go.[61]

By reviewing the countries above, North Korea is at the critical node in the nuclear proliferation network and has been proliferating nuclear capabilities to other states. Iran is also pursuing nuclear weapons, although it has not yet acquired them as of November 2011. The proliferation from Pakistan remains concerned since it is a region, where terrorism and nuclear capability coexist. If threat of proliferation is not eliminated, the world will continue being at risk. Time is on the proliferators' side.

2.3. Types of Networks

Countries, such as North Korea and Iran, have already developed multiorganizational networks of the nuclear black market. In their networks, North Korea and Iran is likely to set up a set of diverse, dispersed "nodes". If any part of the networks is disrupted, others can reorganize a new network to replace the function.

The networks are flexible and difficult to detect and clarify, so interagency cooperation will be needed to identify, track, and stop the money and people that make up these networks.[62] John Arquilla and David Ronfeldt discussed countering networked threats

[60] Chipman, *Nuclear Black Market: Pakistan, A.Q. Khan and the Rise of Proliferation Networks*, 2.
[61] Ibid., 2.
[62] Andrew C. Winner, "The Proliferation Security Initiative: The New Face of Interdiction," *Washington Quarterly* 28, no. 2 (2005): 129-143,

in their book, *Networks and Netwars*, which introduces methodology for developing strategies to counter proliferation network. The international society may consider using their model to counter the proliferation networks. Arquilla categorizes networks to three types (see Figure 3): (1) the chain network, as in a smuggling chain where people, goods, or information move along a line of contacts, (2) the hub network, as in a franchise where a set of actors are tied to a central node, (3) the all-channel network, as in a collaborative network where everybody is connected to everybody else.[63]

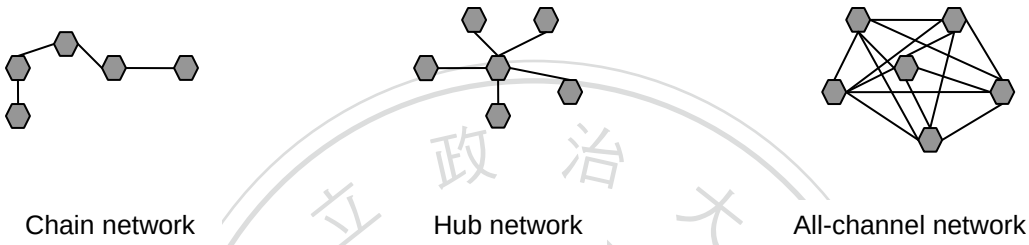

Figure 3 Three Basic Types of Networks

Each type may be suitable for different conditions and purposes. There may be hybrids of the three types, with different tasks being organized around different types of networks.[64] The proliferation network may have a hierarchical organization overall but use network designs for tactical operations in nuclear proliferation and illicit activities. These kinds of networks tend to challenge and cut across standard boundaries, jurisdictions, and distinctions between state and society, public and private, war and peace, war and crime, civilian and military, and legal and illegal. This makes it difficult for the international society to assign responsibility to any single agency to be in charge of responding.

Arquilla suggests three key principles of countering networked threats: (1) hierarchies have a difficult time fighting networks, (2) it takes networks to fight networks, and (3) whoever masters the network form first and best will gain major advantages. The principles depend partly on technological innovation, but mainly on a willingness to innovate organizationally, perhaps especially by building new mechanisms for interagency and

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http://search.ebscohost.com/login.aspx?direct=true&db=mth&AN=16382204&site=ehost-live, 139-141

[63] John Arquilla and others, *Networks and Netwars: The Future of Terror, Crime, and Militancy* (Santa Monica, CA: Rand, 2001), 375, http://www.rand.org/publications/MR/MR1382/; http://www.rand.org/publications/MR/MR1382/, 7-8.

[64] Ibid, 8.

multijurisdictional cooperation. It may require very effective interagency approaches, which involve networked structures. The challenge is to bring together the forms of hierarchy and network skillfully so that governments may become better prepared to deal with the new threats.[65] In addition, the counternetwork should extend to international cooperation in counter proliferation.

Many countries still lack laws and regulations to govern and control trade in nuclear-related goods and technologies, many of which are military and civil dual-use items. Lacking of resources further weakens the capability to control these sensitive items internationally. The international society might need to work with allies to ensure that they have (1) law enforcement and intelligence agencies trained and equipped to deal with nuclear smuggling cases; (2) mechanisms to prevent suspected countries from acquiring controlled materials, equipment, and technologies for developing nuclear weapons and programs; (3) effectively legislate related laws, and making any participation in smuggling of nuclear weapons or weapons-usable materials, or nuclear terrorism, control materials, crimes with penalties.[66]

[65] Ibid, 15-16.
[66] Matthew Bunn and others, *Preventing Nuclear Terrorism : An Agenda for the Next President* (Cambridge, Mass. ; Washington, D.C.: Harvard Kennedy School, Belfer Center for Science and International Affairs : [Nuclear Threat Initiative, 2008), http://belfercenter.ksg.harvard.edu/files/uploads/Preventing_Nuclear_Terrorism-An_Agenda.pdf; http://belfercenter.ksg.harvard.edu/files/uploads/Preventing_Nuclear_Terrorism-An_Agenda.pdf Note: Adobe Acrobat or other PDF file reader required., 5.

3. Evaluation of Export Control System

The continued possession and proliferation of WMD are undoubtedly among the gravest challenges that the international community are facing. A series of tools have been developed to manage these challenges. The international community set up treaties, such as the Nuclear Nonproliferation Treaty (NPT), the Chemical Weapons Convention (CWC), and the Biological Weapon Treaty (BWC), to universalize the formal and binding commitments by states not to acquire or develop WMD. In addition, specific countries organize arrangements, such as the Australia Group, Missile Technology Control Regime and the Nuclear Suppliers Group, to pursue to regulate trade in and transfer of most sensitive components and technologies as well as related dual-use goods. Export controls are tools on the supply-side of the counter proliferation strategy. They are designed to implement the obligation not to assist proliferators to acquire and develop WMD, which are found in major WMD treaties, while ensuring the flow of legitimate trade. Besides conventional military goods and technologies, WMD export controls manage the trade in dual-use items. The difficulty is to balance trade and security imperatives. The rapid growth in dual-use technology around the globe is redefining national interests and severely complicating national capabilities to regulate trade in sensitive commodities. Therefore, it is imperative to pursue the efficient and effective implementation of national nonproliferation export controls, while ensuring the responsiveness to new challenges.[67]

However, the effectiveness and efficiency of export control as a tool for preventing the proliferation of controlled technologies and weaponry has been called into question by globalization and international developments. Therefore, it is likely that export control policies and institutions need to be carefully studied.

3.1. What Are Export Controls?

Export control as a tool for combating weapons proliferation is usually neglected and misunderstood. Many government officials seem to believe that preventing the spread of WMD needs only that these weapons and materials be physically secured. They assume that groups or states seeking such weapons will try to acquire entire weapons systems. Although,

[67] Michael D. Beck and others, *To Supply or to Deny: Comparing Nonproliferation Export Control in Five Key Countries* (The Netherlands: Kluwer Law International, 2003), foreword.

this is a real concern, it is not typically how most states have acquired WMD. Actually, most proliferators purchase the components, equipment, and materials for such weapons, most of which have both commercial and military applications, are dual-use commodities. [68]

Almost all countries possessing and pursuing WMD have procured the necessary components, tools, and technologies from suppliers in other countries. The commodities for such weapons include commercial items, such as machine tools and aluminum alloy, which can be used for developing missiles. This implies that policy makers need to pay more attention to strengthening export control in order to impede efforts by states or terrorists to acquire the goods and technologies for developing WMD. Governments in key supplier states can improve monitoring and tracking exports of sensitive commodities. Regarding the capability of export control, first, export control can delay a country seeking WMD. Further, export control can buy time for political change or diplomatic pressure to solve the risk of WMD. Export controls can be used as a deterrent, which can raise the costs of developing WMD. Nevertheless, export controls support to strengthen international nonproliferation norms. However, there are things that export controls cannot achieve. Export controls, as supply-side strategies, are not a solution to the problem of counter proliferation. Given sufficient time and funding, a determined country will finally be able to procure commodities for developing WMD even if the export control mechanism is functioning well. Therefore, it needs other efforts, such as diplomatic and negotiation measures, to complement to reduce or eliminate the threat and demand of WMD.[69]

3.2. Key Elements of Export Control System

For better implementing data mining technologies, it is necessary to review the elements of export control. The key elements of export control include licensing system, control list, bureaucratic process, customs authority, catch-all clause, regime adherence, information gathering/sharing, verification, training, and penalties.[70]

Licensing System: A licensing system is a requirement for effective controls. Government authorities use licensing to regulate the transfer of sensitive goods and technologies. A licensing system consists of all the legal bases, institutions, and forms that serve to issue the export license. The export

[68] Ibid, 2-3.
[69] Ibid, 3-4.
[70] Ibid, 16-18.

law identifies the agencies involved in reviewing license requests and sets guidelines for issuances of licenses. Licensing systems consist of officials who receive and review export license requests from exporters. Licensing officers decide, sometimes consulting with others, whether to deny or permit a license request. In the licensing process, there should be evidence of licenses with information related to the potential export, which include the exporters, technical specifications of the product, destination of product, end-user, and quantity of the export.[71]

Control lists: Control lists define the products, materials, and technologies being controlled. Control lists regulate the technical specifications of items that need an export license. For effective nonproliferation export controls, countries should have control lists for nuclear, chemical, biological, missile, dual-use, and conventional weapons technologies and materials.[72]

Bureaucratic Process: The bureaucratic process of an export control system is comprised of the domestic agencies which are legally authorized to review the creation and implementation of export control policies. Legal documents should establish which government agencies are responsible for implementing export regulations. These agencies review the rules and procedures of the licensing system and the content of control lists and provide independent assessments. It is needed for more than one agency to be involved in the bureaucratic process to prevent from the abuse of power that could happen if one agency were the sole jurisdiction over issuance of export licenses. In addition, there should be a system to resolve disputes in order that disagreements can be resolved at a higher level of government.[73]

Customs Authority: The customs authority provides the state with the tangible device to do inspections to determine if goods are being illegally shipped into and out of the state and to stop the illicit shipment. By law, the customs authority should be clearly defined as part of a nonproliferation policy. Customs authorities should also have equipment, capability, and techniques to accomplish nonproliferation tasks.[74]

[71] Ibid, 16-17.
[72] Ibid, 17.
[73] Ibid, 17.
[74] Ibid, 17.

Catch-all Clause: A catch-all clause is the legal mechanism that forbids companies from evading export controls. Companies are prohibited to export goods if there is reason to believe that the end use of goods is for an unauthorized military use or for WMD. This mechanism is designed to prevent companies from providing goods to a weapons program by asserting that the goods being shipped are not listed in control lists. As such, a catch-all clause encourages companies who want to export certain types of goods to inquire the potential end-use of the goods.

Regime Adherence: Regime adherence is based on the participation of a country in the four principal export control regimes: the NSG (Nuclear Suppliers Group), the AG (Australia Group) on chemical and biological technologies, the MTCR (Missile Technology Control Regime), and the WA (Wassenaar Arrangement) on dual-use technologies and conventional weapons. Members of the regimes need to adopt a legal basis for adhering to the regime provisions, institutions to carry out the policies of the country with respect to the regime. Although some states are not members of the export control regimes, they do follow their guidelines.[75](Beck and others 2003)

Information Gathering/Sharing: In order to implement export controls effectively, government must share information on export requirements with industry. Governments should also cooperate with other regime members for gathering and sharing information on license denials and proliferation concern. Information gathering/sharing usually involves the intelligence services of the state. In addition, government provides industry outreach programs to promote export control development and assist industry in developing export compliance programs (ICPs).[76]

Verification: The verification element consists of the legal bases, offices and agencies, and rules and procedures to confirm that licensed goods are actually being used by the end-user, and at the actual location that was designated in the license. There are items in this element for effective verification, such as "import certifications" (exporter has to provide information on the importer), "delivery verifications" (did the designated importer actually receive the licensed export), and other forms of pre- and post-licensing investigation (such as post-shipment verification).[77]

[75] Ibid, 17.
[76] Ibid, 18.
[77] Ibid, 18.

Training: The Training element consists of the institutions which provide the training. Effective export controls rely on trained licensing and enforcement officials.[78]

Penalties: In order to have an effective system of export controls, governments must have laws for enacting criminal and civil penalties on violators. These penalties usually include confiscation of materials, revocation of exporting privileges, and jail sentences given to industry. Penalties may also involve a loss of foreign economic privileges for businesses.[79]

3.3. Taiwan Export Control Mechanism

Taiwan started to establish the system of Export Control on Strategic High-tech Commodities in 1990. In Feb 1993, the amended Foreign Trade Act included provisions in Article 13 to regulated export-control system. In 1994, the Regulation Governing Export and Import of Strategic High-tech Commodities was announced. In 1995, Taiwan officially implemented the Export Control on Strategic High-tech Commodities. Article 13 under Foreign Trade Act regulates (see Appendix 1):

> To ensure national security, fulfill international cooperation and agreements, enhance regulation of exportation/importation and flow of strategic high-tech goods, so as to facilitate the need of introducing high-tech goods, the exportation/importation of such goods shall comply with the following provisions:
>
> 1. No exportation is allowed unless otherwise authorized;
> 2. Where import permits are granted, no change of the importer or transfer to any third country or region is allowed unless otherwise authorized;
> 3. Intended use and end user shall be truthfully declared; no change is allowed unless otherwise authorized.
>
> Specific strategic high-tech goods transported to the restricted regions may not transit, transship or become stored in bonded warehouses, logistics centers and free ports via any commercial port of this country without authorization.[80]

[78] Ibid, 18.
[79] Ibid, 18.
[80] *Foreign Trade Act, Ministry of Economic Affairs, R.O.C.* Public Law Article 13, (2010): (accessed Nov 18, 2011).

All exporters who are exporting commodities either directly through manufacturers or through middlemen, such as export agencies, brokers, and wholesalers, are covered by the regulations.

3.3.1. Bureaucratic Process

The competent authority of Taiwan SHTC export control is MOEA (Ministry of Economic Affairs). The licensing authority is BOFT (the Bureau of Foreign Trade) and agencies designated by MOEA.

3.3.2. Control list

There are three categories in the control list of Taiwan Export Control as follows.[81]

1. Export commodities listed in the export control lists for Strategic High-tech Commodities, which include A. Community Regime for the Control of Exports of Dual Use Items and Technology; B. Common Military List of the European Union; C. Goods in Sensitive Commodity List being exported to North Korea and Iran.

2. Export commodities not in the control lists of the preceding item but could be used for producing or developing nuclear, chemical and biological weapons.

3. Imported strategic High-tech Commodities that are to be re-exported and issued an International Import Certificate or a relevant Written Assurance Certificate by the Bureau of Foreign Trade (BOFT) or the government authority (agency) appointed by the Ministry of Economic Affairs.

Taiwan export control specifies restricted areas in the regulation, which are Iran, Iraq, North Korea, Mainland China, Cuba, Sudan and Syria.

3.3.3. Licensing System

Exporters should verify whether export commodities are Strategic High-tech Commodities and whether importers, end-users, etc. are on the international or domestic blacklists (for example, US's Denied Persons List, Unverified List and Entity List, as well as that for violators of Taiwan Strategic High-tech Commodities Regulations). Exporters should list in the related transaction documentation or

[81] Bureau of Foreign Trade, Ministry of Economic Affairs, ROC, *Comprehensive Export Control on Strategic High-Tech Commodities*, 2011), 7.

sales contract with the importer, end-user, etc. that the commodities must not be used for the production or development of nuclear, chemical and biological weapons. Should exporters discover that an exported commodity might have been converted for military use during the transaction process or after-sale, they must immediately notify the BOFT thereof. Exporters should submit the application form and relevant documentation for a Strategic High-tech Commodities Export Permit according to the Regulations prior to exporting relevant goods.[82]

3.3.4. Customs Authority

Where export commodities are declared and identified as "no examination and no documents review", customs shall verify the export declaration after releasing cargo. Where export commodities are declared and identified as "document review and no examination", customs shall verify documents before releasing cargo. Where export commodities are declared and identified as "documents review and examination", in addition to verification documents, customs shall open and examine container to determine whether export commodities comply with export declaration as per the document review. Where no evidence exists that regulations have been violated, customs shall obtain a photographic record or retain samples of export commodities and release them. Exporters would be requested to submit any relevant documents, i.e. affidavit, product catalogue, contract agreement, etc., to the SHTC Verification and Investigation Task Force for follow-up review.[83]

3.3.5. Verification

Taiwan export control system also adopts the management of verification, which is authorized to conduct pre-shipment and periodic post-shipment investigation and to check details of suspicious export records. In suspicious cases, exporters are required to provide detailed information of the suspected export commodities: product specifications, quantity, amount, exporter's name, address, document etc.[84]

3.3.6. Penalties

Foreign importers and end users, who acquire commodities exported from Taiwan for military use without authorization by the BOFT, will be put on the export control blacklist.

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[82] Ibid.
[83] Ibid.
[84] Ibid.

If Strategic High-tech Commodities are exported to a restricted region (Iran, Iraq, North Korea, Mainland China, Cuba, Sudan and Syria) without authorization, the exporter may face the following penalties:

> For violations referred to in Article 27 of the Foreign Trade Act, an exporter may be punished with imprisonment for not more than 5 years, detention or in lieu thereof or in addition thereto a fine of not more than NT$ 1,500,000.
>
> For violations referred to in Article 27-1 of the Foreign Trade Act, the BOFT may suspend the violator from exporting, importing or exporting/importing goods for not less than one (1) month but no more than one (1) year, or revoke the violator's exporter/importer registration.
>
> Where Strategic High-tech Commodities are exported to a non-restricted region without authorization, the exporter may face the following penalties:
>
> For violations referred to in Article 27-2 of the Foreign Trade Act, the BOFT shall impose an administrative fine of not less than NT$30,000 but not more than NT$300,000, or suspend the violator from exporting, importing, or exporting/importing goods for not less than one (1) month but not more than one (1) year, or revoke the violator exporter/importer registration.[85]

3.4. Information Sharing-US Example

Data preparation is essential to data mining process. Before selecting data mining tools for the purpose of export controls, it is needed to review how information is gathered and shared in a system of export controls. As one of the most open societies in the world, the US government makes its laws, regulations, and much of its policies available to the public in a variety of forms, so it is practical to take US export control as an example to review the information process.

US Federal Register regularly updates the followings, entries and modifications of the EAR (Export Administration Regulations), the ITAR (International Traffic in Arms Regulations), the Commerce Control List, the Denied Persons list, the Specially Designated Terrorist List, the Entities list, etc. The Office of Export Enforcement at Commerce also publishes a press release on its enforcement actions, which is important in deterring export control violations. Likewise, Congressional hearings and debate on the EAA (Export Administration Act) almost always open to the public, which are later published in the Congressional Record. Official reports and studies on export controls usually

[85] Ministry of Economic Affairs, R.O.C., *Foreign Trade Act, Ministry of Economic Affairs, R.O.C.*

have unclassified versions, which are widely available through the Internet, the network of Federal Depository Libraries, the Government Printing Office, and other facilities. [86]

The United States acts as a global leader in providing information to governments in Asia, Europe, and Latin America on export controls. In addition to its participation in the multilateral supplier groups, the United States maintains formal bilateral consultations on export controls with many countries, including Japan, EU, China, and Russia.[87]

With supreme range of national technical means and intelligence resources, US is able to contribute to multilateral export control efforts widely. Through its intelligence resources, the United States identifies and monitors procurement activities of sensitive end-users around the world. US officials often share this information with their counterparts in other countries. The United States shares licensing information, especially on license denials. For instance, the United States provided the electronic denial sharing system, which is an essential infrastructure, for in the Nuclear Suppliers Group. US Customs also works with other national customs services through mutual legal assistance treaties with more than 20 countries. International cooperation plays a crucial role in whole enforcement efforts.[88]

3.5. Export Control Challenges

It is often that exporters complain money allegedly lost due to licensing systems. Licensing delays and uncertainties remain a problem for a percentage of export transactions. Shipping delays impose costs on the exporter and may damage customer confidence.[89] Globalization has introduces challenges to efforts to export control. It has included the emergence of increasing numbers of global corporations with no national obligations. The volumes of dual-use trade are increasing. In addition, growing numbers of international suppliers create extra pressures for governments to approve problematic exports. Therefore, states face the difficult task of weapons proliferation, while taking into account globalization of market.[90]

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[86] Beck and others, *To Supply or to Deny: Comparing Nonproliferation Export Control in Five Key Countries*, 58.
[87] Ibid, 58.
[88] Ibid, 58-60.
[89] Heinz, *U.S. Strategic Trade: An Export Control System for the 1990s*, 170, 26.
[90] Beck and others, *To Supply or to Deny: Comparing Nonproliferation Export Control in Five Key Countries*, 10.

In addition to regulating exporters, it is necessary for the government to ensure that third parties involved in foreign trade, such as brokers and freight forwarders, should be educated on export requirements. In recent years, the number of trade facilitators, brokers and freight forwarders has grown steadily. These third parties are able to undermine international counter-proliferation efforts if they assist suspect actors to obtain sensitive items.[91]

In developed economies, the private sector has substituted the State to take the leading role of technological innovation and market expansion, especially in dual-use technologies. The markets for civilian uses of these technologies are global in scope and legitimate. Government attempts to control these items often encounter objections from the private sector and receive complaints of that the foreign policy for such controls is poorly defined. Domestic economic interests are concerned because industry must absorb the costs of compliance with national export control requirements. Exporters of dual-use items regularly complain that government export control licensing is needlessly bureaucratic and time consuming. If a country is experiencing economic setback, government authorities may face pressures from exporters asking for liberalizing trade restrictions. In such circumstances, government officials may consider economic imperatives in advance of security concerns when they consider license requests. [92]

[91] Ibid, 11.
[92] Ibid, 12.

4. Data Mining Solution

After evaluating current proliferation situation and export control systems, the thesis will attempt to develop a data mining solution to improve export control mechanism by selecting a proper data mining tool and use it to develop methodologies to increase the effectiveness and efficiency in screening problematic cased from export licensing and customs inspection.

4.1. What is Data Mining?

First, we need to ask some basic questions. What is data mining? What can data mining technologies provide to improve the management of export control?

Let us review some basic facts about data mining. Many organizations have allocated a lot of resources to the construction and maintenance of large information databases. In many cases, the data cannot be analyzed by normal statistical methods because there are many missing records or the data are in the form of qualitative measures. Because the data cannot be easily accessed or analyzed, the information in these databases is undervalued and underutilized. Some databases have developed so large that even the system administrators do not know what information might be represented or how relevant it might be to the questions at hand. It would be helpful to organizations to have a way to excavate these large databases for important information or patterns that may be contained within.[93]

Data mining is an iterative process. First, the process starts by evaluate the overall picture of the raw data. Then, the data are modeled and analyzed to discover information contained in the data. Based on the discovery of patterns, there may be subsequent resampling of the data set, and so forth. Data mining may take place within a single data source or across multiple databases. It is important to adopt a flexible approach to make discoveries. There are many technologies and tools available for data mining applications. However, the tools alone will not provide the entire solution. It is needed for the user to make decisions regarding how these systems will be used.[94]

Data mining is widely used in industries such as retailing, manufacturing, telecommunications, health-care, insurance, and transportation to discover new purchasing

[93] Westphal and Blaxton, *Data Mining Solutions: Methods and Tools for Solving Real-World Problems*, 617, 5-6.
[94] Ibid, 6.

trends, plan investment strategies, and detect unauthorized expenditures in accounting system. Many law enforcement and intelligence units also used data mining to identify fraudulent activities and discover crime trends.[95]

Regarding the nature of export control, which data mining tools are suitable for providing a solution in improving export control? What are the currently available data mining tools and their applications?

4.2. Evaluation of Current Data Mining Technologies

There are a variety of commercial tools available. The thesis will review data mining tools which are potentially proper to be implemented in export control including the following categories, link analysis tools, landscape visualization tools, and quantitative data mining tools.

4.2.1. Link Analysis

Link analysis is the process of building up networks of interrelated entities so that we can discover patterns and trends. Link analysis uses entity to entity associations to construct networks of connections from data sources. By visually displaying relationships among entities, we are able to get an entirely different picture on the analysis of data and the discovery of patterns. Link analysis methods were originally used in law enforcement fields, but they have recently been used in a wide variety of commercial applications. One potential weakness of link analysis is that the total number of data records that can be shown in the diagrams is sometimes limited, comparing to the other visualization tools. Therefore, the analyses usually focus on analyzing subsets of large data sets. However, link analysis provides a powerful means of performing visual data mining, such as layout options, filter assessments, and presentation formats, to identify patterns, emerging groups, and generational connections quickly. A variety of tools are available for link analysis that support visualization of data that show links or relationships between individual entities, for example, NETMAP, Analyst's Notebook, Imagix 4D, and Daisy.[96]

[95] Ibid, 7.
[96] Ibid, 201-202.

4.2.2. Landscape Visualization Tools

The second class of visualization tools is landscape visualization tools, which use landscape visualization schemes to support data analysis. An important feature of landscape visualizations is that the relative positioning of data elements within the geometric terrain is used to represent important information of the analysis. Landscape visualization systems usually use abstract representations in interactive 3D virtual environments to show large size of data. Landscapes can be used effectively in discovering high-level trends in complex data sets by navigating and visually positioning. Some of the tools also support real-time applications. The most fully developed and fielded systems currently available in the commercial market include MineSet 2.0, Metaphor Mixer, In3D, and other similar tools.[97]

4.2.3. Quantitative Data Mining Tools

Quantitative data mining tools are chosen and often required when we need to find estimates of significance or reliability in a statistical sense. Moreover, quantitative analyses can provide summary information about overall group differences and trends of large data sets. It is not necessary to have numeric data in order to conduct quantitative analyses. Instead, we can create quantitative descriptors of qualitative data to create variables or count information. Quantitative diagrams can handle extremely large size of data. The diagrams of most quantitative data mining tools are capable of clustering, summarization, and range comparisons. There are many quantitative data mining systems on the market, including Clementine, Enterprise Miner, Diamond, and CrossGraphs.[98]

4.3. Selection of a Proper Tool

The purpose of export control is to prevent proliferators from acquiring commodities for producing WMD, so the export control mechanism is expected to be capable of detecting problematical shipments from ordinary exports. Landscape visualization tools are capable in getting a general picture of the data sets and discovering trends and patterns, but detecting odds from a whole data set might not be their strength.

[97] Ibid, 265.
[98] Ibid, 319.

Quantitative data mining tools are able to detect problematic entities from a group. They are widely used in business such as banking to evaluate the risk of default of a loan or the likelihood that a credit card account will default, so it seems quantitative analysis, such as Clementine, can be applied to export control. However, the quantitative methods tend to be statistical and need a large quantity of sample data set to establish models for better prediction while the number of violation cases of export control is apparently not enough to build such models.

Link analysis is capable of discovering associations from data sources and originally used in law enforcement fields. Link analysis tools have been applied to trace money laundering and credit card fraud, so they should be suitable to screen problematical shipment from the whole export activities. By trying to use a link analysis tool, the thesis will take a qualitative approach rather than quantitative methods to solve the problem in export control. Since Analyst's Notebook is one of the widely used tools among private and public sectors, so the thesis attempts to apply it to the management of export control.

4.4. Sample Case--A. Q. Khan Proliferation Networks

Before trying to implementing data mining solution, the thesis choose A. Q. Khan proliferation networks, whose techniques are replicated by other proliferators, as a sample case to review how the proliferators conduct their procurement activities so that we can develop adequate methodologies to discover implicit signs of proliferation activities.

The Khan network was exposed to the public in 2003. It was a transnational organization. The key providers of the necessary technology and several of the network's leaders, including Khan, were located in Pakistan. Other leaders were all over the world, including in Switzerland, the United Kingdom, the United Arab Emirates, Turkey, South Africa, and Malaysia. The network also procured goods from innocent manufacturing companies and suppliers in many countries. It sold centrifuges, which are critical components for uranium enrichment.[99]

Libya tried to acquire nuclear weapons capabilities from Khan's network in the 1990s, but announced that it was abandoning its clandestine nuclear program on December 19, 2003

[99] David Albright and Corey Hinderstein, "Unraveling the A. Q. Khan and Future Proliferation Networks," *THE WASHINGTON QUARTERLY* 28:2 (SPRING 2005): 111-128., 114-115.

due to international interdiction on the German vessel BBC China. In the case, the network focused on producing centrifuge components outside of Pakistan. The Libyans placed an order for 10,000 centrifuges. Because each centrifuge has roughly one hundred different components, this order translates into a total of about one million components. Therefore, Khan network involved a lot of technical experts, companies, suppliers, and workshops. The workshops contracted to manufacture components for the network typically imported the necessary items, such as metals, equipment, or subcomponents. After the item was produced, they would send it to Dubai under a deceitful end-user certificate, where it would be transferred to Libya. Nuclear components designed in one country could be produced in another country, shipped through a third country, assembled in a fourth country, and designated for eventual end-use in a fifth country. Many of the conduits may have appeared to be legitimate users. It was found in Libya there were at least a half-dozen workshops, which were making centrifuge components, across Africa, Asia, and the Middle East. The most publicly known facility, Scomi Precision Engineering in Malaysia, made stationary aluminum components and was the source of 15 percent of the total number of components destined for Libya. Workshops in Turkey imported subcomponents from Europe and elsewhere to assemble other parts of the centrifuges, including centrifuge motors, power supplies, and ring magnets. Tradefin Engineering in South Africa produced the equipment needed to insert and withdraw the uranium hexafluoride gas that is enriched in centrifuges. At some point, Libya may have changed its initial plan and instead planned to build the components itself. Libya also ordered from the network a sophisticated manufacturing center to produce centrifuge components. Most of the equipment was from Europe, particularly from or through Spain and Italy, and was sent to Libya via Dubai.[100]

Members of the network even knew how to evade strict European export control systems to obtain necessary parts, raw materials, machine tools, and other equipment. The network arranged complicated transportation arrangements and supply chain to conceal the true end use of the item and the final destination of its products. The international free zone in Dubai, which is still lack of meaningful export controls, was a major transferring point to the network. Most items found in Libya were transported through Dubai.[101]

[100] Ibid, 115-116.
[101] Ibid, 120.

To sum up, the techniques used by the network include using multiple connections and buyers to search for a given item, using front companies, falsifying end users, and altering product specifications to evade export control.

4.5. Implementing Data Mining Solution to Export Control

How can we use the data mining tools to establish methodologies and models in the management of export control? Firstly, we need to define the problems to be solved. Secondly, it is required to decide which data sets can be accessed and prepared accordingly. Then, the data sets will be processed and analyzed with link analysis tools.

4.5.1. Defining the Problem to Be Solved

Because of that Licensing delays and uncertainties remain a problem for export transactions and that shipping delays impose costs on the exporters, it would be helpful to develop a way to increase the coerciveness and accuracy of detecting problematical shipments from ordinary export activities. By using Analyst's Notebook, the thesis attempts to establish a methodology to improve the management of export control.

4.5.2. Accessing and Preparing the Data

There are databases available among agencies, including export control licensing applications, customs clearance applications, violation records, sanction lists and black lists published internationally, for example, Specially Designated Nationals List, a list compiled by the U.S. Treasury Department. It is the best to incorporate all the data sets into the same database and update regularly for comprehensive outcome of analysis. It is feasible either that each agency maintain its own database or that all agencies share the same database. The key of successful implementation of this kind of link analysis is to include violation records and black lists in the major database.

4.5.3. Defining Entities and Linkages

The fundamental element of link analysis is defined by two entities and the linkage between them, which accumulate the database of business connections. The purpose of link analysis is to excavate implicit associations from explicit linkages in the database in order to discover shipments that have proliferation concerns.

For link analysis in export control management, the entities include person, shipper (supplier), consignee (buyer), telephone number, address, end user, etc., and the types of linkages include transaction of commodities, member of a company, telephone number and/or address owned by a company and/or a person. For analysis purpose, we add attributes to an entity or a link. The destination is an important attribute to distinguish restricted area from ordinary countries. The entities on the black list of export control are critical leads to discover proliferators, so we also add attributes to them in order to make a distinction from ordinary entities (see figure 4).

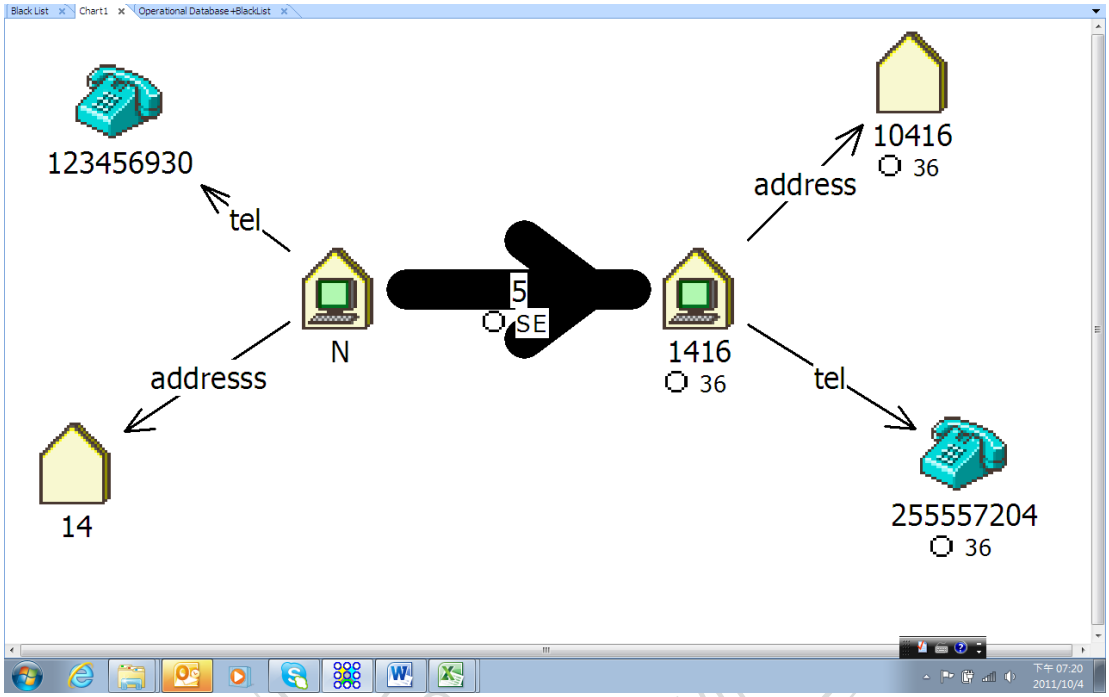
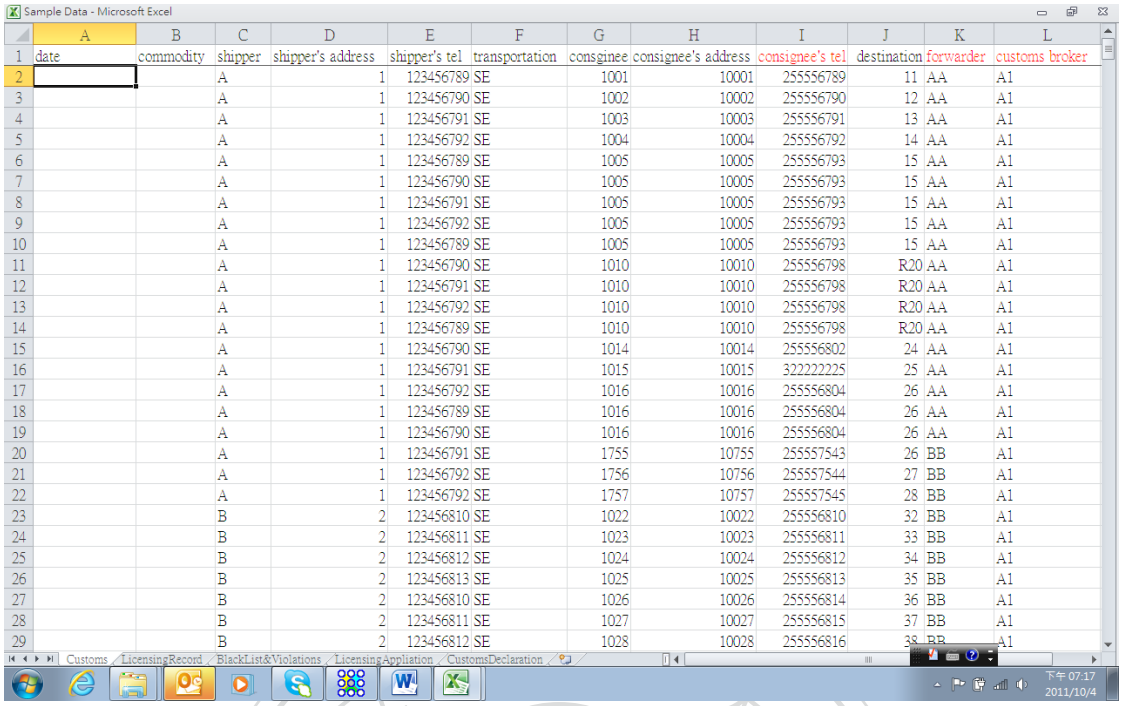


Figure 4 Basic Elements of Link Analysis

We can obtain the data sets from export/import records, export control licensing records, sanction lists, and black lists to establish export control databases. The different interfaces among currently available databases can be overcome by using software, such as iBase and iBridge, to incorporate them. Instead of using government data, which is restricted, the thesis arbitrarily generates entities and linkages to simulate the datasets of the real customs and licensing records (see figure 5, 6, 7). The records consist of columns, such as shipper, shipper's address, shipper's telephone number, transportation, consignee, consignee's address, consignee's telephone number, destination, forwarder, customs broker, and end user.


Sample Data - Microsoft Excel

	A	B	C	D	E	F	G	H	I	J	K	L
1	date	commodity	shipper	shipper's address	shipper's tel	transportation	consginee	consignee's address	consignee's tel	destination	forwarder	customs broker
2			A	1	123456789	SE	1001	10001	255556789	11	AA	A1
3			A	1	123456790	SE	1002	10002	255556790	12	AA	A1
4			A	1	123456791	SE	1003	10003	255556791	13	AA	A1
5			A	1	123456792	SE	1004	10004	255556792	14	AA	A1
6			A	1	123456789	SE	1005	10005	255556793	15	AA	A1
7			A	1	123456790	SE	1005	10005	255556793	15	AA	A1
8			A	1	123456791	SE	1005	10005	255556793	15	AA	A1
9			A	1	123456792	SE	1005	10005	255556793	15	AA	A1
10			A	1	123456789	SE	1005	10005	255556793	15	AA	A1
11			A	1	123456790	SE	1010	10010	255556798	R20	AA	A1
12			A	1	123456791	SE	1010	10010	255556798	R20	AA	A1
13			A	1	123456792	SE	1010	10010	255556798	R20	AA	A1
14			A	1	123456789	SE	1010	10010	255556798	R20	AA	A1
15			A	1	123456790	SE	1014	10014	255556802	24	AA	A1
16			A	1	123456791	SE	1015	10015	322222225	25	AA	A1
17			A	1	123456792	SE	1016	10016	255556804	26	AA	A1
18			A	1	123456789	SE	1016	10016	255556804	26	AA	A1
19			A	1	123456790	SE	1016	10016	255556804	26	AA	A1
20			A	1	123456791	SE	1755	10755	255557543	26	BB	A1
21			A	1	123456792	SE	1756	10756	255557544	27	BB	A1
22			A	1	123456792	SE	1757	10757	255557545	28	BB	A1
23			B	2	123456810	SE	1022	10022	255556810	32	BB	A1
24			B	2	123456811	SE	1023	10023	255556811	33	BB	A1
25			B	2	123456812	SE	1024	10024	255556812	34	BB	A1
26			B	2	123456813	SE	1025	10025	255556813	35	BB	A1
27			B	2	123456810	SE	1026	10026	255556814	36	BB	A1
28			B	2	123456811	SE	1027	10027	255556815	37	BB	A1
29			B	2	123456812	SE	1028	10028	255556816	38	BB	A1

Customs / LicensingRecord / BlackList&Violations / LicensingAppliation / CustomsDeclaration

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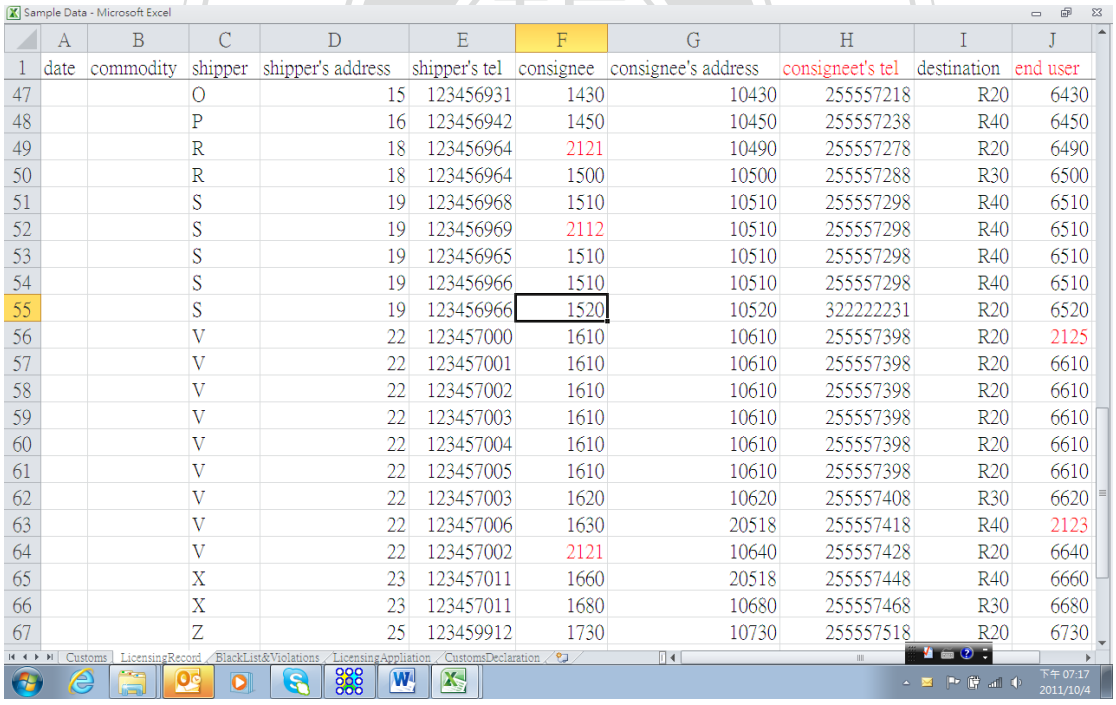
Figure 5 Data Sets of Customs Records.


Sample Data - Microsoft Excel

	A	B	C	D	E	F	G	H	I	J
1	date	commodity	shipper	shipper's address	shipper's tel	consignee	consignee's address	consigneet's tel	destination	end user
47			O	15	123456931	1430	10430	255557218	R20	6430
48			P	16	123456942	1450	10450	255557238	R40	6450
49			R	18	123456964	2121	10490	255557278	R20	6490
50			R	18	123456964	1500	10500	255557288	R30	6500
51			S	19	123456968	1510	10510	255557298	R40	6510
52			S	19	123456969	2112	10510	255557298	R40	6510
53			S	19	123456965	1510	10510	255557298	R40	6510
54			S	19	123456966	1510	10510	255557298	R40	6510
55			S	19	123456966	1520	10520	322222231	R20	6520
56			V	22	123457000	1610	10610	255557398	R20	2125
57			V	22	123457001	1610	10610	255557398	R20	6610
58			V	22	123457002	1610	10610	255557398	R20	6610
59			V	22	123457003	1610	10610	255557398	R20	6610
60			V	22	123457004	1610	10610	255557398	R20	6610
61			V	22	123457005	1610	10610	255557398	R20	6610
62			V	22	123457003	1620	10620	255557408	R30	6620
63			V	22	123457006	1630	20518	255557418	R40	2123
64			V	22	123457002	2121	10640	255557428	R20	6640
65			X	23	123457011	1660	20518	255557448	R40	6660
66			X	23	123457011	1680	10680	255557468	R30	6680
67			Z	25	123459912	1730	10730	255557518	R20	6730

Customs / LicensingRecord / BlackList&Violations / LicensingAppliation / CustomsDeclaration

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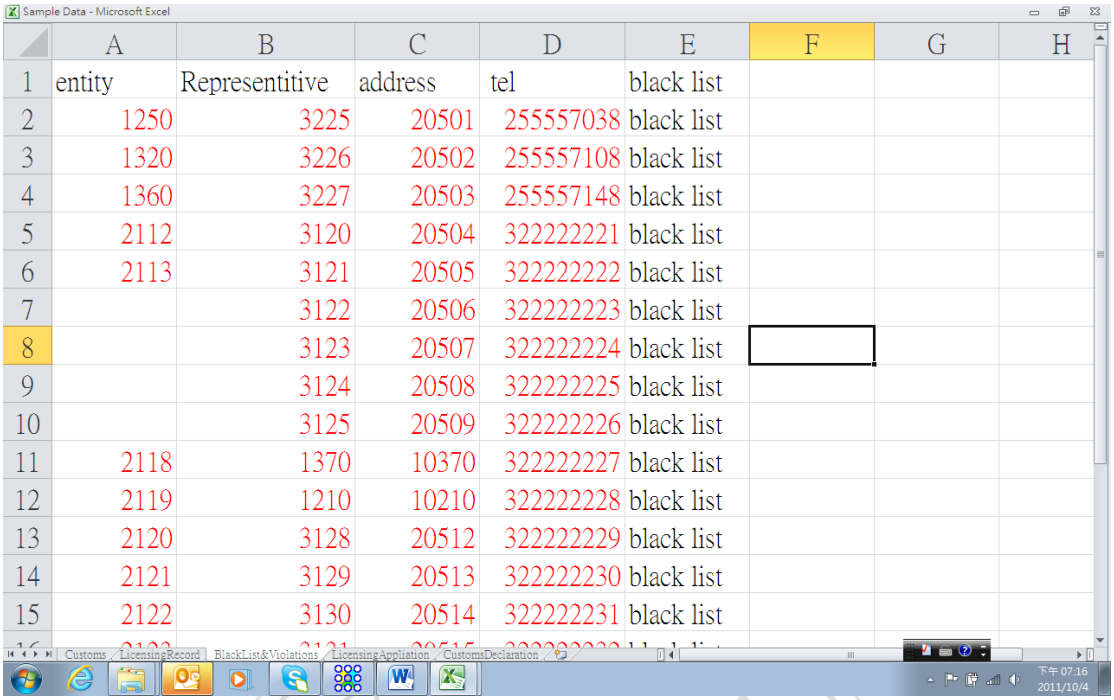
Figure 6 Data Sets of Licensing Records.



	A	B	C	D	E	F	G	H
1	entity	Representitive	address	tel	black list			
2	1250	3225	20501	255557038	black list			
3	1320	3226	20502	255557108	black list			
4	1360	3227	20503	255557148	black list			
5	2112	3120	20504	322222221	black list			
6	2113	3121	20505	322222222	black list			
7		3122	20506	322222223	black list			
8		3123	20507	322222224	black list			
9		3124	20508	322222225	black list			
10		3125	20509	322222226	black list			
11	2118	1370	10370	322222227	black list			
12	2119	1210	10210	322222228	black list			
13	2120	3128	20512	322222229	black list			
14	2121	3129	20513	322222230	black list			
15	2122	3130	20514	322222231	black list			

Figure 7 Data Sets of Black Lists.

4.5.4. Data Processing

In order to demonstrate the process of link analysis, the thesis uses importing function of Analyst's Notebook to generate link charts from the data sets. Firstly, it begins with establishing a link chart (see figure 8 and figure 9) by importing the data from customs records, licensing records, and black lists. The link chart gives us a full picture of how the entities connected to each other. In the chart, there are 3,487 items, consisting of 1,697 entities and 1,790 links, generated.

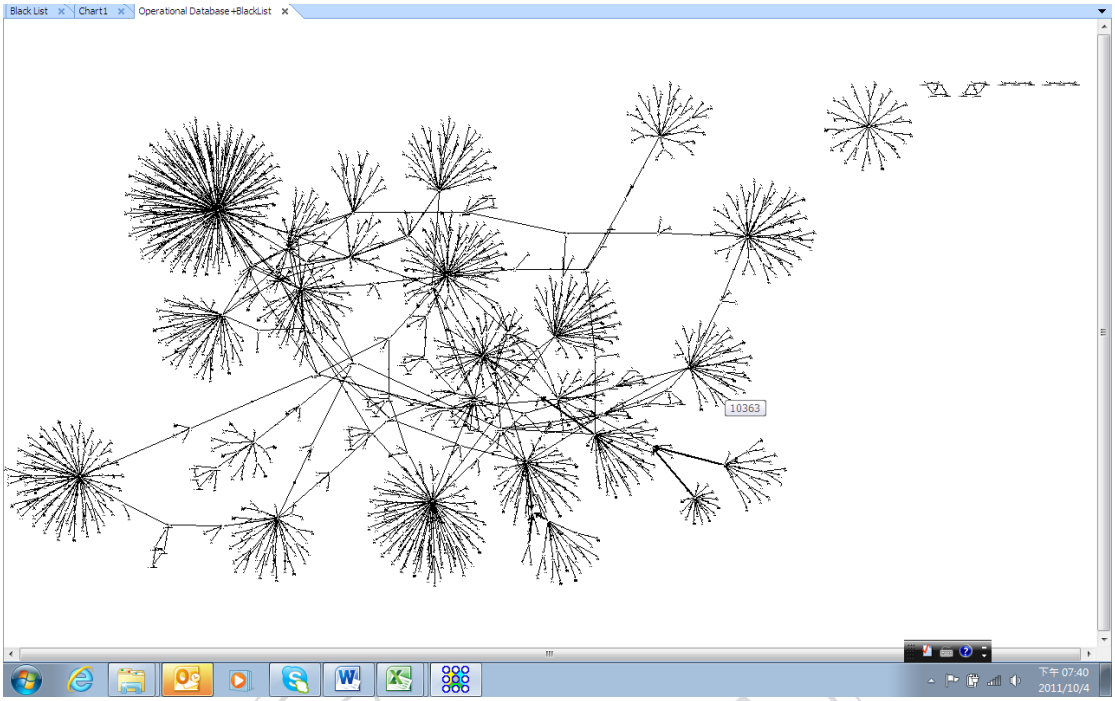


Figure 8 The Full Picture of the Data Sets

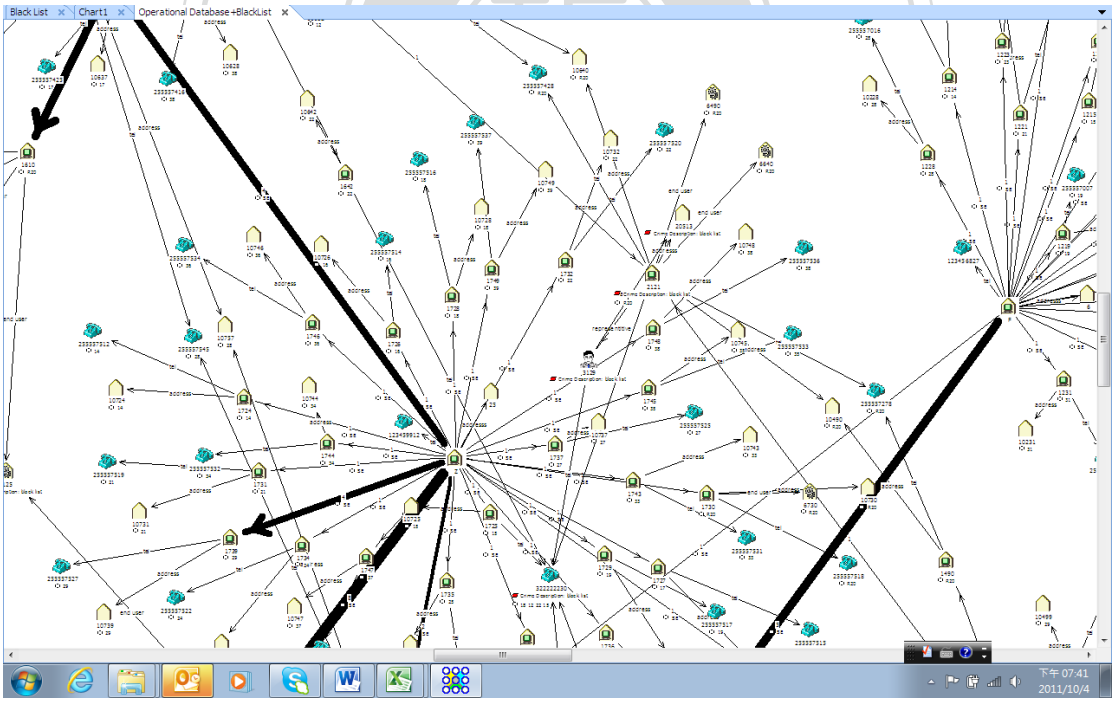


Figure 9 Zoom-in of the Full Picture of Data Sets

4.5.5. Link Analysis

4.5.5.1. Overall Analysis

Once we have populated the chart of all data sets that currently available, we can conduct an overall analysis to excavate information hidden in the webbed business transactions and connections. First, we extract the close associations of the blacklist entities by searching entities linked in one layer of depth and analyze the filtered entities (see figure 10).

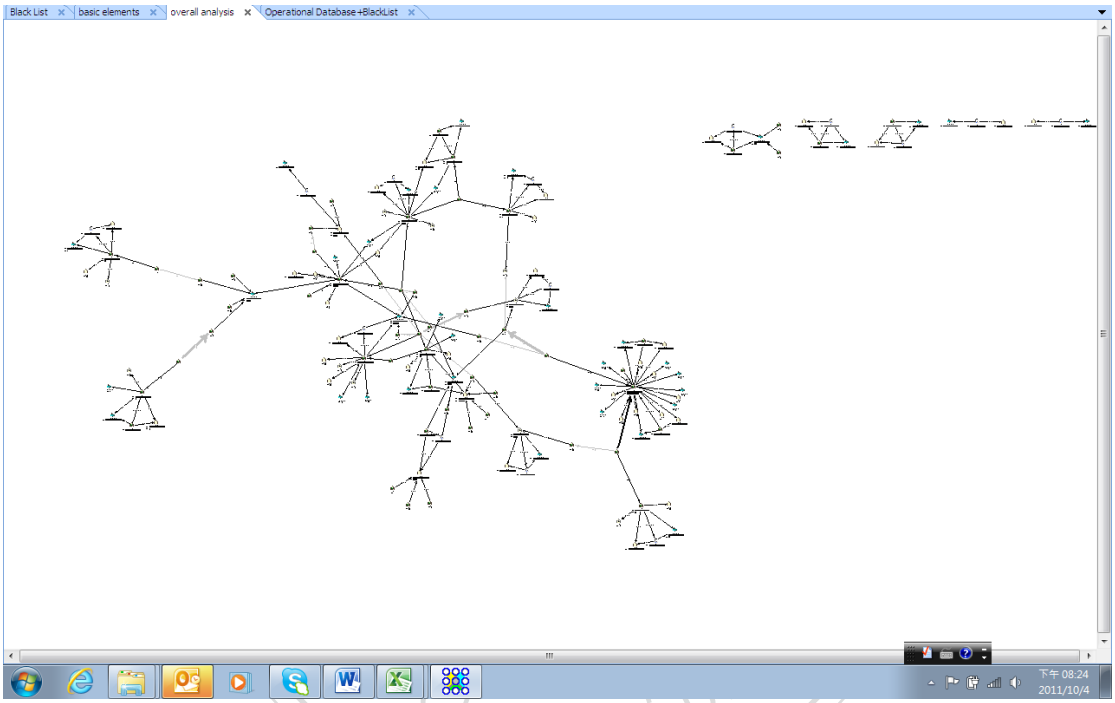


Figure 10 Find Linked Entities

The first piece of information that we found is that some entities own the same addresses or telephone numbers. For example, Company 1031 and company 1062 own telephone number 322222233, which is also owned by company 2124 on the black list. This indicates that Company 1031 and company 1062 are highly possible front-companies used by proliferators (see figure 11).

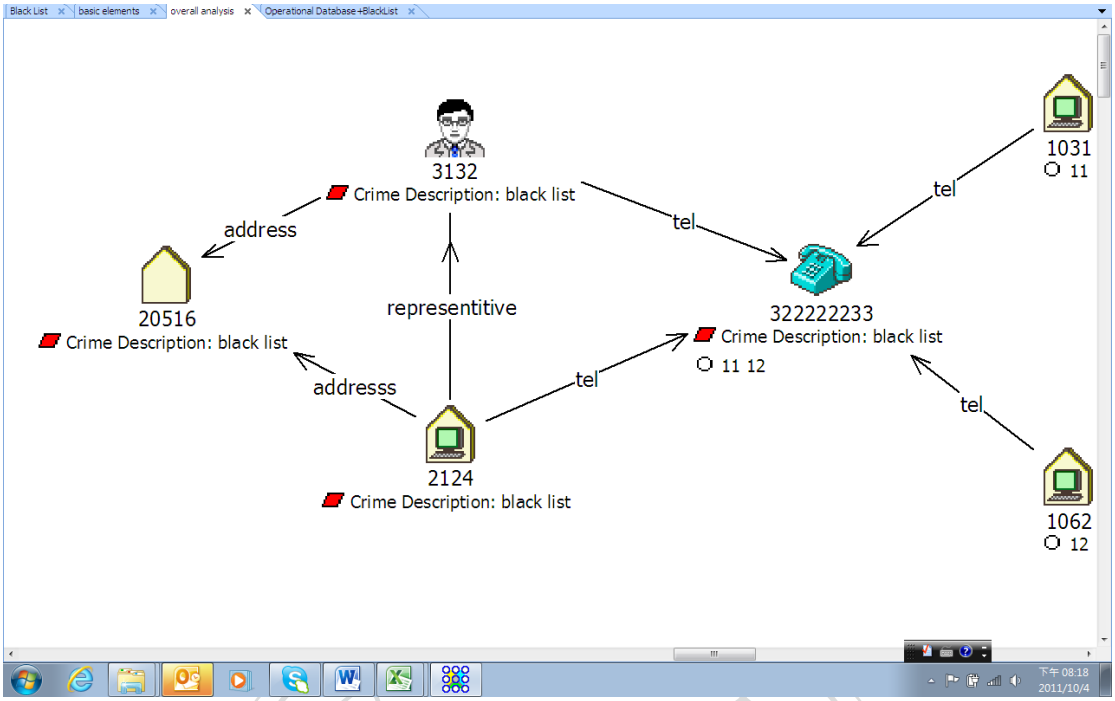


Figure 11 Entities Own the Same Telephone Number

Company 1005, company 1302, and company 1387 have the same address 20154, which is also owned by a blacklist company 2122 (see figure 12). This also indicates that three companies 1005, 1302, and 1387 are used as front companies or brokers by the proliferators.

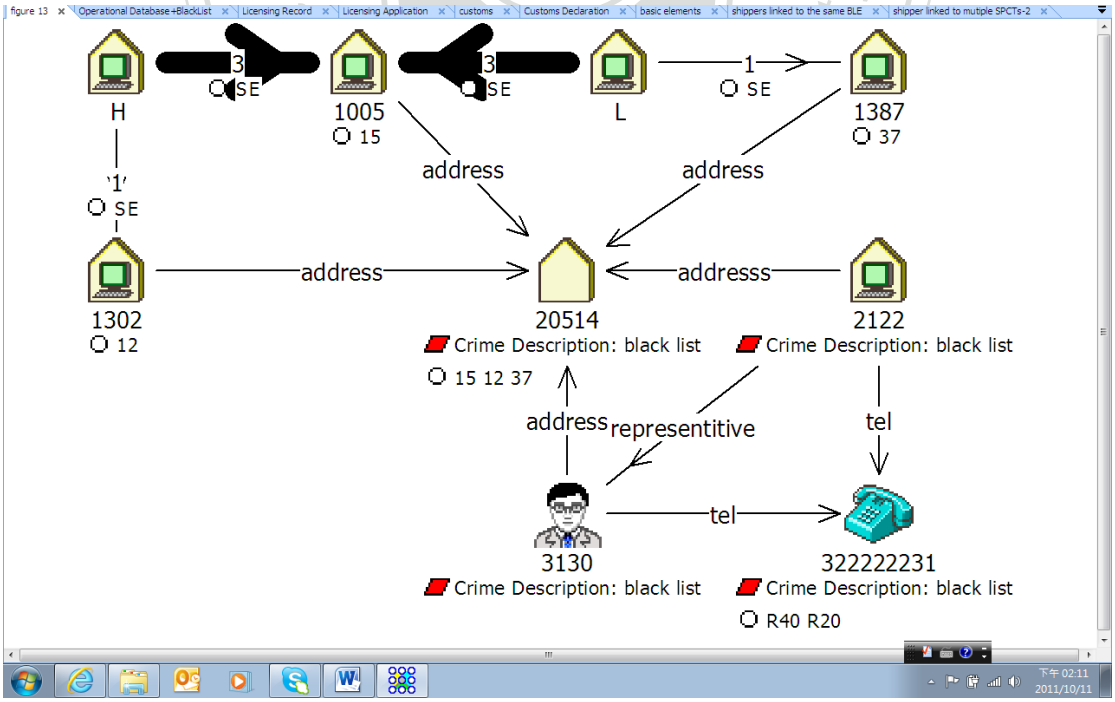


Figure 12 Companies Share the Same Address.

Next, it is found that there are end users linked to blacklist entities. For example, end user 6250 is declared by the consignee 1250, a blacklist entity, as the end user of the shipment, so this suggests that end user 6250 is also an entity of proliferation concern (see figure 13).

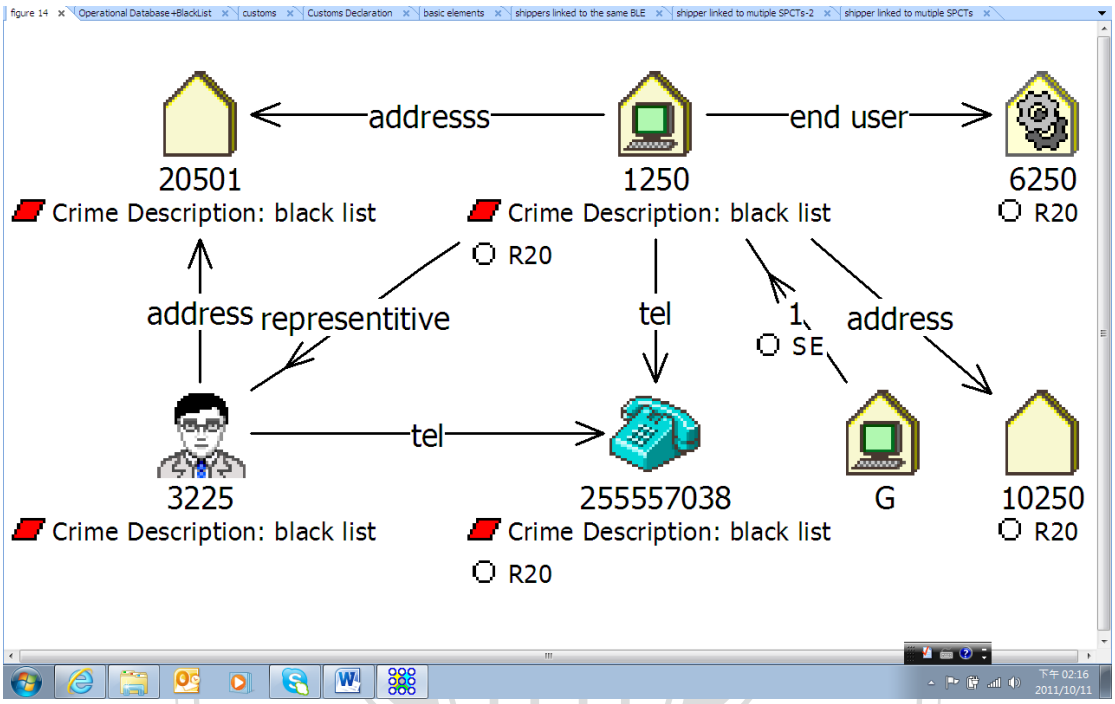


Figure 13 End User Linked to a Blacklist Entity.

Proliferators usually use some major procurement agents to deal with suppliers. In figure 14, it indicates representative 3121 is a key procurement agent since the representative is linked to multiple entities of telephone numbers, addresses, suppliers, and buyers. It represents the hub network extracted from an all-channeled network in the real world. This also implies that proliferators change front companies from time to time to circumvent export control. Therefore, it is critical to identify the key nodes formed by the major procurement representatives and trade brokers in the networks.

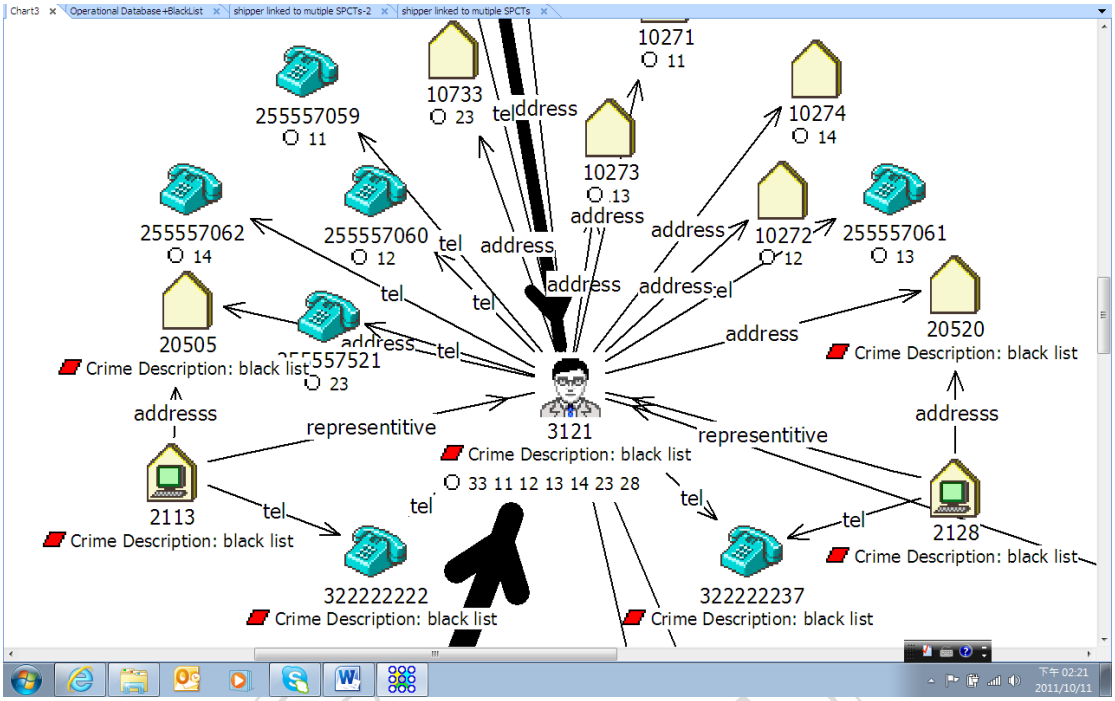


Figure 14 A Representative Linked to Multiple Entities.

By filtering the links to shippers, there are some shippers linked to multiple suspicious entities. For example, shipper Z link to representative 3121, company 1750, and company 1725, which are either a blacklist entity or linked to blacklist entities directly (see figure 15). The analysis shows that certain shippers have more links to suspicious entities than others, which indicates they could be key suppliers or brokers in the procurement activities.

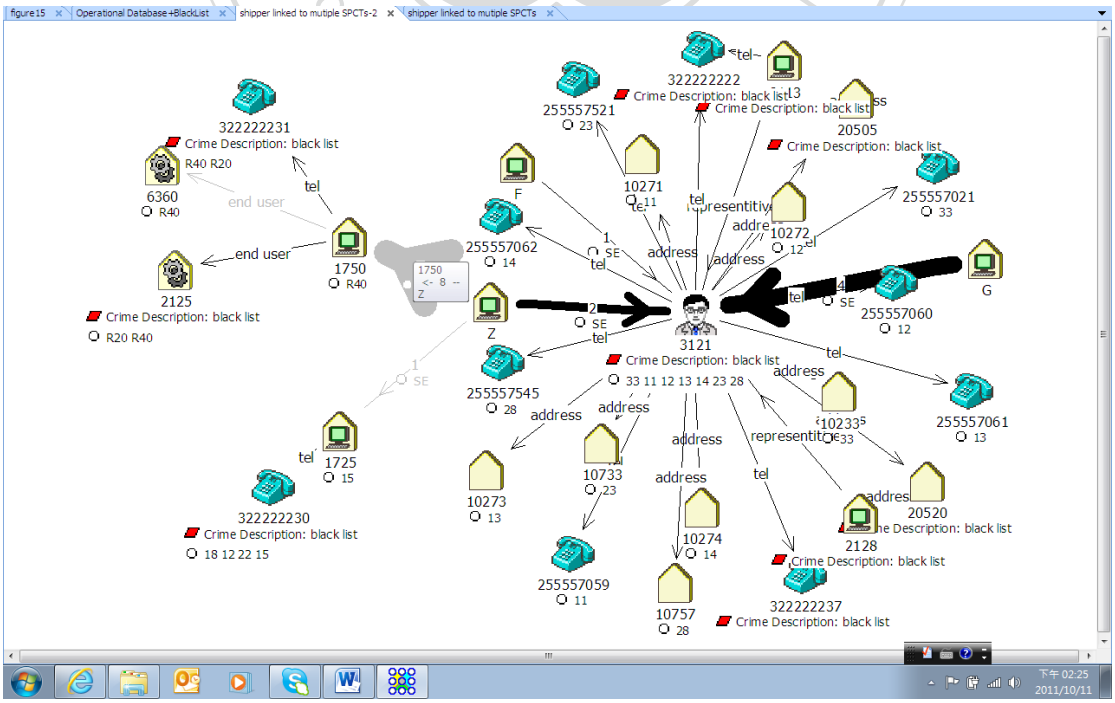


Figure 15 Shippers that Linked to Multiple Suspicious Entities.

From the link analysis, it is found some shippers linked to the same blacklist entity. For example, shipper F, shipper G, and shipper Z all link to blacklist entity 3121, which indicates that these involved shipment all have proliferation concern (see figure 16). It is required to assess the end use of these involved shipments by reviewing the export commodities.

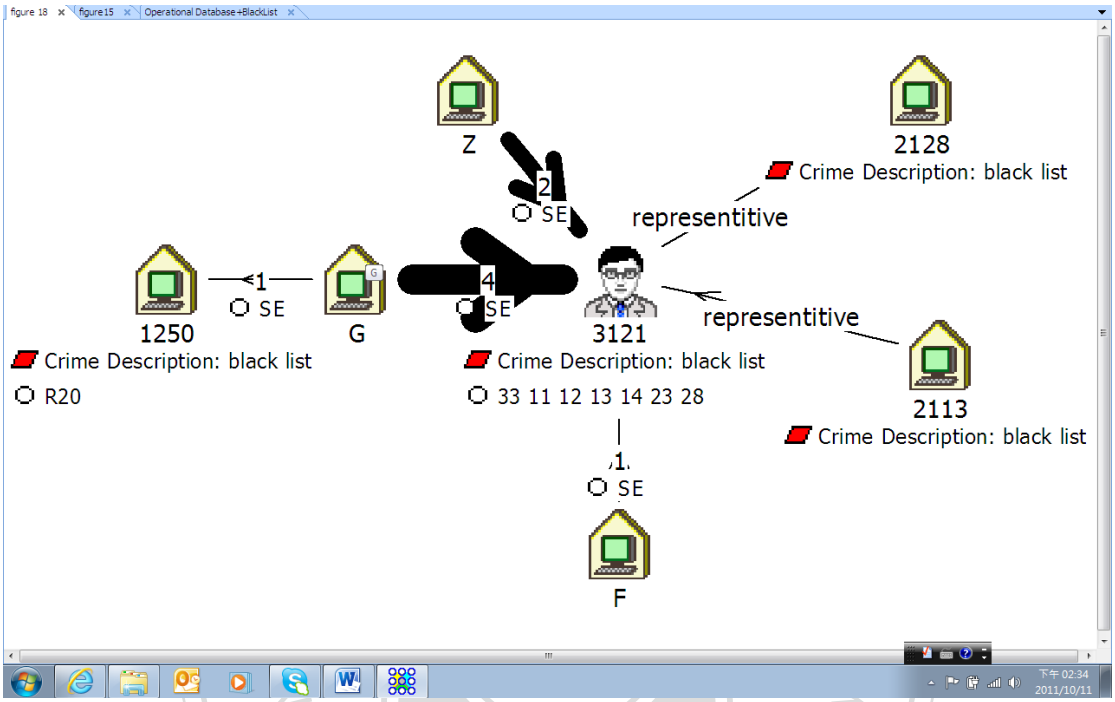
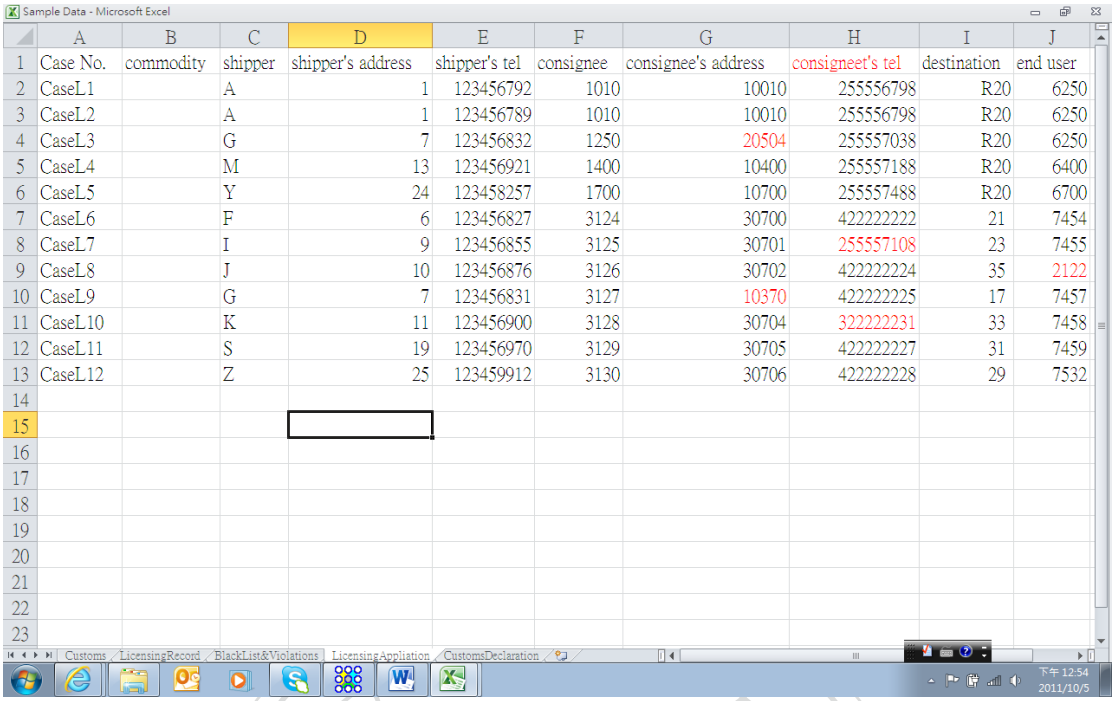


Figure 16 Shippers Linked to the Same Blacklist Entity

4.5.5.2. Screening Individual Licensing Applications

In the case by case process, it is required to assess the individual licensing application to determine if there is any proliferation concern in order to issue the export licenses. For research purpose, the dataset is generated arbitrarily to simulate the real applications (see figure 17).



Sample Data - Microsoft Excel

	A	B	C	D	E	F	G	H	I	J
1	Case No.	commodity	shipper	shipper's address	shipper's tel	consignee	consignee's address	consigneet's tel	destination	end user
2	CaseL1		A	1	123456792	1010	10010	255556798	R20	6250
3	CaseL2		A	1	123456789	1010	10010	255556798	R20	6250
4	CaseL3		G	7	123456832	1250	20504	255557038	R20	6250
5	CaseL4		M	13	123456921	1400	10400	255557188	R20	6400
6	CaseL5		Y	24	123458257	1700	10700	255557488	R20	6700
7	CaseL6		F	6	123456827	3124	30700	422222222	21	7454
8	CaseL7		I	9	123456855	3125	30701	255557108	23	7455
9	CaseL8		J	10	123456876	3126	30702	422222224	35	2122
10	CaseL9		G	7	123456831	3127	10370	422222225	17	7457
11	CaseL10		K	11	123456900	3128	30704	322222231	33	7458
12	CaseL11		S	19	123456970	3129	30705	422222227	31	7459
13	CaseL12		Z	25	123459912	3130	30706	422222228	29	7532
14										
15										
16										
17										
18										
19										
20										
21										
22										
23										

Customs / LicensingRecord / BlackList&Violations / LicensingAppliation / CustomsDeclaration

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Figure 17 Simulated Dataset of Licensing Applications.

The entities and links of each licensing application are added to the database of customs and licensing records (see figure 18).

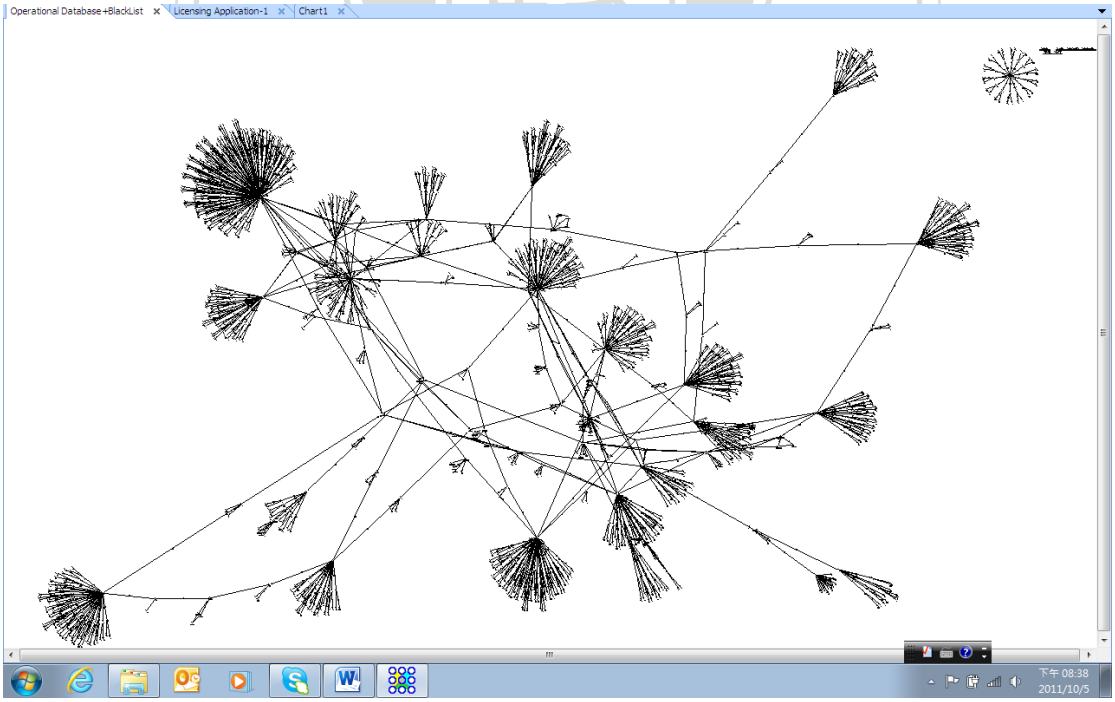

Figure 18 Review Licensing Applications

Firstly, it is found in several cases, such as CaseL3, that the consignees are on the black list. This is an obvious link suggest that the competent agency should consider rejection of the applications (see figure 19).

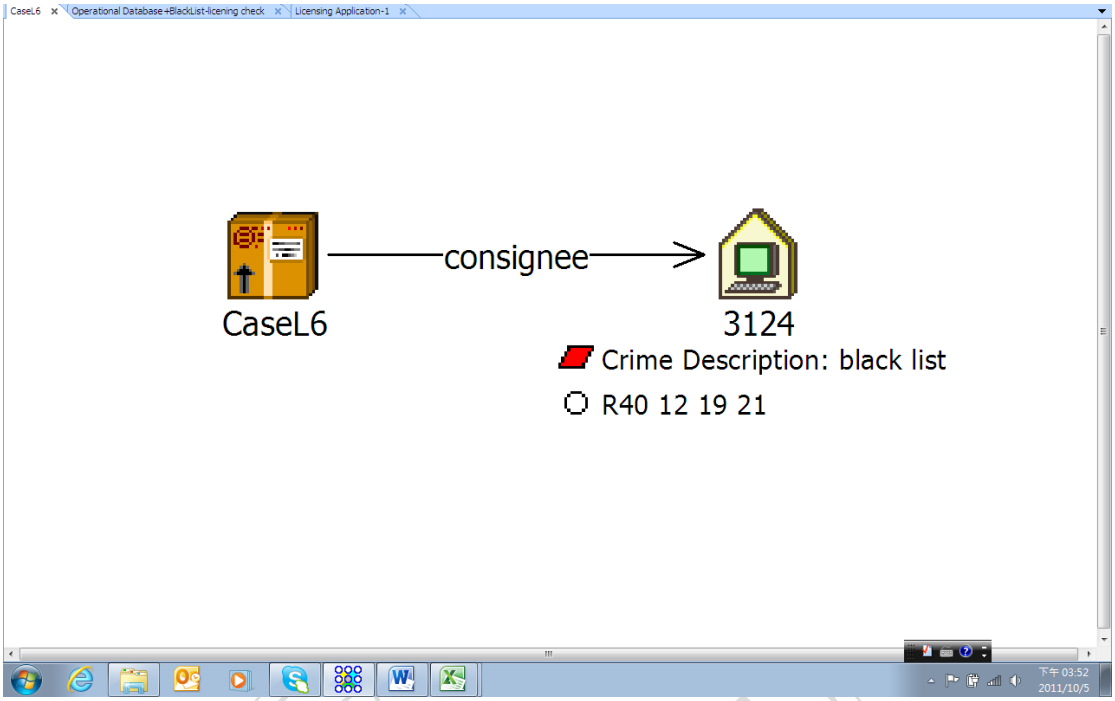

Figure 19 the Direct Link to a Blacklist Entity.

In CaseL8, the end user, company 2122, is on the blacklist, so the competent authority can reject the application accordingly (see figure 20).

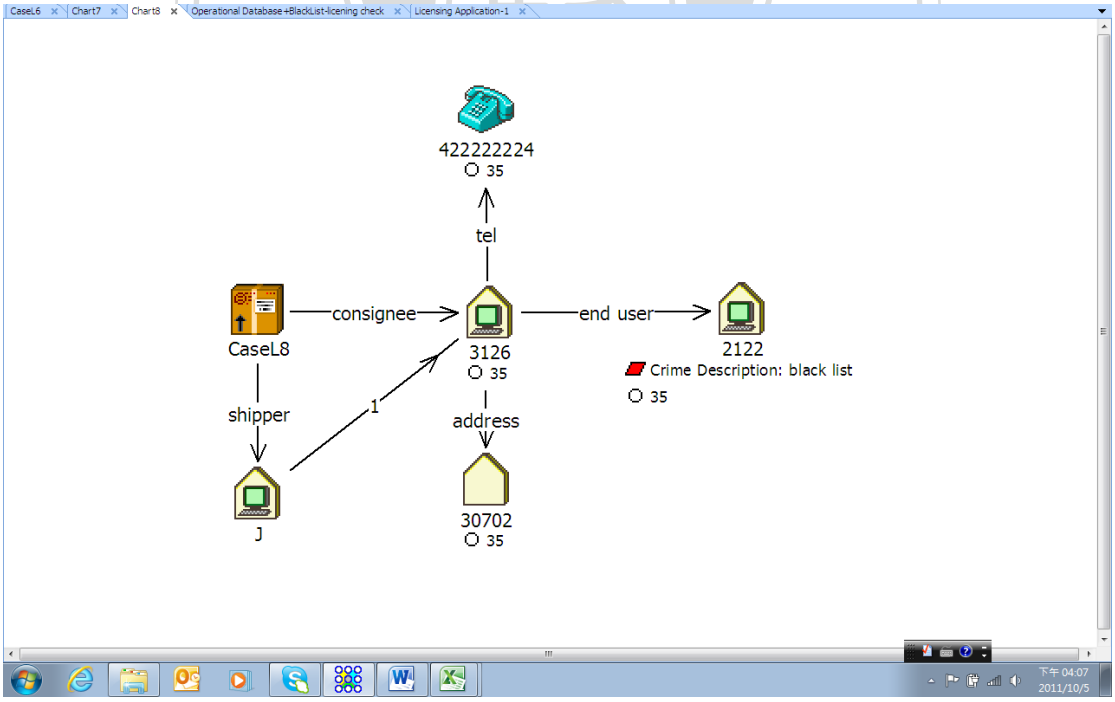

Figure 20 End Users on the Black List

In CaseL9, shipper G and consignee 3127 have implicit linkages to a blacklist entity, which imply proliferation concern (see figure 21).

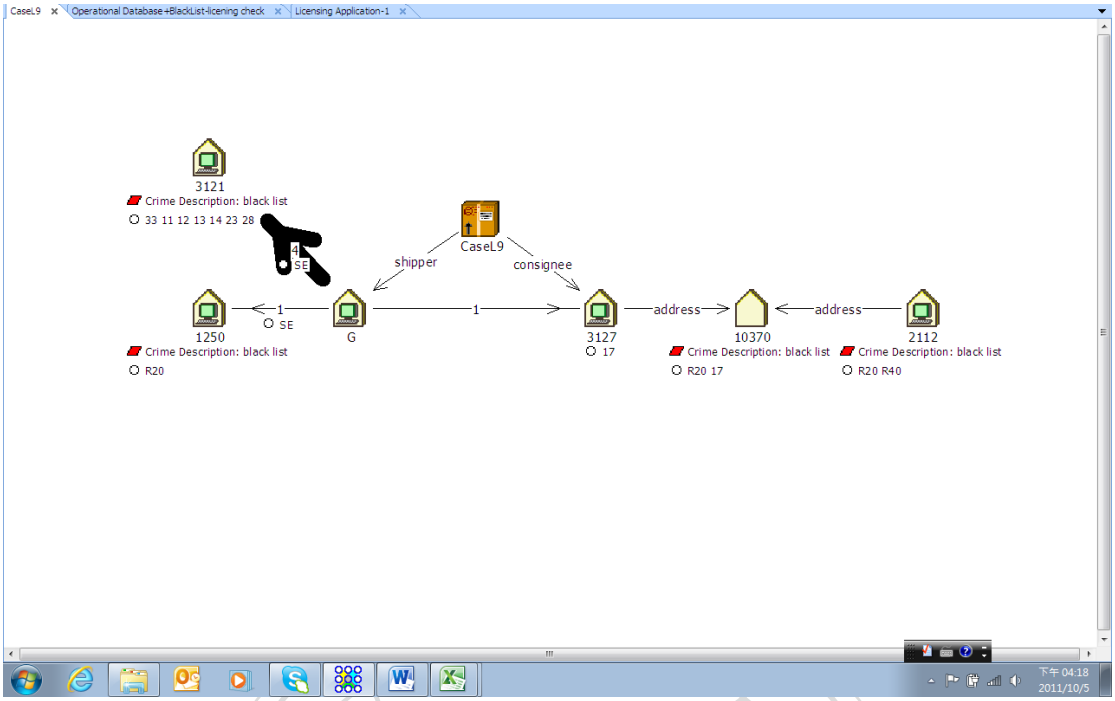

Figure 21 Cases Link to Proliferators

In some cases, both the shipper and consignee have indirect links to suspicious entities, which are possibly front companies use by proliferators. In the scenario of CaseL1 and CaseL2, the consignee 1010 is not on the black list, but it is going to transfer the goods to the end user 6250, which has been the end user of goods sent by company 1250, which is on the black list. This indicates that company 1010 could be a front company. The shipper A sent five shipments to company 1005, which share the same address of an blacklist entity, and also sent one shipment to company 1015, which share the same telephone number with another blacklist entity (see figure 22). This indicates that shipper A is a frequent supplier to proliferators. The competent authority is able to find implicit connections and raise attention to this kind of cases by link analysis.

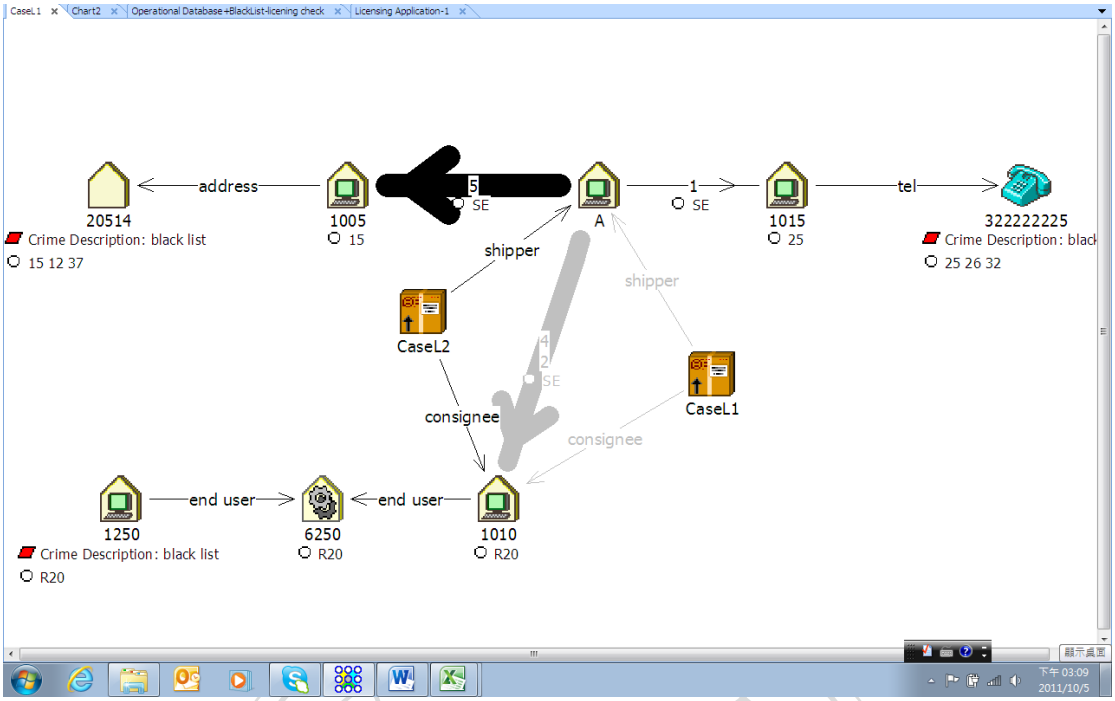

Figure 22 Cases with Implicit Links to Proliferators.

In CaseL4, shipper M has exported goods to company 1757, which share the same address and telephone number with company 3121, which is on the black list. The destination of CaseL4 is R20, a restricted area (see figure 23). There is no direct evidence on this case, but it is sufficient for the competent authority to initiate other measures to verify the concern.

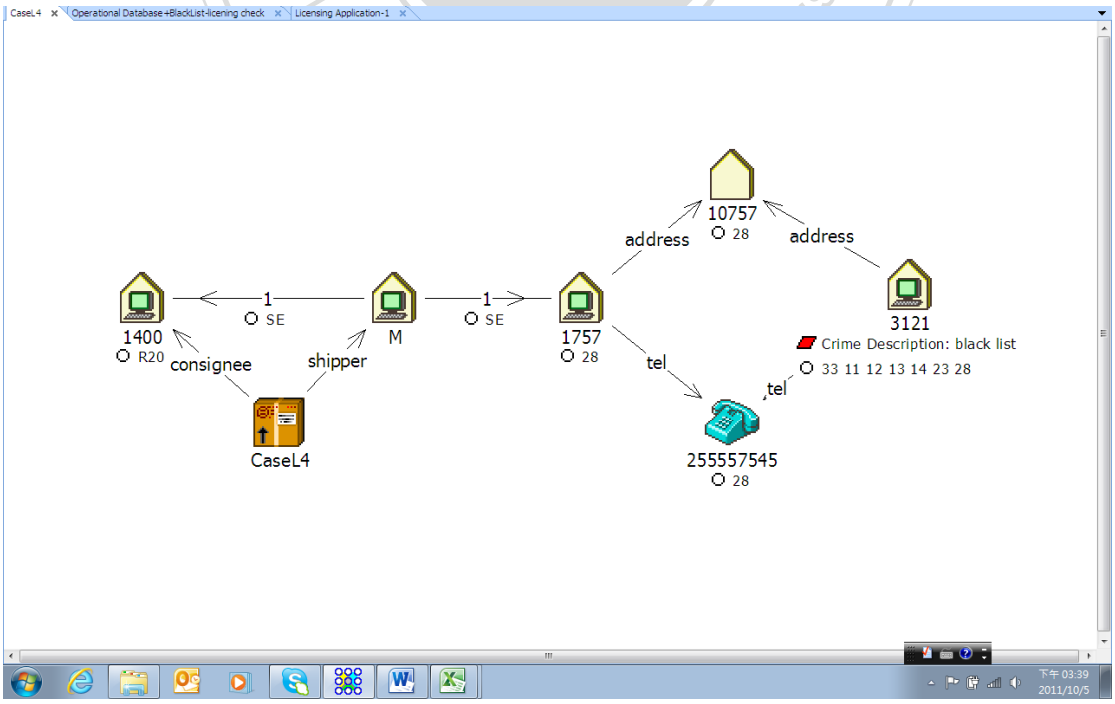

Figure 23 Cases with Implicit Concern.

4.5.5.3. Screening Customs Declaration

Only a portion of the commodities tend to export are required to apply for an export license. However, some of the exporters might not be aware of the export control regulations, or some of the exporters ignore the requirement of export licenses. Therefore, it is necessary to screen customs declarations in order to review and check suspicious shipment at the ports for SHTC export control. The major difference between the two processes is that reporting end users are required in licensing but not in customs declaration. The link analysis processes of screening customs declaration and of screening licensing applications are basically similar, so the simulation of screening is not repeated again. Besides, the Customs review and check is critical in time, so instant verification is an essential.

5. Findings and Discussions

From the research above, it suggests that data mining is a feasible solution to improve the effectiveness and efficiency in export control. Link analysis is a proper tool to be used in export control for discovering entities with proliferation concern from a large quantity of applications. The research suggests that the methodology is able to effectively improve export control management. It is able to screen implicit connections to proliferators and increase the cost and difficulties of circumventing export control so that the proliferation activities are to be contained or hindered.

The thesis has discussed the research questions proposed in the introduction chapter.

- What is the status of WMD proliferation, taking nuclear weapon as an example?
- Having the serious concern of supplying WMD to failing states and non-state actors, who will be the potential proliferators and buyers of WMD?
- How do the proliferation network and procurement black market operate?
- How does the export control mechanism work in major countries and in Taiwan?
- What are the limitations of export control?
- What is data mining? What can data mining technologies provide to improve the management of export control?
- What are the currently available data mining tools and their applications?
- Regarding the nature of export control, which data mining tools are suitable for providing a solution in improving export control?
- How can we use the data mining tools to establish methodologies and/or models in the management of export control?

The discussion of research questions is summarized as follows.

5.1. Estimate of Proliferation Situation

The thesis has done an estimate of proliferation situation. Nuclear terrorism has already been identified as perhaps the gravest danger and most critical concern after Sep 11, 2001. Al Qaeda has demonstrated intent to acquire nuclear weapons to attack the United States and its allies.

A.Q. Khan has supplied nuclear technologies to North Korea and Iran and increased risk of nuclear terrorism. There are concerns of further proliferating to other countries, which could complicate the possibility of nuclear proliferation to terrorists. North Korea and Iran are on the top of list of nuclear proliferation. There is a growing concern that North Korea will transfer nuclear weapons to other states. Iran is also pursuing nuclear weapons, although it has not yet acquired them as of November 2011. The proliferation from Pakistan remains concerned since it is a region where terrorism and nuclear capability coexist.

The Khan network developed systematical means to evade export controls and imported necessary materials, which were later replicated by other proliferators. The methods of black market procurement include using multiple connections and buyers to search for a given item, using front companies, and falsifying end users. In their networks, North Korea and Iran is likely to set up a set of diverse, dispersed “nodes”. The networks can be categorized to three types: the chain network, the hub network, and the all-channel network. There may be hybrids of the three types.

5.2. Evaluation of Export Control System

The thesis did a comprehensive evaluation of export control system. Export controls are tools on the supply-side of the counter proliferation strategy. The international community set up treaties to universalize the formal and binding commitments by states not to acquire or develop WMD and to pursue to regulate trade in and transfer of most sensitive components and technologies as well as related dual-use goods.

The key elements of export control include licensing system, control list, bureaucratic process, customs authority, catch-all clause, regime adherence, information gathering/sharing, verification, training, and penalties. In 1995, Taiwan officially implemented the Export Control on Strategic High-tech Commodities. The competent authority of Taiwan SHTC

export control is Ministry of Economic Affairs. The licensing authority is the Bureau of Foreign Trade. Taiwan adopted control lists from international regimes and specifies restricted areas, which are Iran, Iraq, North Korea, Mainland China, Cuba, Sudan and Syria. Regarding to Strategic High-tech Commodities, exporters are required to apply for Export Permit. By law, the customs is part of a nonproliferation policy and delegated to accomplish nonproliferation tasks. Foreign importers and end users, who acquire commodities exported from Taiwan for military use without authorization by the BOFT, will be put on the export control blacklist. The violators may face penalties.

There are some export control challenges: (1) licensing delays and uncertainties remain a problem for a percentage of export transactions, (2) globalization has introduced challenges from the emergence of increasing number of global corporations and increasing volume of dual-use trade, (3) growing numbers of international suppliers create extra pressures for governments to approve problematic exports. Government officials may consider economic imperatives in advance of security concerns when they consider license requests.

5.3. Selecting Link Analysis as the Research Method

The thesis reviews data mining tools, including link analysis tools, landscape visualization tools, and quantitative data mining tools, which are potentially proper to be implemented in export control. Landscape visualization tools are capable in getting a general picture of the data sets and discovering trends and patterns, but detecting odds from a whole dataset might not be their strength. Quantitative data mining tools are able to detect problematic entities from a group but tend to be statistical and need a large quantity of sample data set to establish models, while the number of violations of export control is not enough to build such models. Link analysis is capable of discovering associations, so the thesis selects Analyst's Notebook, a link analysis tool, for the research.

5.4. Results of Analyzing Simulated Datasets

By using Analyst's Notebook, the thesis attempts to develop a way to increase the coerciveness and accuracy of detecting problematical shipments from ordinary export activities in order to establish a methodology to improve the management of export control.

There are databases available among agencies, including export control licensing applications, customs clearance applications, violation records, sanction lists and black lists published internationally. For link analysis in export control management, the analyzed entities include person, shipper (supplier), consignee (buyer), telephone number, address, end user, etc., and the types of linkages include transaction of commodities, member of a company, telephone number and/or address owned by a company and/or a person. For analysis purpose, we add attributes of destination and black list to an entity or a link. The thesis arbitrarily generates entities and linkages to simulate the datasets of the real customs and licensing records.

In the overall analysis, the thesis analyzed the whole datasets and found patterns indicating proliferation concerns.

- Some entities share the same addresses or telephone numbers with blacklist entities, which indicate that they are possibly front-companies used by proliferators.
- Some entities link to end users which are declared by blacklist entities. The licensing process should pay more attention to them.
- A representative that is linked to multiple entities of telephone numbers, addresses, suppliers, and buyers is a key procurement agent. It represents the hub network extracted from an all-channeled network in the real world. This also implies that proliferators change front companies from time to time to circumvent export control. Therefore, it is critical to identify the key nodes, formed by the major procurement representatives and trade brokers.
- Certain shippers have more links to suspicious entities than others, which indicates that they could be key suppliers or brokers in the procurement network.
- Some shippers linked to the mutual blacklist entity. It is required to assess the end use of these involved shipments by reviewing the export commodities.

The thesis also analyzed samples of licensing applications individually and concluded ways to identify problematic cases. It shows that the method is able to find implicit connections.

- The consignees are on the black list. This suggests that the competent agency should reject the applications.
- The end user is on the blacklist, so the competent authority can reject the application accordingly.
- In some cases, both the shipper and consignee have indirect links to suspicious entities, which are possibly front companies use by proliferators.
- The consignee shares the same address or telephone number with a blacklist entity. There is no direct evidence on this case, but it is sufficient for the competent authority to initiate other measures to verify the concern.

The link analysis of screening customs declaration applications can be processed in the same way.

Link analysis is able to check a huge amount of datasets to verity if there is any direct link to blacklist. Besides, the most powerful strength of data mining is that it is able to find implicit information in the datasets, which could not be properly done by manual review. From the simulated analysis of data mining, it is evident that we are able to confidently assess buyers with no direct link to black list are front companies. By analyzing historic licensing and customs records, we are able to discover patterns of proliferation activities and how the proliferators use front companies or legitimate businesses to evade export control. In the test of screening licensing applications, it is evident that link analysis is an effective tool to verify the links to blacklist and find implicit leads to proliferators. The process is easy and intuitive, so both the first line task force member and managers can be easily trained. In addition, the result of analysis can also be shared clearly and effortlessly.

Link analysis is a feasible tool to discover implicit connections to proliferation concern, but by using it alone is not enough to complete the process of verification. No matter how discreet it is, there are always risks. Export control mechanism need to adopt other tools to verify the risk, such as pre-shipment verification, post-shipment verification, and follow-up investigations to perfect the export control mechanism. If it is necessary, the exporters are required to provide reasonable explanations of the proliferation concern.

For decision of following response to concerns discovered by data mining methodologies, it is recommended to incorporate the method of score card to evaluate the risk. By using score card, the different situations can be classified into different risk level. For example, the cases have direct links to the entities on violation records and black lists have the highest risk. Cases with indirect linkages to blacklist entities have lower risk scores. The variables of risk scores can include destination, routes, quantity of goods, etc. However, the weight of the variables to the score cards ought to be evaluated according to the real-world data and the resources available to do the follow-up tasks, so the thesis does not discuss this in depth.

It is needed to notice that the simulated datasets are simplified comparing to real-world datasets. Hopefully, more hidden information can be discovered while there are larger quantity of datasets and more data on the types of entities and linkages. The simulated analysis in the thesis is an analogue to what can be done in the real export control process. The purpose of the research is to demonstrate some feasible concepts to implement data mining tools to export control management. When the concepts are applied to the real management process, which have more quantity and variety of datasets, more analysis methods and information are expected to be developed and discovered.

5.5. Export Control Management Model

Based on the findings and the results of data mining research, the thesis suggests an export control management model that incorporates databases among agencies, applies data mining technologies, and coordinates information sharing among agencies to improve the effectiveness and efficiency in screening problematic entities and the overall performance of the management. (see figure 24)

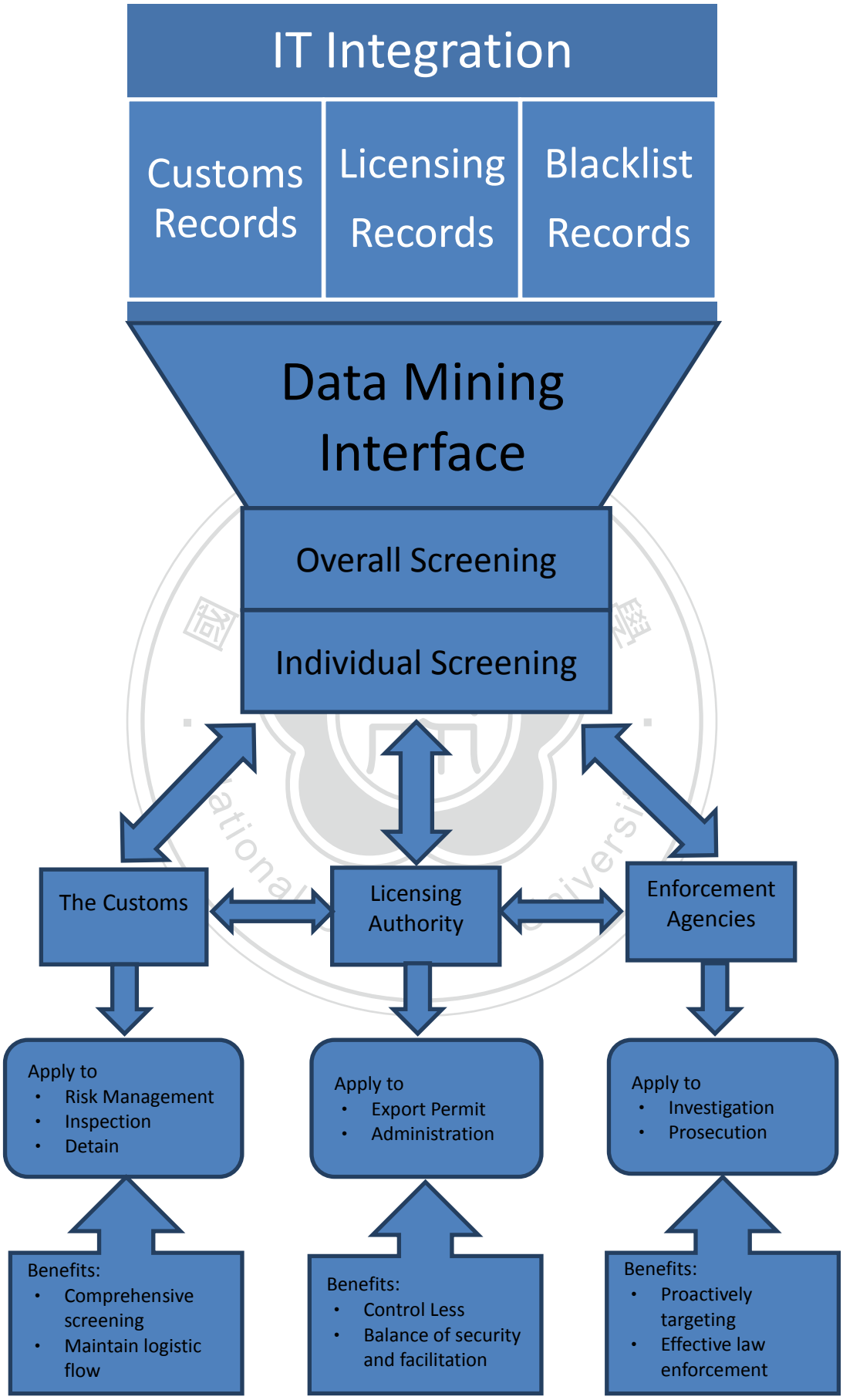

Figure 24 Export Control Management Model

First, IT integration, which incorporates the datasets of customs, licensing, and blacklist records, is the foundation of the reform. The combined database is shared among the Customs, licensing authority, and law enforcement agencies. These relevant agencies access and process the database through the data-mining interface to extract the information needed for their functions respectively.

The Customs can conduct individual screening on the shipments instantly and overall screening on the blacklist entities periodically. Data-mining process can improve customs risk management and increase the accuracy of targeting suspects so that the resources of inspection can be relocated to necessary tasks. As a result, the successful detain is also increased. The Customs would be able to conduct instant screening on the shipments and so to lessen interference to logistics flow.

By using data-mining solutions, the licensing authority can conduct individual screenings on export permits to discover not only blacklist entities but also the conduits used by proliferators, which includes legitimate companies in non-restricted countries. In addition, the licensing authority can also conduct overall screening once for a while to analyze and discover new patterns developed by proliferators to increase screening capability. When the capability to discern normal and suspicious applications is increased, the licensing authority will be more confident in easing the control on legitimate businesses so that the export control management can regain the balance of trade security and facilitation.

The law enforcement agencies, which are focusing and tracing the few individuals who violate export control regulations intentionally and recurrently, can use data-mining tools to effectively target the suspects and conduct following investigations. Comparing to tip-offs, the data-mining solution provides a more proactive way in chasing the violators.

The process and communication of the model is all-channeled. The Customs, licensing authority, and law enforcement agencies not only extract information form the combined database but also contribute to the blacklist records whenever they discover suspicious entities; therefore, the coverage of the database is constantly expanded. The information is also shared in an all-channeled network to increase the internal knowledge of each agency.

In general, the proposed management model is comprehensive, targeting, and dynamic. The cost of building such a model is moderate. The major expenses will be IT system reform and relevant training. The success of the reform will rely primarily on interagency coordination and cooperation.

6. Recommendations

The research is just a beginning to explore possible ways to implement data mining solutions to export control. There are some issues worth further research.

Although link analysis tools are intuitive and easy to use, the users still need certain extent of training and knowledge on export control and data analysis. It is favorable to establish a once-for-all model that is able to predict the risk of proliferation by the input of variables such as the risk management in banking loan and credit card. By using a prediction model, the risk management process can be standardized to reduce human mistakes and judgments, which negatively influence the outcome of assessment.

The link analysis tools are widely used in investigation, which is based on the logic of tracing leads. However, it is worth of exploring the implementation to other applications in business fields, such as inspect and audit, logistics, customer behavior since most of the business activities are formed by interactions and communications.

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Appendix 1 Related Articles under the Foreign Trade Act

Article 13

To ensure national security, fulfill international cooperation and agreements, enhance regulation of exportation/importation and flow of strategic high-tech goods, so as to facilitate the need of introducing high-tech goods, the exportation/importation of such goods shall comply with the following provisions:

No exportation is allowed unless otherwise authorized;

Where import permits are granted, no change of the importer or transfer to any third country or region is allowed unless otherwise authorized;

Intended use and end user shall be truthfully declared; no change is allowed unless otherwise authorized.

Specific strategic high-tech goods transported to the restricted regions may not transit, transship or become stored in bonded warehouses, logistics centers and free ports via any commercial port of this country without authorization.

For the types of goods and the regions restricted as referred to in the two preceding paragraphs, the competent authority shall render a public notice and publish a government bulletin.

For specific strategic high-tech goods in breach of the provisions in Paragraph 2, the competent authority may detain such goods in accordance with this act or relevant acts. Besides confiscation, the competent authority shall return shipment of such goods.

For detainment of aforementioned goods, Customs officials are entrusted with enforcement by the competent authority.

The application requirements and procedures, the regulations governing exportation/importation, transit, transshipment or storage in bonded warehouses, logistics centers and free ports, the declaration, changes and restriction of the export/import use and end user and the investigation of destinations and use of goods, and any other matters

required for compliance, as referred to in Paragraphs 1 and 2 of this Article, shall be prescribed by the competent authority.

Article 27

Exportation/importation of strategic high-tech goods under any of the following circumstances, shall be punishable with imprisonment for not more than five (5) years, detention, or, in lieu thereof or in addition thereto, a fine of not more than NT$1,500,000:

Where such goods are transported to restricted regions without authorization;

Where, after import permits are granted, such goods are transferred to restricted regions without authorization prior to being imported;

Where, after being imported, the use and end user of such imported goods are changed without authorization from that originally declared to the production or development of military weapons, such as nuclear or biochemical weapons, or ballistic missiles.

Where the legal representative or agent of a juristic or natural person, or the employee or any other staff member of a juristic person or natural person, commits any of the crimes provided for in the preceding paragraph during the course of business, not only shall the guilty party be punished as prescribed, but the juristic person or natural person shall also be punished with the fine prescribed in the preceding paragraph.

Article 27-1

For any of the circumstances referred to in Paragraph 1 of the preceding Article, the BOFT shall suspend the liable party from exporting, importing or exporting/importing goods for not less than one (1) month but not more than one (1) year, or revoke the liable party's exporter/importer registration.

Article 27-2

For exportation/importation of strategic high-tech goods under any of the following circumstances, the BOFT may impose an administrative fine of not less than

NT$30,000 but not more than NT$300,000, or suspend the liable party from exporting, importing, or exporting/importing goods for not less than one (1) month but not more than one (1) year, or revoke the liable party's exporter/importer registration:

Where such goods are transported to any region other than the restricted regions without authorization;

Where, after import permits are granted, the importers are changed without authorization, or the said goods are transferred to any third country or region other than the restricted regions without authorization;

Where, after being imported, the use or end user of such imported goods are changed without authorization from that originally declared to the use of production or development of military weapons, such as nuclear or biochemical arms, or ballistic missiles.

For specific strategic high-tech goods in breach of the provisions of Paragraph 2 of Article 13, the competent authority may confiscate such goods.