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THIRD PARTY LOGISTICS: COLD STORAGE FACILITY IN BEIRUT PORT

by
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AN ABSTRACT OF THE PROJECT OF

Wael Ziad Aoun for Master of Business Administration
Major: Business Administration

Title: Third party logistics: Cold storage facility in Beirut port

An established company in Lebanon is in the process of building a cold storage facility in the Beirut port free zone. The company intends to setup an efficient operating model to meet the Lebanese market demand taking into consideration the industry's best practices and controls. The purpose of this project is to analyze the Lebanese market looking at potential players concerned with this endeavor: Major potential competitors and clients, national environment, potential trade flows, services mix and pricing… to develop a decision support tool for determining the size of each temperature section within the warehouse.
In addition, this project provides recommendations for the company to develop a sound business operational model based on standard operating procedures and best practices development.

CONTENTS

ILLUSTRATIONS

Figure Page

TABLES

Table Page

CHAPTER I

INTRODUCTION

Logistics, as defined by the council of logistics Management in 1991, is: "the process of planning, implementing, and controlling the efficient, effective flow and storage of goods, services, and related information from point of origin to point of consumption for the purpose of conforming to customer requirements"(Logistics, 2014).

In the logistics industry, third party logistics providers (TPL or 3PL) offer a range of logistic services for a client's outsourced needs focusing mainly on two major service functions: Transportation and warehousing (Armstrong & Associates, 2013). Global third party logistics revenues follow an ongoing upward trend; nonetheless the incremental growth rate differs across regions and across 3PL services. According to Armstrong & Associates (2013) the estimated growth rate in the global third party logistics revenues for the year 2012 was 9.9%, with 3PL revenues totaling $677 billion.

While traditional developed markets are still experiencing modest economic growth because of the ongoing global crisis, emerging markets continue to grow at a faster pace. The logistics sector in the Middle east region is expected to experience rapid growth, due to a combination of rapid and concentrated population growth, huge infrastructure investments especially in the GCC countries, high foreign investments and increasing trade flows; however uncertainty of future prospects remains very high (Agility, 2013).

The Middle East region is characterized by a hot and humid weather during most of the time, therefore products have to be transported and stored in a controlled environment that can maintain quality and reduce products deterioration. As a result the

demand for temperature controlled environment in general and cold storage facilities in particular remains high (Mcfann, 2010).

Free zones are geographically restricted areas offering better infrastructure facilities, beneficial financial incentives, and immune political, social, economic and legal environments than the host countries mainland, allowing them to be a better place for operations especially in countries with relatively high risk (Malhotra & Papadopoulos, 2008)

An established company in Lebanon is in the process of building and launching a cold storage facility in Beirut Port Free zone. The scope of the project includes a market research for developing a cold storage industry in Lebanon, in addition to the design of the operational model based on the industry's best practices.

In this project we analyze the market through different dimensions:

- National environment
- Logistics infrastructure network
- Major logistics flows / Potential trade flows
- Major potential competitors and clients
- Services mix and pricing
- Warehousing current needs and future opportunities

In addition, this project addresses partially the business operational model of the company:

- Standard operating procedures and Best Practices Development for some key processes (refrigerated warehousing, inventory management, layout/design, security & safety measures…)
- A decision support model for determining the size of each temperature

segment within the refrigerated warehouse.

Project organization:

We discuss in chapter 2, the Third Party Logistics sector in terms of the benefits and risks associated with outsourcing in addition to TPL profitability by segment. In chapter 3, we investigate some of the cold storage industry practices in terms of operations, warehouse design and geographic location. In chapter 4, we examine the current state of the Lebanese market in terms of economy, infrastructure, trade flows and indicate the rules and regulations governing the operations of a cold storage facility in Beirut port free zone. In chapter 5, we conduct a competitive market analysis for the cold storage facility in the Lebanese market in addition we provide a list of services that must be offered and the pricing of these services. In chapter 6, we develop a model to propose an approach for the company to determine the size of the warehouse. In chapter 7, we provide the cold storage facility company with a set of recommendations related to the operational model

CHAPTER II

THIRD PARTY LOGISTICS

Third party logistics (TPL or 3PL) as described by Alessandra (2008) is a mutually beneficial business-to-business relationship, in which a provider of logistics services fulfills outsourced needs of a client traditionally performed internally. The scope of the services provided may be narrow tackling selected logistic activities such as transportation or warehousing, and may be broad incorporating the logistics process entirely. The two basic business models of TPLs are asset and non-asset based.

A. Overview

Global third party logistics revenues follow an upward trend; nevertheless the percentage incremental increase in revenues differs from one region to another and is accelerating in emerging markets. As shown in figure 1, TPL revenues have been increasing in all major regions for the past years and are expected to increase for the upcoming years but at a slower pace. The geographic region with the highest TPL revenue of $245 billion for 2012 and the highest growth rate is Asia Pacific, where growth has traditionally been driven by companies outsourcing or off-shoring manufacturing to emerging markets.

The highest regional cumulative average growth rate (CAGR) from 2007 to 2012 was for china equaling 18.8% followed by South America 13.3%, Asia pacific (excluding china and japan) 9.5%, japan 6.3%, North America 4% and Europe -1.7%; nevertheless this CAGR is expected to decrease for the years 2012 to 2015 in China, South America, Asia pacific (excluding china and japan) and japan to equal 8%, 3.6%,

4.8% and 1.5% respectively, and to increase in North America to 4.2% and in Europe to 1%. (Armstrong and associates, Inc., 2014)

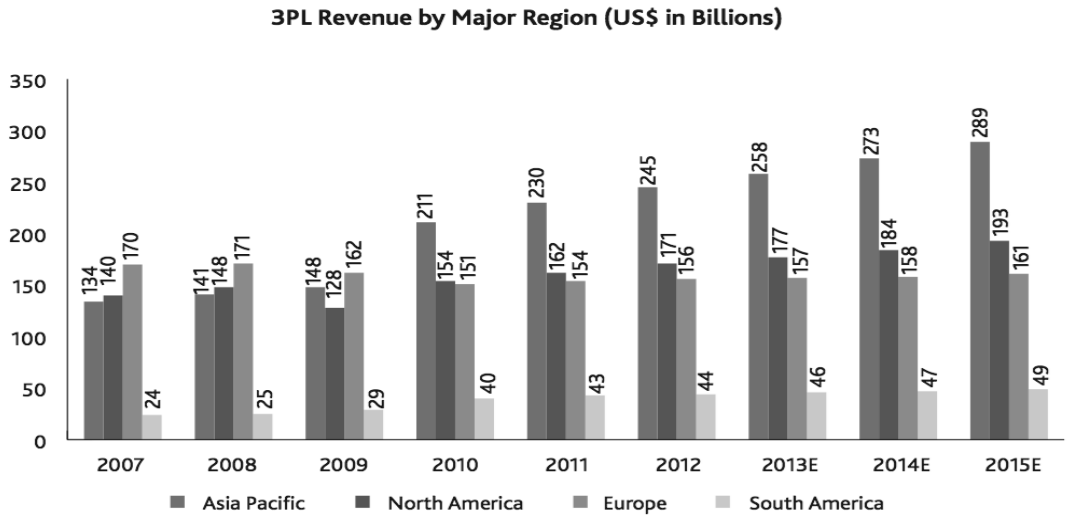

Figure 1: TPL revenue by major region

According to the 2013 Third Party Logistics Study, the total logistic expenditures on distribution, transportation, warehousing and value added services are around 12% of sales revenues from which 39% are directed to outsourcing. Normally TPLs offer a wide variety of services for their clients across their supply chains, including: warehousing, international & domestic transportation, freight forwarding, customs brokerage, cross docking, inventory management, fleet management, order management & fulfillment, and IT services… that do not have to be necessarily all used.

B. Agreements

According to Alessandra (2008) TPL agreements encompasses strategic rather than just tactical dimensions, due to the broad range of services offered, the long-term nature

of the relationship, the customization of the services offered, in addition to the benefits / risks sharing. Internal and external factors affecting TPL agreements are summarized in table 1 below:

Table 1: Factors affecting TPL agreements

External factors:	**Internal factors:**
○ The general macro environment (economic trends, technological developments…) ○ The increasing global competition ○ Deregulation of the transportation industry ○ Increased customer expectation for better logistical services ○ The rising focus of companies on their core competencies ○ Revolution in communication technology ○ Increasing trend for just in time operations	○ Strategic intent for both TPLs and customers ○ Organizational structure ○ Firm size ○ Network complexity (geographic dispersion and frequency) ○ Process complexity ○ Product complexity

C. Benefits and risks

Konstantinos and Martin (2007) summarize the benefits and risks for outsourcing as follows:

Table 2: Benefits and risks for outsourcing

Benefits:	**Risks:**
○ Focus on core competencies ○ Increased customer satisfaction ○ Access to international distribution networks ○ Enhanced flexibility ○ Reduction in asset investments ○ Reduction in equipment maintenance and labor costs ○ Higher utilization rates leading to economies of scale (not always true) ○ Reduction in inventory levels and order cycle times	○ Loss of control over the logistics function ○ Loss of in-house capability and customer contact ○ Lack of responsiveness to customers' needs (loss of customer feedback) ○ Inadequate provider expertise ○ Disruption to inbound flows ○ Inability of TPL providers to deal with special products needs

D. Selection criteria and techniques

Konstantinos & Martin (2007) identified several criteria for choosing logistics service providers, mainly focusing on cost saving, service quality and reliability, increased flexibility, timeliness, managerial capabilities and financial stability.

There are different techniques used for selecting a TPL based on the aforementioned criteria, such as: mathematical programming, linear and non – linear programming, mixed integer programming, multiple criteria decision making methods, integrated approaches and artificial intelligence techniques (Gupta, Sachdeva & Arvind, 2011)

E. Global TPL ranking and top performers profitability

Armstrong and associates, Inc. (2014) provides a list of the top 50 global TPL providers by 2012 revenues. Table 3 below, shows the list of the top 10 performers who are mainly either Asian or European:

Table 3: Top 10 TPLs by 2012 gross revenues

Rank	Third-Party Logistics Provider	2012 Revenue in millions
1	DHL Supply Chain & Global Forwarding	$31,639
2	Kuehne + Nagel	$22,141
3	Nippon Express	$20,321
4	DB Schenker Logistics	$19,789
5	C.H. Robinson Worldwide	$11,359
6	Hyundai GLOVIS	$9,832
7	CEVA Logistics	$9,290
8	UPS Supply Chain Solutions	$9,147
9	DSV	$7,759
10	Sinotrans	$7,523

A sample of 8 US asset based third party logistics listed companies was taken out of the top 50 performers to calculate their profit margins across the years. Non-listed and non-US companies were not included in the sample due to the lack of data availability. The following companies were included: C.H. Robinson Worldwide, Inc., United Parcel Service, Inc. Expeditors international of Washington, Ryder System Inc., Ceva Group PLC, Ingram Micro Inc., UTI worldwide, and Landstar System, Inc.

Results are summarized in figure 2, and show that the average TPL profit margin for the year 2012 in the US is around 6.2% and that the average across the years 2005 to 2012 equals 5.5%.

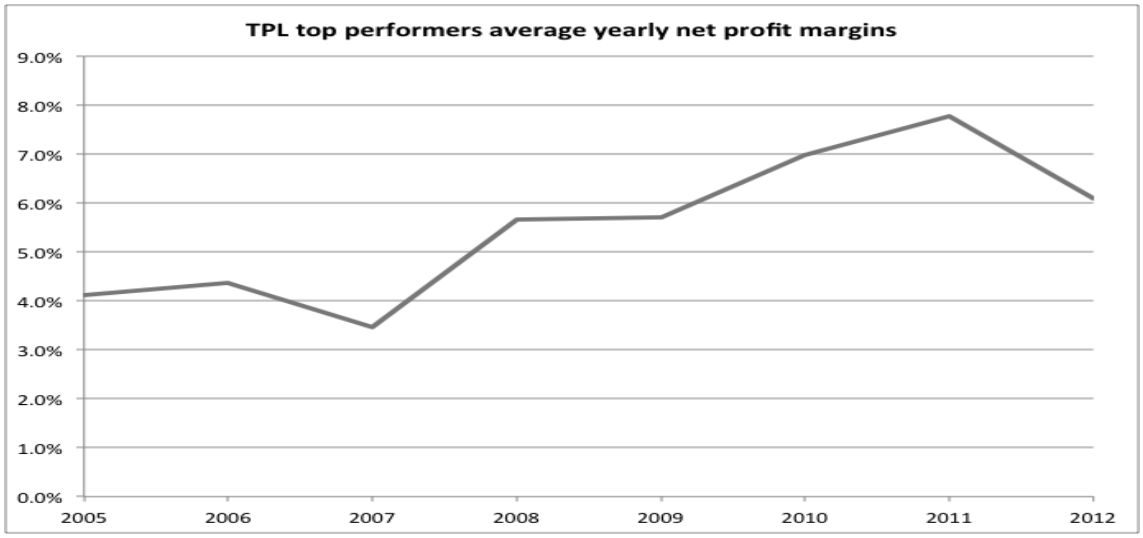

Figure 2: TPL top performers average yearly profit margins

Source: Wharton research data services (2014)

Armstrong and associates, Inc. (2014) provides the breaking of the calculated profit margin across the main 3PL segments in the US (table 4). Results show that value added warehousing and distribution was in 2012 the 3PL segment with the highest net revenue of $27.6 billion; nevertheless it had the lowest profit margin of 2.9% compared

to 20.3% for domestic transportation management.

Table 4: Revenues and profitability by TPL segment – U.S

Revenues and profitability by 3PL segment (2012)						
3PL Segment	Gross Revenue (Turnover) (US$ Billions)	% Change 2012 vs. 2011	Net Revenue (US$ Billions)	% Change 2012 vs. 2011	Net Income (Profit Margin %)	% Change 2012 vs. 2011
Domestic Transportation Management	45.1	9.2%	6.6	5.4%	20.3	16.7%
International Transportation Management	46.3	0.4%	17.9	1.0%	7.0	-4.1%
Dedicated Contract Carriage	11.6	4.5%	11.4	4.7%	5.2	15.6%
Value-Added Warehousing and Distribution	35.8	5.3%	27.6	3.8%	2.9	-3.3%
Total*	138.8	6.0%	63.5	4.1%	6.5	6.6%
*Total 2012 gross revenue (turnover) for the 3PL market in the U.S. is estimated at $141.8 billion. $3 billion is included for the contract logistics software segment. Source: Armstrong & Associates						

F. TPL – Middle East

According to Haq (2009) the Middle East Third party logistics sector has a three-tier structure, with "Agility" leading the first tier, followed by the "Gulf Agency Company (GAC)" and "Aramex" in the second tier, and by a wide group of specialized providers in the third tier. The importance of the Middle East region as a distribution hub is still on the rise, however more international players are expanding their operations in the region to benefit from the market opportunities thus pressuring local firms to develop their operations and broaden their services to meet global standards.

Moreover, the increasing demand for food, pharmaceutical and medical products in emerging markets constitutes a niche for growth for 3PL providers in temperature controlled supply chains (cold chains), especially in the Middle East region characterized by its hot and humid weather during most time of the year.

CHAPTER III

LITTERATURE REVIEW

This section investigates some of the cold storage practices; a description of the industry's opportunities and challenges in the design, operations and geographic location of a cold storage facility.

Victoria and Rodolfo (2002) state that the cold chain is a physical process dominating the supply chain logistics of certain processed chilled or frozen foods with temperature requirements varying between categories, and across types of foods.
An efficient management of the cold chain is the key to prevent unnecessary losses and to maintain the bottom line since any disruption in the time-distance, temperature, exposure to light, or humidity of the stored goods can reduce significantly their present value (Joshi et al., 2009).

Surange (n.d.) recognizes refrigerated warehouses as the heart of the cold chain and considers refrigeration as the best technique for extending shelf life and preserving quality of food products. The effective freezing and cooling of food reduces the activity of enzymes and microorganisms and ultimately delays deterioration.

The 2010 American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) Handbook on refrigeration describes any building or section of a building providing controlled storage conditions using refrigeration as refrigerated warehouses. The two essential types of cold storage facilities are coolers storing commodities at temperatures above 0°C and freezers storing commodities at temperatures under 0°C.
Cold storage facilities are either public: storing goods for various customers at a certain fee, private: storing goods for a particular company, or both. While private warehouses

are either in the same building or neighboring the company's other operations, public warehouses must be situated to serve transit storage point, producing area, large consuming area or various combinations of the former places to acquire a good average utilization. In addition to the convenient location, sites must mainly have an adequate power and water supply, a minimal tax and insurance burden, an easy access to routes, and a provision for sanitary water disposal.

In order to be competitive, cold storage facilities must efficiently coordinate with transportation companies, integrate with their products suppliers and be cost-effective. Cold warehouses are considered a crucial component of the food distribution network, and their profitability relies heavily on economies of scale achieved especially through high occupancy rates, however this requires an accurate estimation of the total inventory demand and the types of products to be stored. Estimating the total inventory demand by solely assessing the available data is not sufficient, cold warehouses must also investigate the products' dissipation rate, i.e. the speed at which products flow out of the system, and that depends on a variety of factors deferring between product categories. The time elapsed before products exit storage has its implications on their quality when sold, and may lead to a reduction in their value especially for those that deteriorate rapidly (Burden et al., 2002).

A very important concern for newly established warehouses is racking which has direct implications on operations especially in terms of picking efficiency, cross docking… leading ultimately to an inside-out designed warehouse (Arabian supply chain, 2009).

The Link 51 racking and warehousing storage guide (2014) states that racking solutions must take into consideration variables such as capital, product lines and

anticipated growth. The major racking systems can be summarized in table 5 below, however in most of the cases a combination of racking schemes is typically the best solution for achieving better plant utilization.

Table 5: Racking systems

Racking system / **Criteria**	Standard aisle pallet racking	Standard aisle double deep (1)	Narrow aisle pallet racking (2)	Push back (3)	Drive in	Mobile (4)	Pallet live–Dynamic (5)
Space utilization of floor area	3/5	4/5	4/5	5/5	5/5	5/5	5/5
Utilization of cubic storage space	3/5	4/5	4/5	4/5	5/5	5/5	4/5
Access to individual pallet loads	5/5	3/5	4/5	3/5	1/5	5/5	3/5
Speed of access & throughput	3/5	3/5	4/5	2/5	2/5	1/5	4/5
Efficiency in stock rotation	3/5	3/5	4/5	4/5	2/5	2/5	5/5
Efficiency in stock control	4/5	3/5	4/5	2/5	3/5	4/5	5/5
Specialized handling equipment	None	Required	Dedicated trucks	None	None	None	None
Ease of re-location	5/5	3/5	3/5	1/5	3/5	2/5	1/5
Ease & speed of installation	5/5	4/5	3/5	2/5	3/5	2/5	1/5
Adjustability of beam positions	5/5	4/5	3/5	None	1/5	3/5	None
Inventory management	100% access to every pallet	FILO	100% access to every pallet	FILO	FILO	100% access to every pallet	FILO

(1) Allows pallets to be stored two deep but still accessible from the same aisle
(2) Requires half the width of conventional adjustable beam pallet racking
(3) Pallets are loaded in sequence onto wheeled carts and are pushed back
(4) Particularly suited to cold stores
(5) Pallets are loaded onto dedicated lanes of inclined gravity rollers

Burden et al., (2002) identify two main variable costs for operating a cold warehouse: energy and labor costs. Factors such as the design of the building, interior and exterior temperatures and the storage capacity affect energy expenses. As for the labor expenses, they increase primarily with inventory increase and low automation levels.

Lekov et al (2009) states that refrigerated warehouses have substantial power demand especially during peak periods, therefore creating a need for implementing various energy saving techniques such as curtailment of warehousing processes, well designed airlock loading doors, ample dock area to ensure efficiency in loading and unloading merchandise…Demand response (DR) is a set of actions designed to lower electricity usage, improve the reliability of the electric grid and to lower the total system costs during contingencies or market conditions that raise electric supply costs. These procedures can be automated (Open Automated Demand Response-OpenADR) but cannot be fully automated because they are subject to many challenges, in terms of: loading patterns, variations in loads and processes, control capabilities… The magnitude of the load reduction can be restricted by product temperature limitations and concerns about product quality (Kitinoja, 2013).

Hilton (2013) identifies four main factors affecting energy use in cold storage facilities: utilization, seasonal factors, throughput and the volume of blast freezing. Many energy savings techniques were identified resulting not only to greener operations but also to considerable monetary savings, among which:

- Improved monitoring and control of chamber temperatures and plant controls.
- Improvements in door design to reduce infiltration: The infiltration of warm

and humid outside air and the leakage of refrigerated air to the atmosphere are considered the largest heat load in a refrigerated warehouse.

- Energy-saving solid-state led lights: led lights reduce electricity consumption and heat inside a cold storage facility (Traditional lighting costs accounts for 10 to 12% of the total electricity utilization costs).
- The application of variable frequency drives on: Fans, Condenser fans, Screw, compressors, and Pumps. A variable frequency drive permits most induction motors to function at reduced speeds leading to tremendous power reduction.

Rogers (2012) considers automation as a solution for controlling costs; it can considerably reduce energy consumption (sometimes by as much as 80%), labor (sometimes by as much as 70%) and space requirements (sometimes by as much as 50%). Advancements in robotics have also allowed the use of automation in Palletizing.

According to the 2010 American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) Handbook on refrigeration, the pros and cons for using automation in warehouses are summarized as follows:

Table 6: Pros and Cons for using automation in warehouses

Pros	**Cons**
• Maintaining FIFO • Favorable cost per cubic meter (reducing footprint) • Minimizing product damage and pilfering • Minimizing direct material handling costs	• First cost of the racking system and building are very high • Slower access to products depending on product flow and location • Difficult access to cooling equipment for maintenance, unless installed in a penthouse • Careful evaluation of Air distribution

Automated Storage & Retrieval System (AS/RS) technology is a combination of equipment and controls implemented for accurately handling, storing and retrieving commodities. The benefits for using AS/RS as stated by the global cold chain alliance (2012) are:

- Organizing the warehouse (all goods are accounted for and are easily accessible).
- Reliable product handling and flexibility in fulfilling customers' needs.
- Warehouse space optimization (Reducing footprint).
- Continuous operations.
- Energy Efficiency.
- Keeping people out of Harsh Environments.

As totally automated warehouses are very expensive and render the firm less flexible and vulnerable during mechanical failures, an alternative solution is the use of a Warehouse management system (WMS). A WMS is an ongoing job allowing the firm to automate its operations by coordinating the tasks, recording accurate information and maximizing warehouse performance. It permits the facility to benefit from high productivity rates from its personnel, stock accuracy, and space utilization while removing manual record keeping and paperwork. The cost related to a WMS implementation has mainly 4 components: Licenses, professional services (training…), development costs (interfaces…), and support costs. However reasons such as having a slow moving stock or a low utilization rate or a shortage in funds or a rented warehouse, hinder the use of a warehouse management system (Cross, 2012).

Maintaining facility refrigeration in warm and humid climates is an absolute

necessity for reducing ice in freezers and equipment maintenance, providing a comfortable and safer work environment due to drier floors and preserving product quality. The amount of water moisture in a cold system must be maintained under the allowable maximum for acceptable operations and efficiency, and that because humidity is a universal contaminant of refrigeration systems.

According to the 2010 American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) Handbook on refrigeration, choosing the appropriate refrigerant is a crucial step. Ammonia is considered the typical refrigerant used mainly in the food and beverage industry; however R-22, R-507A or R-404A (replacements for R-502 and R-22) are used as well. The factors to consider when choosing refrigerants are: Cost, safety code issues, state and local codes, and the effects on global warming and ozone depletion.

The environmental effects during service and maintenance of refrigeration systems are not to be underestimated because of potential emissions. Clodic (1997) identified 6 types of emissions:

1. Fugitive emissions (cannot be precisely located)
2. Tightness degradation (due to temperature variations, pressure cycling and vibrations)
3. Component failures (poor construction or faulty assembly)
4. Losses during refrigerant handling (charging or opening the system without recovering the refrigerant)
5. Accidental losses (fires-explosions-theft…)
6. Losses at equipment disposal (intentionally venting rather than recovering refrigerant at the end of its life)

Warehousing contracts are usually managed by bidding for a project through a request for quotation (RFQ). Some of the pricing models include gain sharing and others don't, however no model is better than the other and the final judge is the customer. The most commonly used pricing models are listed below:

- Fee based on percentage of Sales Turnover or volume: includes usually a floor price covering the warehouse fixed costs and the rest is earned as a percentage of sales revenue or turnover. This model is easy for the customer, however it requires from the TPL to have a minimum number of employees because labor is the most variable cost in warehousing practices.
- Cost Plus model: includes estimating the total cost plus a mutually agreed upon fixed fee as a percentage of total cost. Works well for startups and when value added services are being offered.
- Price per square or cubic meter: a flat fee per area or volume per unit of time.
- Price per pallet position
- Cost per transaction pricing: a flat fee per unit of work.

The chamber of eco commerce (2012) identified many challenges for cold chain in emerging markets, especially in terms of security, underdeveloped infrastructure, and political instability mainly in the Middle East region. However, free trade zones have considerably better production, infrastructure facilities, beneficial financial incentives, and immune political, social, economic and legal environment than the host countries mainland. This allows trade free zones to be a better place for companies to operate and expand in countries with relatively high risk on their mainland (Malhotra& Papadopoulos, 2008).

FIAS (2008) describes free trade zones as duty-free areas, located globally in most ports of entry, offering mainly warehousing and distribution facilities for trade, re-

export, and transshipment operations. Both static and dynamic benefits can result from establishing these zones, among which: direct employment creation and income generation, foreign exchange earnings, foreign direct investment, government revenues, and regional development. Despite these benefits free zones have some potential but manageable economic costs for the government in terms of infrastructure spending, lost import duties, wages of government employees and duty-free goods leakage.

In the Middle East and North Africa region some zones permits manufacturing processes, however trading remains the predominant activity. Jebel Ali Free Zone in Dubai has become a successful model in the Middle East region that triggered the initiation of an increasing number of similar zones in the region (FIAS, 2008).

CHAPTER IV

CURRENT STATE OF THE LEBANESE MARKET

A. Overview

Lebanon has a resilient, free market, primarily service-oriented economy with a large pool of skilled professionals whom are considered to be the pillars of a successful business. However, Lebanon is currently facing high economic uncertainty as a result of major political and financial challenges caused especially by the conflicts and political turbulence in Syria. According to the Transparency International Corruption Perception Index report (2013), Lebanon is ranked 127 out of 177 countries with a score of 28/100 compared to a score 30/100 in 2012, where 100 means that the public sector is perceived as very clean and 0 as highly corrupted. In the Middle East, the average regional corruption score in 2013 was 37/100 with 84% of the countries scoring less than 50%, and Lebanon ranks 13 out of the 19 MENA countries.

Currently Lebanon operates two free zones situated in Beirut port and Tripoli port, one duty free area situated in Rafic Hariri international airport and one logistics Free zone situated in Beirut port that allows 100% foreign ownership and customs' duties exemption. The Lebanese legislation encourages foreign investment, and according to the World Bank's Doing Business report (2013), starting a business in Lebanon requires 5 steps on average and 9 days, compared to an average of 8 steps and 23 days in the Middle East and North Africa region. However, Lebanon ranked 115 out of 183 countries in 2013 on the ease of doing business. This is mainly due to the burdensome

bureaucracy, the complex customs procedures, corruption, political intervention, the lack of adequate infrastructure and electricity shortages.

These challenges along with high levels of public debt (138% of GDP in 2012 according to the ministry of finance) are hindering the economy's growth. Since 2011, GDP growth was slowed down from 8% in 2010 according to the International monetary fund data, to 2% in 2011and and was estimated at 1% in 2013 (Refer to figure 3). Forecasted growth rates for the years 2014 & 2015 are 1% and 2.5% respectively according to IMF forecasts and 2% and 2.7% according to World Bank forecasts.

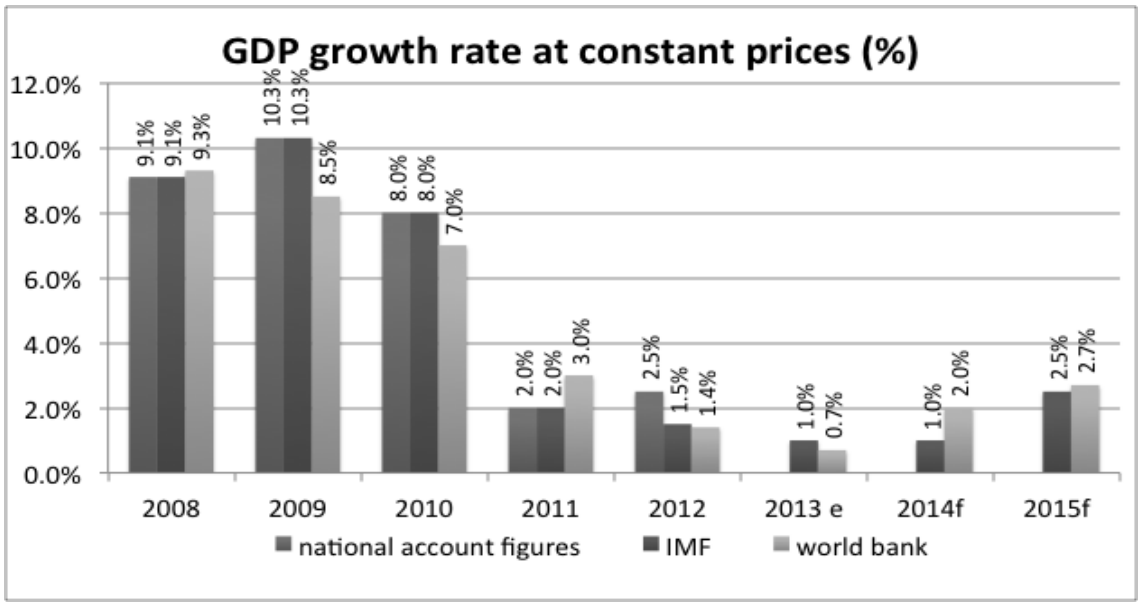

Figure 3: GDP growth rate at constant prices (%)

Note: no national account figures estimates for 2013 or projections for 2014-2015

Source: Ministry of finance (2014), IMF (2014), World Bank (2014)

Pegging the exchange rate of the Lebanese pound to the dollar, along with inflation rates and regulations concerning boycotting Israeli products all have their implications on the economy in general and on the balance of trade in particular. According to the central administration of statistics (2013) the consumer price index

(CPI) for December 2013 was 130.9 compared to the selected base year (December 2007). This means that prices at the end of 2013 are 30.9% higher than prices at the end of 2007. However, CPI only increased by 1.4 points from Dec 2012 to Dec 2013 from 129.5 to 130.9.

The worldwide Logistics Performance Index (LPI), a study conducted by the World Bank, measures the performance on trade logistics of a country across 160 countries based on six dimensions: customs, infrastructure, international shipments, logistics competence, tracking & tracing, and timeliness (Logistics performance index, 2014). The top logistic performer for the year 2014 is Germany with an LPI score of 4.12 over 5, and the worst logistic performer is Somalia with an LPI score of 1.77 over 5. Lebanon has dramatically lost its global ranking as the 33rd logistic performer in year 2010 to a ranking of 96 in year 2012, nevertheless its position ameliorated in 2014 to a ranking of 85 with an LPI score of 2.73 over 5. Figure 4, tracks Lebanon's performance on each of the LPI criteria over time. Since 2007, Lebanon's timeliness used to outperform all other measured dimensions, however in 2014, the highest score became for tracking and tracing scoring 3.22 over 5, and the worst for customs procedures scoring 2.29 over 5.

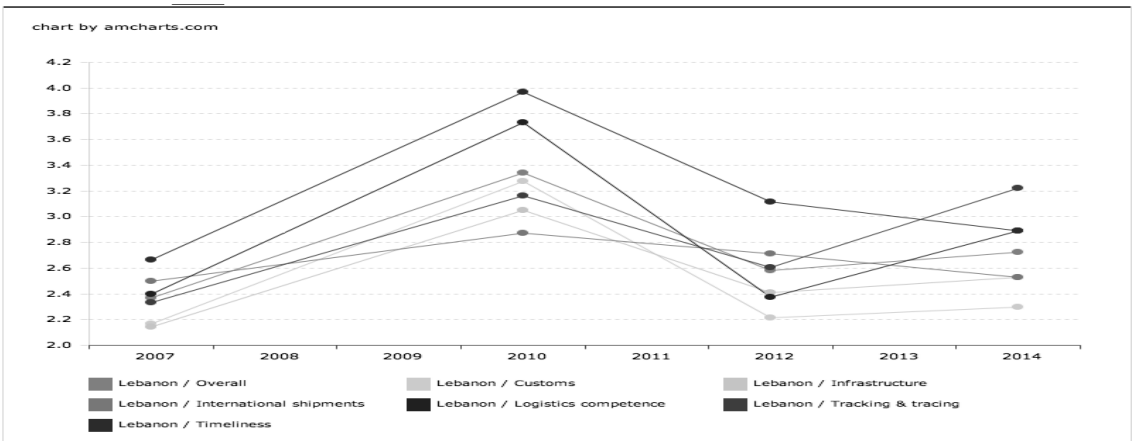

Figure 4: Logistics performance index - Lebanon from 2007 till 2014

According to the World Bank worldwide logistics performance index (2014) United Arab Emirates is the top performer in the Middle East region and is ranked 27 worldwide with an overall LPI score of 3.54, however Lebanon is still performing well among its income group " upper middle-income" category and the Middle East and North Africa region. (Refer to Figure 5 for benchmarking)

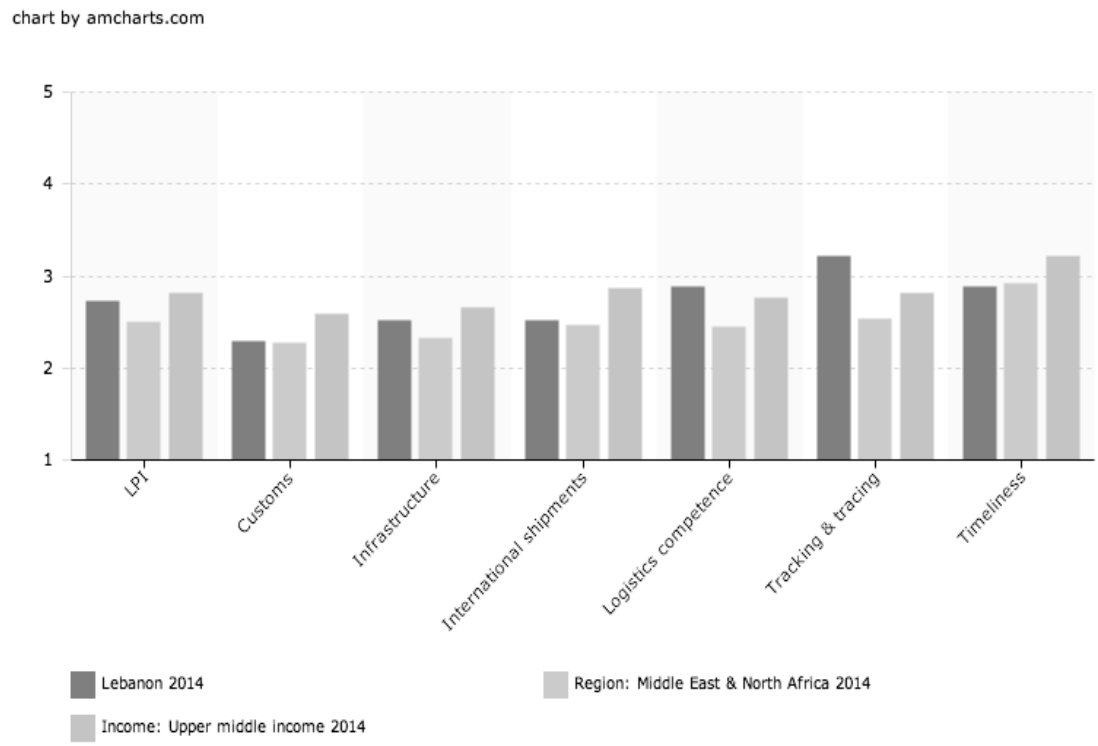

Figure 5: Logistics performance index- Lebanon vs. Income level & Region 2014

B. Trade statistics

Lebanon recorded a balance of trade deficit of approximately 26 trillion LBP for the year 2013. The largest incremental increase was in the year 2008 where the trade deficit

increased by 40.7%. Since 2009 the trade deficit has been increasing at an average rate of 6.6% per year. (Refer to figure 6)

The value of the Lebanese total imports for the year 2013 was around 32 trillion LBP. The average yearly increase in the value of imports from 1996 to 2013 is equal to 7.1% (not adjusted to inflation), and the average 5-year trend increase is 5.8%.

The value of the Lebanese total exports for the year 2013 was around 6 trillion LBP. The average yearly increase in the value of exports from 1996 to 2013 is equal to 11.3% (not adjusted to inflation), and the average 5-year trend increase is 3.1%.

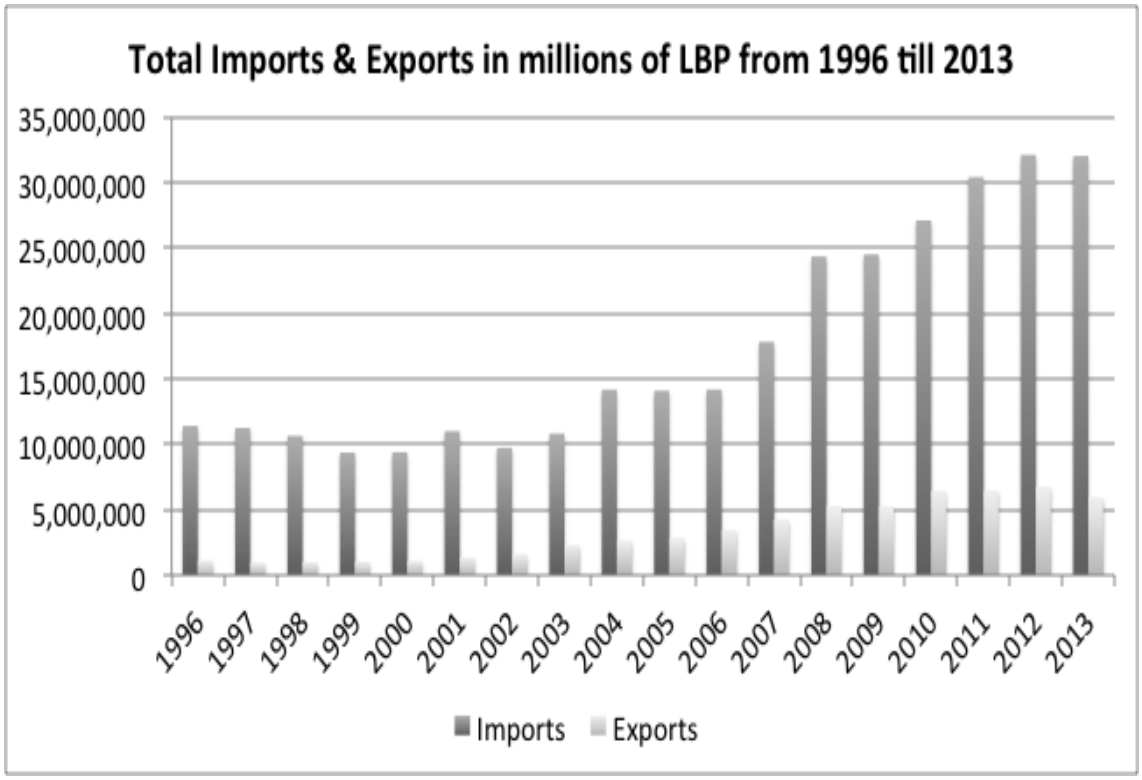

Figure 6: Total value of the Lebanese imports and exports 1996 -2013

Source: Ministry of economy and trade (2014)

Figure 7 shows the yearly distribution of the Lebanese imports and exports by net weight. Imports for the year 2013 were around 15.8 million tons and exports for the

* Note:
- The values used for the imports and exports are those of imports and exports special accounts.
- Exchange rate is: $1= 1,508 LBP.

same year were around 2.7 million tons. Import net weights are increasing by 5% per year (5-year average) and export net weights are decreasing by 4.2% per year (5-year average).

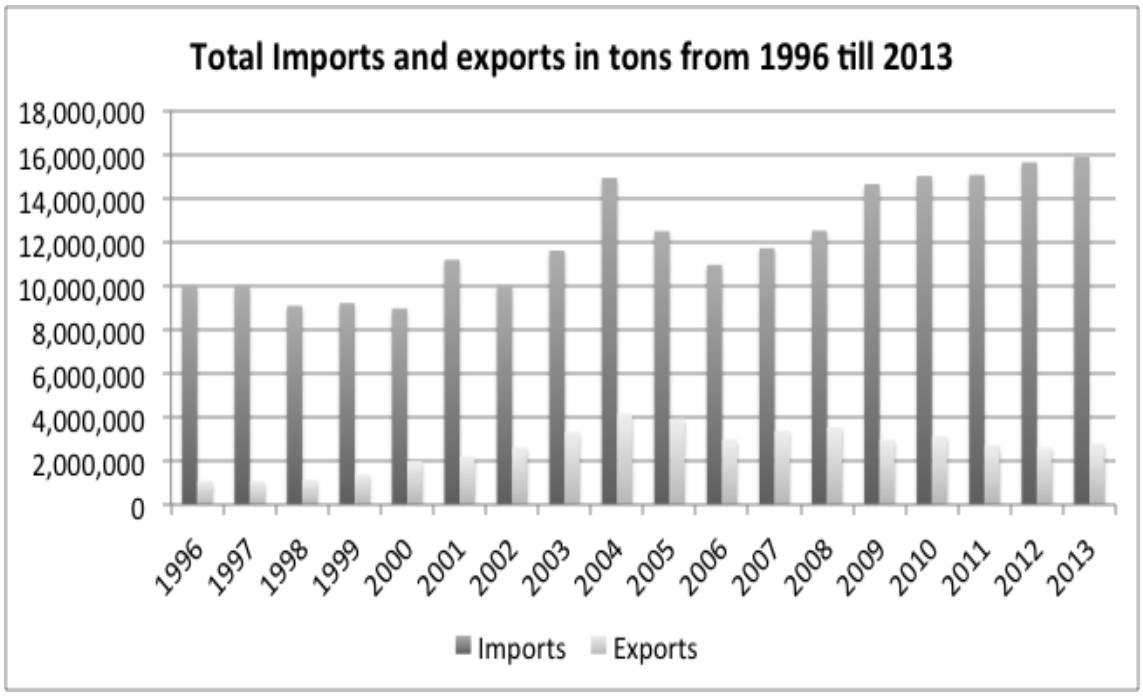

Figure 7: Total net weight of the Lebanese imports and exports 1996 – 2013

Source: Ministry of economy and trade (2014)

Out of the total Lebanese imports reported by the Lebanese customs authority for the year 2013 around 23 trillion LBP (73%) were imported through Beirut port, and 2.6 trillion LBP (44%) of total exports for the year 2013 were exported through Beirut port. The second largest customs office by value is Rafic Hariri international airport with 18% of imports and 30% of exports (Refer to figure 8)

As for the net weight distribution for the imports and exports, 11.7 million tons (74%) were imported through Beirut port and approximately 1 million tons (38%) of total exports for the year 2013 were exported through Beirut port.

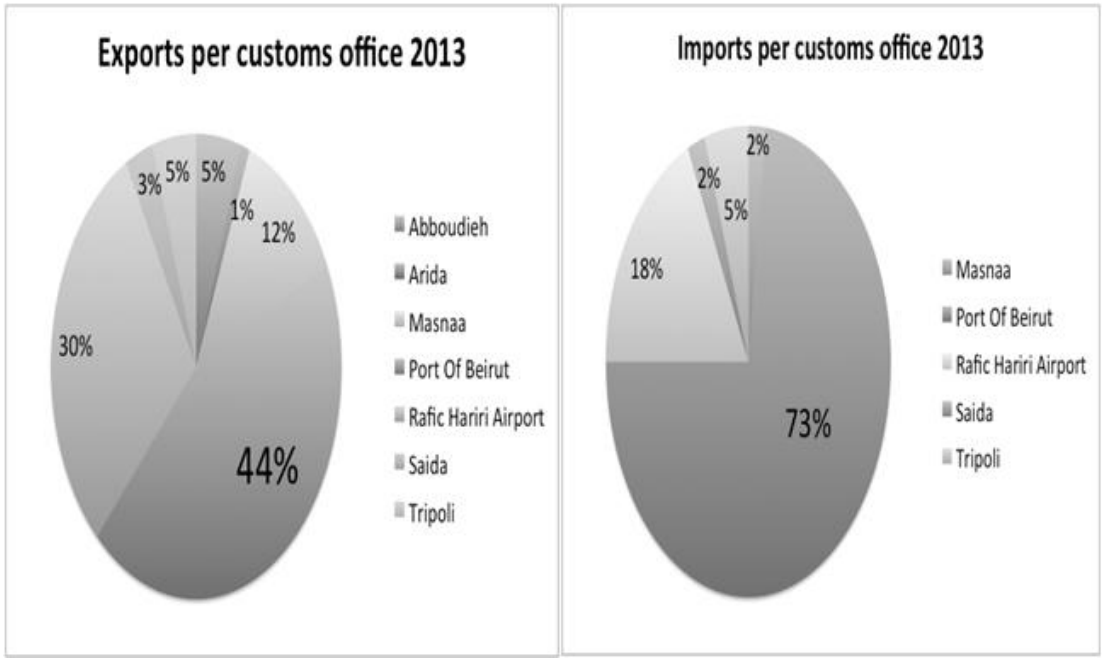

Figure 8: Lebanese Imports and exports per customs office 2013

Source: Lebanese customs (2013)

Re- export is the act of exporting goods that have been previously imported. Total Re-exports for the year 2013 was around 367 billion LBP and the maximum amount reached in the past years was 857 billion LBP in 2011. (Refer to figure 9)

Figure 9: Total Re-export

Source: Lebanese customs (2013)

Total Lebanese country's transit for the year 2013 was around 700 billion LBP with an increase of 34.2% increase from that of 2012. (Refer to figure 10)

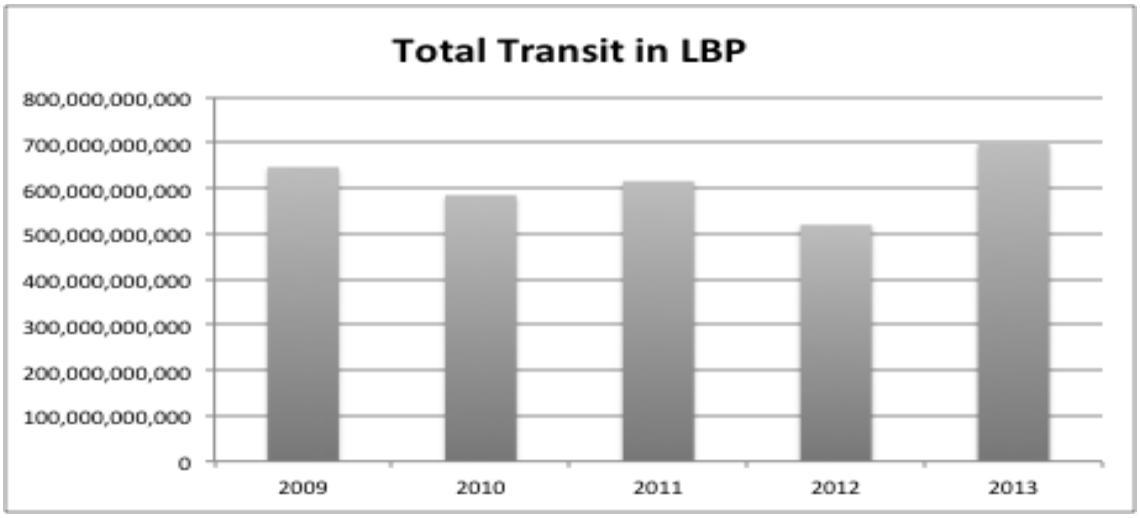

Figure 10: Total Transit

Source: Lebanese customs (2013)

C. Lebanese customs

a. Rules and regulations

Import and export of goods must be performed under one of the following customs statuses:

Table 7: Lebanese customs statuses

Export	Ordinary export	EX1
	Temporary export	EX2
	Re - export	EX3
Import	Import for local consumption	IM4
	Re - Import	IM6
Suspension tariffs cases	Temporary Admission for manufacturing or completion of manufacturing and temporary import	IM5
	Admission to the public, private, industrial or specialized warehouses	IM7
	Ordinary Transit	TR8
	International transit	B9 B10

Article 8 of the Lebanese customs law states that the classification of goods and their implied tariff codes and rates are categorized according to the "Harmonized Tariff Schedule".

This schedule is divided into 21 sections (HS1), each section is divided into chapters (HS2), each chapter is divided into headings (HS4), and each heading is divided into sub-headings (HS6). (Appendix IV provides a list of the different sections and chapters).

The higher council of customs is the competent authority to decide where to classify a certain good when no clear categorization based on the harmonized schedule is applicable.

The value of the imported goods to be declared is transaction based and equals the purchasing price from origin in addition to all the subsequent expenses incurred by the buyer until the arrival of goods to Lebanon (shipment, insurance, unloading etc.) Customs do not include charges paid after the arrival of goods, including Lebanese taxes and duties.

Demonstrating the origin of imported goods, i.e. the country of production or the country where the product is fully obtained, is crucial for fighting commercial fraud, implementing public health procedures and benefitting from preferential tariffs if applicable. If two or more countries were involved in the production of a product, the origin would be the last country in which a considerable increase in economic value took place. Transit and exported goods are exempt from specifying the country of origin.

Drugs, weapons, ammunition and explosive material in addition to the goods covered by the Israeli boycott law are not allowed in the free zone.

Article 180 of the Lebanese customs law defines transit as a duty deferring customs status allowing transportation of foreign goods from one customs house, warehouse or free zone to another inside Lebanon or abroad. There are two types of transit: **Ordinary Transit (**by Land, Sea or Air) and **International Transit (**railway or authorized road transport companies at their own risk)

Article 292 of the Lebanese customs law allows re- exporting goods discharged in customs warehouses to other countries under special guarantees stated by the customs administration.

Imported goods are subject to the following duties:

- **Customs duty:** articles 8 &9 of the Lebanese customs law differentiates two types of Customs tariffs on imports: Ordinary and preferential, where preferential tariffs apply to goods originating from countries with which Lebanon is bound by special customs agreements. The tariffs applied on the remaining ordinary classified goods shall be either:
    - A proportion of the value of goods.
    - A qualitative duty on the basis of a specific amount ("x" LBP per kilogram).
    - A combination of proportion of value and qualitative minimum (the highest duty is collected).

- **Local consumption duty:** this duty is applicable to certain types of goods including, but not limited to tobacco products, fuels, cars, cement, lime, plaster and alcohols.
- **The Value Added Tax (VAT):** 10% of the value of the goods approved by the customs in addition to the customs duty and any other charges
- **Stamp duty:** a lump sum of LBP fifty thousand.

Customs warehouses:

Articles 195 to 241 of the Lebanese customs law define customs warehouses as a "duty deferring status permitting temporary duty-free entry of goods for **storage and manufacturing purposes"**. Publically or privately managed warehouses can be located either within or outside the Custom's area, but either way they are subject to the custom's administration supervision. Goods exiting such warehouses are entitled to all applicable duties of goods directly imported.

There are three types of customs warehouses:

- Public warehouses storing goods belonging to third parties.
- Private warehouses storing licensed goods. These warehouses are also divided into two categories:
    - Private warehouses exclusively storing petroleum products
    - Specialized warehouses storing specific goods specified by the Higher Council of Customs.
- Manufacturing or industrial warehouses

Goods can be stored in public warehouses for a period of **two years** and in private warehouses for a period of **one year,** both renewable by a decision of the custom's General Director provided the good condition of the stored goods.

Private warehouses can be located in coastal or inner cities or suburbs and store foreign goods under the sole authority of the private warehouse owner.

Free zones:

Articles 242 to 261 of the Lebanese customs law allow the creation of free trade zones and free industrial zones by assigning segments of the ports and internal premises for such purposes, and are considered to be outside the customs area. These zones can admit all types of goods local or foreign, for an unlimited period of time, free of taxes and duties except for taxes charged by the entity operating the free zone. Goods offered to consumption are subject for the applicable duties.

The location of the free zone is to be decided by the higher council of customs upon the approval of the council of ministers, in addition the establishment has to confirm to special regulations governing the operations aimed for preventing illegal outflow of goods, but on the other hand all types of equipment used for setting and maintaining the infrastructure, except for those analogous to domestically produced goods, shall benefit from minimum customs duties.

Manufacturing and other manipulation processes can be executed in a free zone.

Goods imported by sea are to enter a free zone upon submission of a summary manifest, and can exit the premises at a later stage only after obtaining a license from the free zone operators.

b. Customs services fees

1) Storage fees

Articles 321 to 327 of the Lebanese customs law address storage fees for products stored for a period greater than five days within the area of customs or in the yards or

warehouses managed by customs. Storage fees must reflect the effective cost of the storage operations.

- Storage costs as of the sixth day are as follows:
    - In Beirut International Airport warehouses: LBP10.000/100 Kg/Week.
    - In other Customs Offices warehouses: LBP 2000/100 Kg/Week
- Storage costs rules:
    - Any fraction of 100 Kg pays charges imposed on 100 Kg
    - Fees are due at the beginning of each week
    - Storage in open- air areas are half the regular charges
- If the storage period exceeds 30 days, an extra charge shall be added as follows:
    - In Beirut International Airport warehouses:
        - From day 31 to 60: LBP2000/100Kg/day
        - From day 61 and above: LBP4000/100Kg/day
    - In other Customs Offices warehouses:
        - From day 31 to 60: LBP8/100Kg/day
        - From day 61 to 90: LBP16/100Kg/day
        - From day 91 to 120: LBP24/100Kg/day
        - From day 120 and above: LBP32/100Kg/day.

The five-days delay is extended to 30 days for goods in transit and to 15 days for goods intended for re-export. The total amount of storage fees should not in any way exceed half the value of goods.

2) Overtime fees

Overtime fees and services fees are to be fixed by the higher council of customs after consulting the general director of customs.

D. Beirut port

Beirut port is situated within a longitude of 35 57' E and a latitude of 35 15'N, forming the median of Europe, Asia and Africa continents. The port's total area is 1,200,000 m^2 and its water basin total area is around 1,000,000 m^2. The port hosts on average 3000-ships / year and is equipped with 6 ship-to-shore gantry cranes. The port contains 4 warehouses for general cargo (total area 25,547m2), 3 warehouses for groupage operation (total area 20,488m2), 3 warehouses for cars (total area 17,958m2), 1 open warehouse for cars and heavy load engines (total area 8,220m2), 1 warehouse for hazardous goods (total area 5.231m2), 156 warehouses in the Free zone area (approximately 200m2 each), 17 logistics warehouses in the logistics Free zone operated by 10 different companies and 6 industrial warehouses under construction. The logistic free zone in Beirut port was established in 2007 and includes warehouses receiving goods with a free zone destination. Investment in the logistic free zone is accessible to all companies operating in sectors related to transport, transit, export and international trade. The zone added value benefits are: hundred percent foreign ownership, customs exemptions on import and export, long-term / low-cost land and building leases, low-cost utilities (port of Beirut, 2013 a).

Leasing agreements for private courtyards in the logistic free zone are for 10 years renewable year by year after the termination of the contract and allow the occupant to

establish a private warehouse with a maximum height of 12 meters in the logistical area and 18 meters in the industrial area. The annual leasing fee in the logistical area is $\$22/m^2$ for the 2014 – 2016 period and increases by $3 every 3 years thereafter. The annual leasing fee in the industrial area is $\$27.5/m^2$ for the 2014 – 2016 period and increases by $3.75 every 3 years thereafter. Electricity charges are set based on the consumption level at a rate of 150LBP per kilowatt/hour, and may vary according to the tariffs set by electricity of Lebanon, plus 10% of technical and administrative expenses and 20% for established warehouses. Water charges are calculated by dividing total port Beirut water consumption by the total built up area in port Beirut and then charges for each warehouse are set on the basis of its area according to the official tariff of Water Service of Beirut, plus 10% as technical and administrative expenses. Special water consuming facilities are provided with counters and are charged on the basis of their consumption according to the official tariff of Water Service of Beirut, plus 15% as technical and administrative expenses. Direct delivery fee for general cargo to warehouse intended for local consumption is $25/ton and for those intended for transit, export or re-export $8/ton. Personal entry permits cost $15 per year (port of Beirut, 2013 b).

Article 24 in Beirut port tariffs (2013 c) indicates the charges collected for plugging refrigerated containers in electricity as follows:

- $35/day for a 20' reefer container (~$28m^3$ capacity).
- $45/day for a 40' reefer container (~$67m^3$ capacity).

Customers may also ask for an optional control service for refrigerated containers adding an extra $20/ day fee for both container sizes.

Note: Reefers intended for exporting goods benefit from a 27% refund on the electrical power fee.

The value of Beirut port imports is steadily increasing by 10% on average each year. Total Beirut imports in 2013 were equal to 23 trillion LBP and constituted 73% of the total Lebanese imports for the same year. (Refer to figure 11)

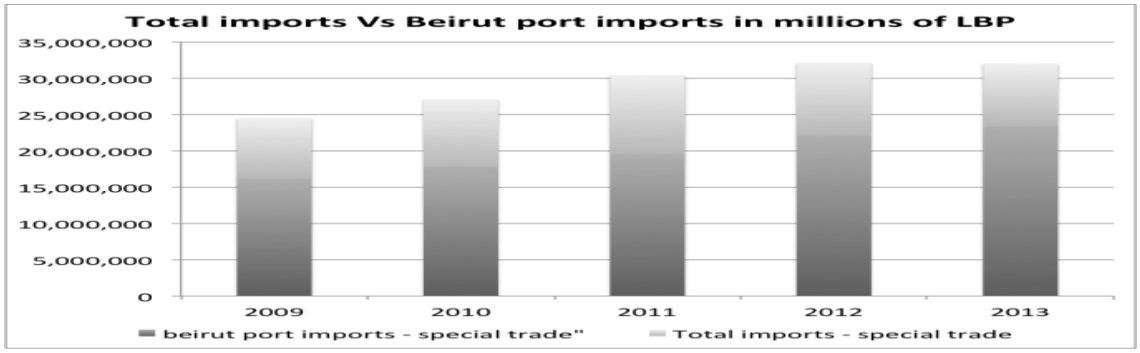

Figure 11: Total imports Vs. Beirut port imports

Source: Lebanese customs (2013)

The value of port Beirut exports increased by 36% from 2012 to 2013. On average 28% of the Lebanese total exports are usually from port Beirut, nevertheless in 2013 this share increased to 44% of total exports (Refer to figure 12). This abrupt increase may be partly attributed to the political situation in Syria and the shift of traders from moving goods through land to moving them through sea.

Figure 12: Total export Vs. Beirut port exports

Source: Lebanese customs (2013).

Beirut port exports to 163 countries and imports from 162 countries. China's imports by value constitute the highest share of imported goods 12%, followed by Italy 8% and France 8%. As for the port Beirut exported goods 10% of goods are to Saudi Arabia and 9% to Syria (Refer to figures 13 & 14). 18% of imported goods by net weight originate from china and 19% of exported goods by net weight are shipped to Turkey.

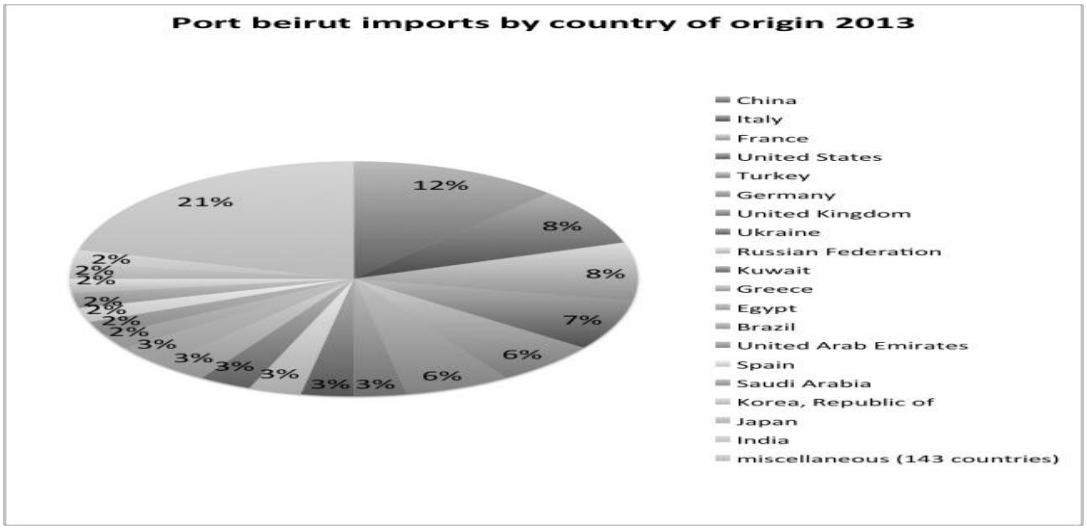

Figure 13: Port Beirut imports by country of origin

Source: Lebanese customs (2013)

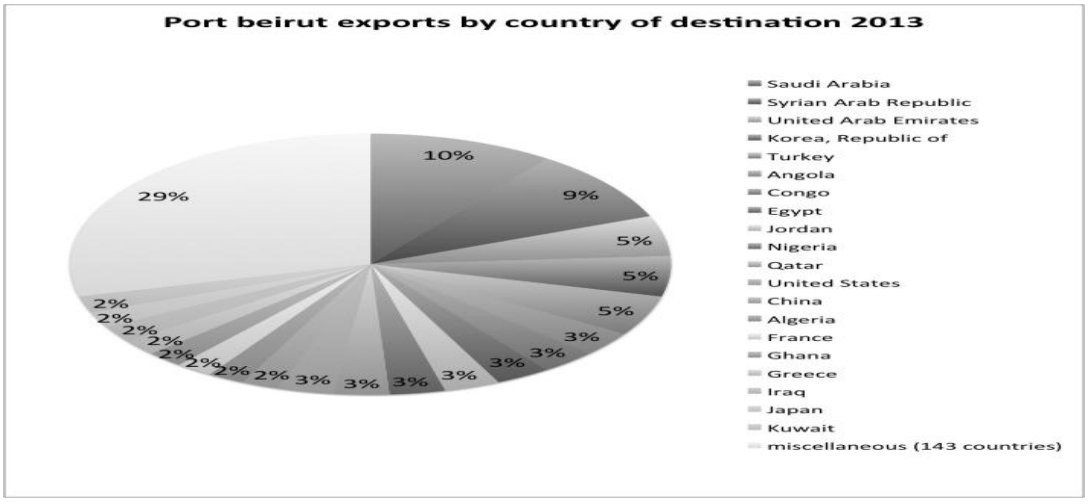

Figure 14: Port Beirut exports by country of destination

Source: Lebanese customs (2013)

The value of transit products vary widely from year to year, however on average 65% of transiting products by value are from Beirut port. A 40% increase in the value of transited goods was witnessed in port Beirut from 2012 to 2013 reaching a total value of 470 Billion LBP (Refer to figure 15). In addition, 79% of transit products by weight in 2013 are from Beirut port compared to a 21% average for the past years. This increase can be attributed to the decrease in the land transport because of the political situation in Syria (refer to figure 16).

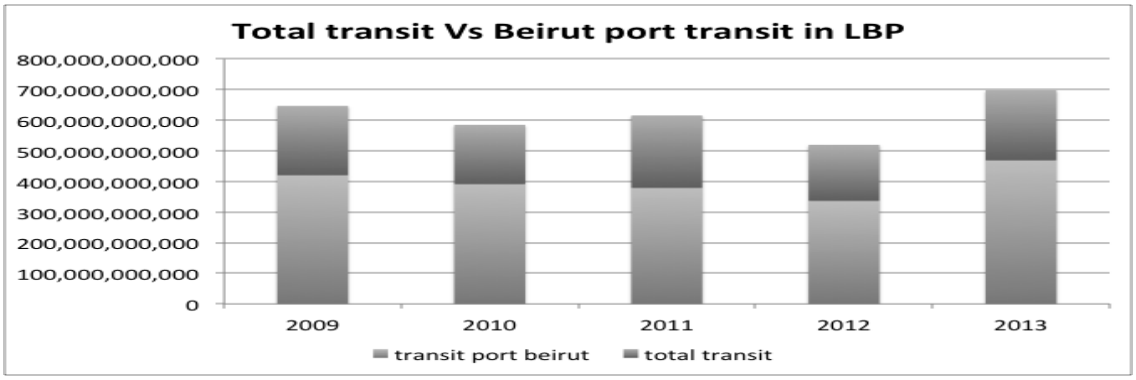

Figure 15: Total transit Vs. Beirut port transit in LBP

Source: Lebanese customs (2013)

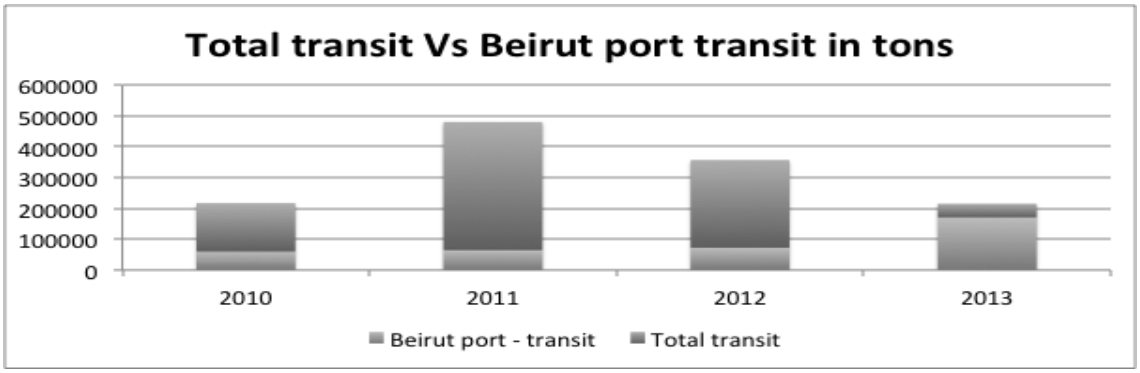

Figure 16: Total transit Vs. Beirut port transit in tons

Source: Lebanese customs (2013)

The distribution of imports and exports by chapter for products requiring refrigeration is shown in tables 8 & 9. Some of the recorded numbers may differ from the chapter distribution amounts published by the Lebanese customs because some

headings within each chapter do not require refrigeration and were omitted from the analysis (refer to appendices 1 and 2 for heading distribution of imports and exports).

Table 8: Refrigerated port Beirut imports & exports by chapter (LBP)

Beirut port		imports in millions of LBP ('000,000)					exports in millions of LBP ('000,000)				
		2010	2011	2012	2013	%	2010	2011	2012	2013	%
2	Meat and edible meat offal.	271,321	244,765	220,387	223,669	-6%	1,009	2,023	3,235	2,986	51%
3	Fish and crustaceans, molluscs	43,514	56,913	49,118	46,675	4%	184	130	330	204	29%
4	Dairy produce; birds' eggs; natural honey	321,866	356,835	386,585	469,452	14%	3,358	4,105	2,861	4,227	13%
7	Edible vegetables and certain roots and tubers.	59,092	59,208	55,572	84,362	15%	4,138	9,514	11,407	31,577	109%
8	Edible fruit and nuts; peel of citrus fruit	5,482	8,055	10,317	21,303	61%	7,396	7,155	14,759	22,050	51%
16	Preparations of meat, of fish or of crustaceans	117,845	115,852	138,099	154,313	10%	6,173	7,483	13,774	24,179	60%
21	Miscellaneous edible preparations	93,937	112,070	146,463	152,766	18%	15,505	14,845	15,476	26,338	23%
22	Beverages - spirits and vinegar	125,063	143,925	136,322	130,308	2%	22,061	23,772	30,225	33,640	15%
30	Pharmaceutical products.	434,817	473,461	414,954	487,169	5%	2,085	15,180	2,909	6,391	222%
Total		1,472,937	1,571,084	1,557,818	1,770,017	6%	61,909	84,207	94,975	151,591	36%

Table 9: Refrigerated port Beirut imports & exports by chapter (tons)

Beirut port		import in tons					Export in tons				
		2010	2011	2012	2013	%	2010	2011	2012	2013	%
2	Meat and edible meat offal.	42,035	31,362	32,389	34,733	-5%	1,507	2,276	2,616	2,505	21%
3	Fish and crustaceans, molluscs	10,307	11,266	9,345	9,702	-1%	37	33	76	92	47%
4	Dairy produce; birds' eggs; natural honey	54,215	48,030	55,500	64,965	7%	445	578	439	565	12%
7	Edible vegetables and certain roots and tubers.	68,298	57,727	62,468	88,882	12%	10,493	27,589	37,382	83,928	108%
8	Edible fruit and nuts; peel of citrus fruit	2,883	4,312	4,947	10,908	62%	14,634	10,889	30,645	47,986	71%
16	Preparations of meat, of fish or of crustaceans	20,095	17,753	19,424	21,873	3%	1,150	1,650	3,015	5,058	65%
21	Miscellaneous edible preparations	11,047	13,064	14,001	14,313	9%	5,068	4,290	4,227	7,650	21%
22	Beverages - spirits and vinegar	39,906	42,571	37,481	35,240	-4%	3,472	3,919	5,782	7,017	27%
30	Pharmaceutical products.	6,430	6,465	5,979	6,741	2%	85	236	195	302	72%
Total		255,216	232,550	241,534	287,357	5%	36,891	51,460	84,377	155,103	62%

Total refrigerated imports are increasing by an average of 6% per year by value and 5% per year by net weight. The highest average yearly increase of 62%, by net weight, is for imported fruits and nuts. The most imported refrigerated goods by weight are vegetables and dairy produce, and the total net weight for refrigerated imported goods for 2013 equaled approximately 287,000 tons.

Total refrigerated exports are increasing by an average of 36% per year by value and 62% per year by net weight. The highest average yearly increase of 108%, by net weight, is for vegetables. The most exported refrigerated goods by weight are vegetables and fruits, and the total net weight for refrigerated exported goods for 2013 equaled approximately 155,000 tons.

CHAPTER V

LEBANESE COLD STORAGE INDUSTRY

This section conducts a competitive market analysis for the cold storage industry in the Lebanese context and lists the services that can be offered and their relative prices.

A. Porter's five forces

The cold storage industry structure and future prospects for the facility being implemented were assessed based on Mickael Porter's five competitive forces:

a. Threat of new entrants [medium]

The establishment of a warehouse can be considered a relatively easy task due to the limited requirements for starting a business in Lebanon; however it is a high capital-intensive investment especially when implementing high levels of automation leading ultimately to lower flexibility and higher exit barriers. The capital requirements are considered high compared to local competitors yet they are reasonably affordable to foreign firms. Lebanese rules and regulations encourage foreign ownership especially in the free zone area, thus there is high risk of foreign competition offering broad warehousing and value added services. Infrastructure in Lebanon is not well developed however the situation is a lot better in the free zone. Economies of scale in this industry are hard to achieve due to the vast diversity of products and their required temperatures, the need for customization, and the reliance on high utilization rates. Outsourcing warehousing activities is considered to be a costly step for potential customers, however once done switching costs from one TPL to another is low. Brand equity is an important

element in this industry due to the vulnerability of products stored and the reluctance of customers to outsource in general. Finally, the profitability of the industry is moderately low (approximately 3%) and adding the country risk premium the possibility of foreign firms entering the market is reduced.

b. Threat of substitute products or services [Low]

Refrigeration remains the best way for preserving perishable products therefore there is a low propensity to substitute it for other conservation techniques. Imported goods at ports may be kept in refrigerated containers (reefers) until their consumption date without using a refrigerated facility but this leads to higher storing fees with fewer services and to a limited storage time period; In addition, products stored in reefers cannot be deconsolidated and have to be completely cleared before entering the market. Moreover products can be stored in warehouses outside the free zone area however this step in case of imports requires clearing products and paying customs charges directly at their exit from the customs area leading to an unnecessary expense that can be delayed if placed in the free zone. As for exports the customer is indifferent between storing goods inside or outside the free zone.

Customers may also return the warehousing activity in-house after outsourcing it or they may switch to other firms offering additional services to warehousing or other value added services. Bringing the activity in-house has a low likelihood of occurrence due to the logistical implications and capital investments associated with such a decision, as for switching to multipurpose firms, the decision increases storage costs but allows the firm to sign a one contract fits all type of agreement.

c. Bargaining power of customers [medium]

Traders importing or exporting goods and users of refrigerated services are dispersed all over the Lebanese market, and therefore have a low bargaining power. Concentrating TPL operations on few big accounts may pressure the firm for higher quality services and lower prices especially because of the relatively low switching costs as mentioned earlier. The range of services offered may increase the firm differential advantage however the firm must take into account the price sensitivity of buyers especially for those with small accounts. Products' quality remains a big concern for outsourcing companies and may reduce their likelihood to outsource.

Potential customers identified in the Lebanese market:

Clients for the cold storage facility are mainly of two categories:

- Companies owning refrigerated private warehouses and willing to outsource to benefit from economies of scale, or delay payment of customs fees, or profit from additional storage space, or amend inventory replenishments, or store products before export …(table 10)

Table 10: Potential customers for the refrigerated warehouse

Name	Location	Type and size	Stored products
Ali zaatari	South	Cold store 15,000 m3	Fruits & vegetables
Café najjar factory	Fanar	6 coolers rooms and 1 SAS a total volume of 2,000 m3	Coffee
Compagnie Generale du Levant	Beirut	Freezer 10,000 m3 Cold store 6,500 m3	-
Dekerco	Fanar	Distributor + 10 coolers and freezers, 1 blast freezer and 8 SAS corridors a total volume of 13,000 m3	Foods
Ghrawi chocolate factory	chwayfet	3 coolers rooms of total volume 1,000 m3	Chocolate and delights
Hawa chicken slaughter house	Anfeh	-	Poultry
Harkous chicken	khaldeh	-	Poultry
Malco-pain d'or	South	Cold store 13,000 m3	Foods
Nasser Jabali	Bekaa	Refrigeration 12,000 m3	-
Poulco	Mount Lebanon	Blast freezer 7t/day	Poultry
SLMC-pepsi	Mount Lebanon	Freezer of 3,000 m3	Beverages
Yamak	North	Cold store 11,000 m3	Fruits & vegetables

- Distributors of refrigerated products (table 11)

Table 11: Distributors of refrigerated products

Name	Location	Type and size	Stored products
Al aanani	Beirut	Distributor	Foods
Al wafaa al hadisa	Beirut	Distributor	Foods
Chafic halwani	Beirut	Distributor	Foods
Jounaidi	Jiyeh	Distributor	Foods
Tfayli	Beirut	Distributor	Foods
U food	Hazmieh	Distributor	Foods

d. Bargaining power of suppliers [Low]

Suppliers of a refrigerated warehouse are mainly tangible asset providers, software vendors, and transportation companies. There are plenty of tangible asset providers and IT companies in the Lebanese market and outside it. As for the distributors they are mostly concentrated in Beirut and Tripoli ports and the firm switching costs are relatively low, in addition the firm can also perform a backward integration and perform distribution services in-house, therefore there is a moderate bargaining power for suppliers of cold storage facilities. However the firm must take into consideration the consistency in transportation services in maintaining products' quality and the reliability of inventory tracking.

e. Intensity of competitive rivalry [medium]

The number of cold warehouses per capita in the Lebanese market is thought to be moderate especially because of the growing number of Syrian refugees. The competition between existing firms is mainly focused on the services offered, the pricing of these services and the use of technology mostly through inventory tracking systems. Several local, regional and international third party logistics providers offering refrigerated warehousing services were identified in the Lebanese market in general and

in Beirut port free zone in particular.

There are many small-refrigerated warehouses in Lebanon fulfilling the need of a specific region especially during fruits and vegetables harvesting seasons however they were not considered as direct competitors

Major competitors identified in the Lebanese Market

Table 12: Potential competitors for the refrigerated warehouse

Name	Location	Type and size
Agility (PWC logistics)	Beirut	Temperature regulated warehouse 19,000m^3
Aramex	Beirut port free zone	-
Atallah & Muheissein	Bekaa	Cold store 14,000m^3
BPC logistics - Osayran	Dekwaneh	Freezers and cold store 10,843 m^3
Daccache green line	Bouwar	Freezers 405 m^3
Damco	Dekwaneh	-
Hdayed industrial trading & refrigeration	Majdlaya-zgharta	Cold store 19,800m^3
Holdal abou adal group	Beirut	Temperature regulated warehouse for F&B and pharmaceuticals
Idriss	Mount lebanon	Freezers 3,000m^3
Logistica - Obegi	Safra	Freezers 11,000m^3
Moreco – societe Tabbara	Chwayfet – mount Lebanon	Freezer 24,000 m^3
M+M Hechme logistics	Dayshounieh	Freezers 19,000m^3
NPPC	Bekaa	Cold store 55,000m^3
Selman trading	Bekaa	Cold store 8,000m^3
Transmed	Beirut	-

B. Services

Many refrigerated warehouse services were identified among the list of the top 25 public cold storage facilities performers for the year 2013 published by the global cold chain alliance (2014), with “Americold” ranking first as the top global performer in the industry with a capacity of approximately 27 million cubic meters. The most common services applicable in the Lebanese market, are summarized below:

- Multi temperature capability (freezer- cooler-dry)
- Accurate and efficient order picking (pallet-case-piece)
- Inspection
- Export/import services
- Weighing
- Labeling
- Bar coding
- Stamping
- Palletizing
- Repacking and custom packaging
- Boxing/re-boxing - Bagging
- Banding
- Stable and standardized WMS platform
- Web based computerized inventory Management (tracking products-generating reports…)
- Integrated billing system
- Goods rejection (returning defective goods)

- Cross docking (transporting products from inbound suppliers to outbound customers with minimal or no handling and storage time)
- Blast freezing
- Container loading/unloading

In addition, refrigerated warehouses must provide services related to the protection and safety of stored products, such as:

- Calibrated automatic temperature recording equipment for coolers and refrigerators.
- A continuous humidity-monitoring device with sensors placed at points representing humidity extremes.
- Ammonia sensors.
- Backup generators for power loss.
- Safety standards codes for: life, public health, fire and food.
- Pest control programs.
- Environmental procedures
- Hygienic performance of all operations

There are many international, regional and local companies offering temperature controlled warehousing in Lebanon. The distinction between them relies mainly on quality, cost and broadness of the services offered. The cold storage facility is strategically located in the Beirut port free zone; therefore most the services mentioned must be offered to apply a differentiation strategy, setting it ahead of its competition nonetheless while offering competitive prices.

Note the following:

- Do not offer blast freezing because the majority of stored products are imported and are already frozen, therefore this service is not crucial.
- Do not offer the service of downloading and uploading containers because it is offered by Beirut port administration at affordable prices.
- Allow piece picking in order to stress on the added value feature of the cold storage that allows partial container integration through deconsolidation, however, thrive to keep manipulating products in pallets as much as possible to reduce inventory levels and packaging requirements.
- Ensure that the implemented WMS allows integration with the customer's ERP\Accounting system for better coordination and real-time information

C. Services pricing

Cold storage charges are basically of two types: handling charges (in & out) and storage charges. Handling charges increase as wages increase, as for storage charges, they increase as the number of value added services increases and as storing temperature decreases.

Handling charges were calculated as shown in table 13 below. The fees for downloading and uploading a container and the fees for emptying a container are those set by the Beirut port administration. The in & out fee was calculated as 2 times the emptying fee per cubic meter. The sum of the weighted averages of the fees paid for

emptying and downloading or uploading 20’ and 40’ containers, amounted to a total fee of $4.77/m^3. The cost of goods sold was assumed to be 60% of the total handling fee, therefore obtaining a **$7.95/m^3** handling fee.

Table 13: Handling fee calculation

Handling fee		
Container type	20'	40'
m3	28	67
emptiying a container fee ($)	66.43	85.82
$/m3	2.37	1.28
In+out	4.75	2.56
total containers (2009-2013)	3,168,870	1,968,225
weighted average $/m3	**3.91**	
download or upload a full container ($)	19.39	25.45
download or upload an empty container ($)	9.69	13.33
total fee	29.08	38.78
fee per m3	1.04	0.58
total containers (2009-2013)	3,168,870	1,968,225
weighted average $/m3	**0.86**	
total costs $/m3	**4.77**	
COGS	60%	
Handling fee $/m3	**7.95**	

There are many internal and external factors affecting the storage fee calculation. Internal factors include but are not limited to the initial costs, automation level, storing temperature, product type, the product volume, the inventory turns… External factors require market research and include mainly the willingness to pay of potential customers and the prices charged by competitors.

- An example for storage fee calculation is given in the “Model” section.

Freezers prices can be benchmarked against the price charged by Beirut port authority for plugging reefers in electricity, and coolers & dry prices can be

benchmarked against the prices charged for storing products in public warehouses managed by customs.

1. Price charged by Beirut port authority

The price is **$1.58/m^3 per day** and is calculated as the weighted average of the fees paid for plugging 20' and 40' reefers in Beirut port including the optional control $20 fee. The proportion of reefers to regular containers is unknown therefore the general proportion of 20' to 40' containers was assumed to be the same for 20' & 40'reefers and was used to calculate the weighted average price. (Calculations are shown in table 14)

Table 14: Price charged by Beirut port for plugging reefers

Plugging reefer in electricity fee		
Container type	20'	40'
m3	28	67
electricity charges per day + control service ($)	55	65
$ per m3	1.96	0.97
total containers (2009-2013)	3,168,870	1,968,225
price per $/m3	**1.58**	

2. Price charged by customs authority

Storing costs as of the 6th day is 2000 LBP per week per 100kg and increases each month to reach a maximum of 2032 LBP per week per 100kg as of the fifth month. The price is **$1.13/m^3 per day** and is calculated as the weighted average of the price per week times the number of weeks in which they are applied. Exchange rate is 1507 LBP/$1 and 0.6 tons were assumed to be the weight of one cubic meter. (Calculations are shown in table 15)

Table 15: Fee for storing goods in public warehouses managed by customs

Fee for storing goods in public warehouse managed by customs			
number of weeks	price per week LBP per 100kg	price per week LBP per ton	price per week $ per ton
3.63	2000	20000	13.27
4.33	2008	20080	13.32
4.33	2016	20160	13.38
4.33	2024	20240	13.43
34.64	2032	20320	13.48
weighted average fee	2844.83	2844.83	1.89
tons/m3	0.6		
price per $/m3	**1.13**		

The fee charged by customs for storing products in open-air areas is half the regular fee, therefore equaling **$0.57/m^3 per day**.

CHAPTER VI

MODEL

A model was developed in order to estimate the facility dimensions based on the expected weight of imports and exports requiring refrigeration for the ten upcoming years, by taking into consideration the firm's market share, the products' temperature requirements and approximate shelf lives, and the associated costs. The ten-year period was chosen to equal the land leasing agreement in Beirut port free zone. The objective of the simulation is to maximize the Net present value of the project by finding the best area for a one-story facility.

The first step consists of categorizing imports and exports requiring refrigeration based on the harmonized schedule of the Lebanese customs by headings and sub-headings. Inputs for each product category describe its net weight in tons for the years 2010 to 2013.

The second step comprises adding temperature requirements (refer to appendix III for more details on temperature requirements for food products) and approximate shelf lives for each of the categories in order to classify them into different temperature segments. Shelf lives include mainly a minimum and a maximum time period for each product category due to a multitude of factors, however the average of these two periods was considered to be the product's validity. As for the temperature segments, chilled products were classified into 3 main temperature segments: [0;3]°C, [5;10]°C and [13;18]°C. Some chilled products especially fruits and vegetables can further be segmented based on their humidity requirements however this was not addressed in the model. Temperature ranges are relatively small due to the sensitivity of some products

to temperature changes and their likelihood to experience chilling injuries in case of large temperature changes. Frozen products were also classified into 3 more binding temperature segments: high temperature freezers [-2;0[°C, and low temperature freezers -18°C and -28°C.

The third step included computing sub-totals for each temperature segment for imports and exports across the years 2010 to 2013 in order to deduce their linear trend to predict future trade flows.

In the forth step, the dissipation rate i.e. the average stay of products in inventory was calculated for each temperature segment as equaling 60% of the weighted average of the average shelf lives of the products constituting this segment.

A. Illustrative example

The temperature segment [-2;0[was chosen as an example of application for the model because its imports and exports linear trends have the highest R-squared value (80%) and supposedly contain the least estimation error.

Model parameters & assumptions

- The cost of the storage box (warehouse without any refrigeration equipment), refrigerated machinery, foundation, sprinklers and racking were calculated based on the log linear distribution for refrigerated warehouses (-23°C) retrieved from Burden et.al (2002) adjusted to inflation. The -23°C warehouse costs in the United States were used for the -2°C warehouse in Lebanon in order to adjust for price differences between the two countries.

- The cost of material transport was calculated by using the linear distribution retrieved from Burden et.al (2002) adjusted to inflation without any adjustments for price differences due to the long distances travelled in the United States and the comparable fuel prices.
- Architecture and contingency costs are 9% and 10% respectively of the cost of box and refrigeration
- The cost of electrical and sewer work is 2% of cost of box.
- The plant requires 1 forklift (3 tons) and 1 alternative generator for $20,000 and $7,000 respectively

Limitations for the model:
- The actual fixed costs of the project in the Lebanese market such the cost of the storage box and refrigeration machinery… can be acquired through market research. The model can easily be adjusted once these values are available.
- The model can further be adjusted to account for uncertainty

- The plant will start its operation in the beginning of 2015
- The plant has $15,000 in miscellaneous revenues each year
- The electricity usage in KWH was also calculated by using the log linear distribution retrieved from Burden et.al (2002) as equaling 60% of the -23°C warehouse electricity usage.
- The maximum potential market share is 100% for imports and 40% for exports because exporters have lower incentive to store their products in a duty free area and hence are less likely to use the cold storage facility services. Therefore the ratio of exports to imports in the warehouse is 40:100.

- The market share for the refrigerated warehouse in 2015 is expected to be 5% of imports and increase by 1% thereafter to reach a maximum of 13% in 2023 since the facility has 7 main competitors in the market.
- All stored products are cleared after 11 weeks (Dissipation rate 0.21 years).
- The estimated product weight per cubic meter is 0.6 ton /m^3.
- The maximum warehouse height is 12m in compliance with Beirut port regulations for logistical area and the expected height utilization is 50% due to racking and the required empty space above racks (1.8 to 3 meters) to allow proper ventilation and sprinklers.
- The clear area required for aisles and ventilation is 40% of the total area.
- The number of skilled employees operating inside the warehouse is 1 employee per 460m^2.The monthly salary for a skilled employee is $900.
- Insurance and maintenance expenses are 4% of net fixed assets and 1% of total fixed assets respectively
- Marketing cost is 5% of the total revenues.
- Electricity, water, general cargo, downloading and uploading containers fees are those set by Beirut port administration.
- Storage cost is estimated to be 20% of the fee charged for defective & deteriorated products.
- Miscellaneous expenses are estimated to be 3% of total revenues.
- Straight-line depreciation is used for the building over a 10-year period and for the forklift and backup generator over a 7-year period.
- No offices or office equipment are required
- Charges do not include the value added tax (VAT)

- Terminal value of the firm was calculated as FCF 2023(1+g)/(WACC-g)
- The working capital is estimated at 15% of total revenues (Canadian Financial Executives Research Foundation, 2013)
- The weighted average cost of capital is estimated to be 13.73%. Debt to equity ratio is 40:60, tax rate is 15% and the cost of debt is 6%. There are no listed refrigerated warehouses to calculate the beta of the industry, however the beta for public warehousing was used as calculated by Reuters (2014). The risk free rate and risk premiums are those found on Damodaran online website (2014). WACC calculations are summarized in the table 16 below:

Table 16: WACC calculation

Beta	1.94
Rf USA	3.04%
Risk premium USA	5.00%
Ke cold storage USA	12.74%
country risk premium	6.75%
Ke Cold strage/Leb	19.49%
Kd	6%
tax rate	15%
weight of debt	40%
weight of equity	60%
WACC	**13.73%**

Demand calculations for temperature segment [-2;0[:

The demand for temperature segment [-2;0[was calculated as shown in the table below. “T bar” is the weighted average dissipation rate for this temperature segment per year, and the inventory calculated based on Little’s law is at any time of the year.

	2015	2016	2017	2018	2019	2020	2021	2022	2023
imports - tons	24,476	21,953	19,431	16,908	14,386	11,863	9,341	6,818	4,296
exports - tons	53,836	62,793	71,749	80,706	89,662	98,619	107,575	116,532	125,488
market share - imports	5%	6%	7%	8%	9%	10%	11%	12%	13%
market share - exports	2%	2%	3%	3%	4%	4%	4%	5%	5%
demand (tons/year)	2,300	2,824	3,369	3,935	4,523	5,131	5,761	6,412	7,084
T bar (year)	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21
Inventory (tons)	479	588	702	820	942	1,069	1,200	1,336	1,476
Inventory (m3)	799	981	1,170	1,366	1,570	1,781	2,000	2,226	2,459
required area m2	133	163	195	228	262	297	333	371	410
total area needed (+40%)	222	272	325	380	436	495	556	618	683
total volume m3	2,662	3,268	3,899	4,554	5,234	5,938	6,667	7,420	8,198

Warehouse dimension calculation for temperature segment [-2;0[:

The warehouse space in m^2 is the changing cell in the model, and the $460m^2$ is the initial value of the model that was set at random and will be optimized at a later stage. The available volume is calculated as the available space, which is equal to 60% of the warehouse space times 6 meters of height, which is equal to 50% of the maximum allowable height of 12m. The utilization of the warehouse is calculated as the inventory divided by the available volume.

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
warehouse space m2	460	460	460	460	460	460	460	460	460	460
warehouse volume m3	5,520	5,520	5,520	5,520	5,520	5,520	5,520	5,520	5,520	5,520
available space m2	276	276	276	276	276	276	276	276	276	276
available volume m3	1,656	1,656	1,656	1,656	1,656	1,656	1,656	1,656	1,656	1,656
available volume tons	994	994	994	994	994	994	994	994	994	994
Utilization	-	48.23%	59.21%	70.63%	82.50%	94.82%	100.00%	100.00%	100.00%	100.00%

Net income calculation for temperature segment [-2;0[:

Pro forma income statements were calculated for the years 2015 – 2023.

	2015	2016	2017	2018	2019	2020	2021	2022	2023
revenues from operations	**$368,856**	**$452,825**	**$540,194**	**$630,963**	**$725,131**	**$764,777**	**$764,777**	**$764,777**	**$764,777**
misc revenues	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000
Total Revenues	**$383,856**	**$467,825**	**$555,194**	**$645,963**	**$740,131**	**$779,777**	**$779,777**	**$779,777**	**$779,777**
handling costs	**($18,293)**	**($22,457)**	**($26,790)**	**($31,291)**	**($35,961)**	**($37,927)**	**($37,927)**	**($37,927)**	**($37,927)**
storage costs(perishables - defecive products)	**($67,666)**	**($83,070)**	**($99,097)**	**($115,749)**	**($133,023)**	**($140,296)**	**($140,296)**	**($140,296)**	**($140,296)**
Gross revenue	**$297,898**	**$362,299**	**$429,307**	**$498,923**	**$571,146**	**$601,553**	**$601,553**	**$601,553**	**$601,553**
cost of leasing land	($10,120)	($10,120)	($11,500)	($11,500)	($11,500)	($12,880)	($12,880)	($12,880)	($14,260)
electricity costs	($25,210)	($25,210)	($25,210)	($25,210)	($25,210)	($25,210)	($25,210)	($25,210)	($25,210)
water costs	($2,000)	($2,000)	($2,000)	($2,000)	($2,000)	($2,000)	($2,000)	($2,000)	($2,000)
fees on general cargo	($33,127)	($40,668)	($48,515)	($56,667)	($65,124)	($68,685)	($68,685)	($68,685)	($68,685)
skilled labor costs	($10,800)	($10,800)	($10,800)	($10,800)	($10,800)	($10,800)	($10,800)	($10,800)	($10,800)
G&A expenses (9% of total revenues)	($34,547)	($42,104)	($49,968)	($58,137)	($66,612)	($70,180)	($70,180)	($70,180)	($70,180)
insurance expense (4% net fixed assets)	($46,697)	($41,981)	($37,265)	($32,549)	($27,833)	($23,117)	($18,401)	($13,685)	($10,049)
maintenance costs (1% total fixed assets)	($11,674)	($11,674)	($11,674)	($11,674)	($11,674)	($11,674)	($11,674)	($11,674)	($11,674)
marketing expense (5% of total revenues)	($19,193)	($23,391)	($27,760)	($32,298)	($37,007)	($38,989)	($38,989)	($38,989)	($38,989)
IT	($5,000)	($5,000)	($5,000)	($5,000)	($5,000)	($5,000)	($5,000)	($5,000)	($5,000)
Misc. (3% of total revenues)	($11,516)	($14,035)	($16,656)	($19,379)	($22,204)	($23,393)	($23,393)	($23,393)	($23,393)
EBITDA	**$88,014**	**$135,315**	**$182,960**	**$233,709**	**$286,182**	**$309,625**	**$314,341**	**$319,057**	**$321,312**
depreciation	($117,899)	($117,899)	($117,899)	($117,899)	($117,899)	($117,899)	($117,899)	($117,899)	($117,899)
EBIT	**($29,886)**	**$17,415**	**$65,060**	**$115,810**	**$168,283**	**$191,725**	**$196,441**	**$201,157**	**$203,413**
interest (7%)	($32,687.84)	($32,687.84)	($32,687.84)	($32,687.84)	($32,687.84)	($32,687.84)	($32,687.84)	($32,687.84)	($32,687.84)
EBT	**($62,574)**	**($15,273)**	**$32,373**	**$83,122**	**$135,595**	**$159,037**	**$163,753**	**$168,469**	**$170,725**
taxes (15%)	$0	$0	($4,856)	($12,468)	($20,339)	($23,856)	($24,563)	($25,270)	($25,609)
NI	**($62,574)**	**($15,273)**	**$27,517**	**$70,654**	**$115,256**	**$135,182**	**$139,190**	**$143,199**	**$145,116**

Income statement results shown above are for the 460m^2 facility with handling prices set at \$7.95/m^3 and storage price as calculated in the next section.

<u>Storage price calculation for temperature segment [-2;0[:</u>

The total costs per year for operating a cold storage facility were calculated from the income statement. The average total cost for the 9 years (2015-2023) was divided by the minimum between the inventory volume and capacity volume to get the cubic meter storage cost per year. Adding a 2% markup the storage price for a 460 m^2 facility is **<u>\$1.03/m^3 per day.</u>**(Refer to table below) The markup is usually between 0.5 to 2% depending on the number of value added services offered.

	Storage price calculation								
	2015	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
total costs per year	($468,596)	($473,081)	($480,241)	($485,695)	($491,634)	($491,990)	($484,504)	($477,019)	($473,438)
inventory volume required m3	799	981	1,170	1,366	1,570	1,781	2,000	2,226	2,459
inventory volume available m3	2,459	2,459	2,459	2,459	2,459	2,459	2,459	2,459	2,459
costs $/m3/year	($586.70)	($482.48)	($410.57)	($355.50)	($313.11)	($297.10)	($292.58)	($288.05)	($285.89)
average storage costs $/m3/year	($368.00)								
Markup	2.0%								
price $/m3/year	**$375.36**								
price $/m3/day	**$1.03**								
price $/ton/year	**$625.59**								

B. Optimization result

The optimization is a linear maximization problem. The result obtained after maximizing the objective cell i.e. the net present value of the project by changing the area of the warehouse, under the constraint that the available volume for storage is less or equal the maximum volume requirement in 2023, was as follows:

- Build a 683 square meters warehouse facility for products requiring temperature of [-2,0[with an initial investment of approximately $1,600,000.
- Storage price are related to the size of the warehouse and are calculated by the model at **$1.25/m^3 per day.**
- The terminal value of the project is approximately $5,000,000.
- NPV of the project is: $1,070,681
- IRR of the project is: 21.87%.

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
market share - imports	0%	5%	6%	7%	8%	9%	10%	11%	12%	13%
market share - exports	0%	2%	2%	3%	3%	4%	4%	4%	5%	5%
EBIT	($15,030)	($91,744)	($38,756)	**$14,068**	**$70,827**	**$129,473**	**$187,956**	**$250,374**	**$314,679**	**$377,740**
Taxes	$0	$0	$0	$0	($3,956)	($12,753)	($21,525)	($30,888)	($40,534)	($49,993)
NOPAT	($15,030)	($91,744)	($38,756)	$14,068	$66,871	$116,720	$166,431	$219,486	$274,145	$327,747
NWC	$0	$59,517	$73,067	$87,164	$101,810	$117,005	$132,748	$149,040	$165,880	$183,269
Δ NWC	$0	$0	$13,549	$14,098	$14,646	$15,195	$15,743	$16,292	$16,840	$17,389
Fixed assets	$1,587,646	$1,587,646	$1,587,646	$1,587,646	$1,587,646	$1,587,646	$1,587,646	$1,587,646	$1,560,646	$1,587,646
net fixed assets	$1,587,646	$1,427,724	$1,267,802	$1,107,881	$947,959	$788,037	$628,115	$468,194	$335,272	$175,350
Δ Net fixed assets	0	($159,922)	($159,922)	($159,922)	($159,922)	($159,922)	($159,922)	($159,922)	($132,922)	($159,922)
									TV	**$5,026,630**
FCF	($1,602,675)	$68,178	$107,616	$159,892	$212,147	$261,448	$310,609	$363,116	$390,226	$470,280
warehouse space in m2	683									
height in m	12						**growth rate EBIT (perp.)**		**4.0%**	
NPV	$1,070,681						**WACC**		**13.73%**	
IRR	21.87%									

Note: The storage price calculated is an aggregate for all types of products stored, however in reality each type has its own storage price

CHAPTER VII

RECOMMENDATIONS

Besides market research results, the following recommendations must be taken into consideration to develop a sound operational model based on the industry's best practices.

Recommendation 1: Develop strategic outsourcing agreements and partnerships

Refrigerated warehouses abide to a great deal of rules and regulations affecting their daily operations and are subject to complex material handling, fluctuating energy costs and spatial constraints therefore firms are more willing to outsource their refrigerated warehousing operations to a third party in order to achieve economies of scale and support their future growth initiatives. However, the outsourcing intensity for refrigerated warehouses services is still low compared to other TPL services due to the perishable nature of the products stored and the inclination of firms to keep controlling refrigerated warehousing and transportation services for quality purposes, consequently outsourcing agreements must tackle strategic rather than just tactical dimensions, aligning the mission and vision of TPL providers with those of their customers.

The following steps must be undertaken:

- Develop long-term strategic agreements with customers involving risk-sharing pacts in order to increase customers' willingness to outsource.

- Use procurement arrangements such as “cost-plus incentive” contracts. These arrangements allow best in class refrigerated warehouses to optimize their operations while guaranteeing a fair price for their customers.
- Partner with some major transportation companies to ensure delivery accuracy.

Recommendation 2: Build and implement an accurate refrigerated facility design

The following tips must be taken into consideration:

- Build a single story warehouse since the majority of refrigerated warehouses have single story structures allowing them to benefit from lower first costs than those of a multistory facility and from maximum unit investment capacity with minimum overall operating costs, including refrigeration, labor and amortization. Typically the height of a cold storage facility is between 8.5 to 10.7 meters to allow forklift operations and usually an empty space of 1.8 to 3 meters is required above products for air units, sprinklers and lighting. Usually, about 40% of the floor area in a facility storing diverse merchandise is for aisles and space above products (American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE), 2010).
- Use automatic closing doors with improved designs to control heat loss.
- Provide multiple temperature segments: for Coolers: [0;3]°C, [5;10]°C and [13;18]°C and for freezers [-2;0[°C, -18°C and -28°C. The area of each temperature segment can be calculated by using a similar approach to that provided in the model section, and resulted in a 683 m^2 section for the [-2;0[temperature segment.

- Provide a place for dry storage since refrigerated products only account for 2.4% of total Beirut port imports and 9.6% of total Beirut port exports by weight.
- Provide controlled atmosphere storage rooms for preserving certain types of perspiring products especially fruits and vegetables constituting the majority of imports and exports to lengthen their storage time. Controlled parameters are humidity, temperature and the concentration of non-condensable gases.
- Use pallet racking for high-class operations. Pallet racking facilitates handling commodities stored and ensures a First Expire- First out (FEFO) or First In – First Out (FIFO) inventory management systems. On the other hand, pallet stacking allows the firm to use a large portion of the height of the storage facility however the practical height for stacking pallets without racks is 4.5 to 5.4 meters due to floor load limitations.
- Use mobile racking since it is the most used type of racking in refrigerated warehouses, however the major drawback for this racking type is its low speed for accessing products.
- Ensure that pallets are about 45 cm distant from walls to allow appropriate air circulation.
- Offer ample temperature controlled docking areas with seal-cushion closures on the doors to maintain product quality due to reduced ice formation, to lower equipment maintenance and to maintain a safer more suitable working environment.
- Provide completely operable areas for shipping office, electrical area, personnel welfare facilities and administration office.
- Provide a space for empty pallet storage and repair.

Recommendation 3: Operational tips

- Use First expire – First Out (FEFO) inventory management system since it is most commonly used in the cold storage industry.
- Perform frequent physical inventory counts for reliability based on the customers' requirements.
- Use 2 crews for introducing products to the warehouse, 1 from inside the warehouse and 1 from outside to safeguard the health of the employees due to constant temperature changes (Under normal operations docking areas are kept at a temperature of 1 °C).
- Provide security measures for theft of products such as recording cameras.
- Employ trained personnel to operate the plant and ensure the appropriate temperature requirements (Usually warehouses allocate 1 employee per 460m^2).
- Use radio frequency identification or pick-to-light systems for faster and more accurate order picking.
- Introduce parcel sortation in the shipping area to improve shipments accuracy and reduce labor costs.
- Introduce a specialized in-line system for case sealing and manifesting with semi-automated equipment in addition to barcoding during manifesting to efficiently speed up operations.
- A warehouse utilization of 60 to 70% is usually required to justify operations. The average utilization for members of the international association of refrigerated warehouses averaged 85% and79% in the first and second half of 2012 respectively.

- Purchase a standard battery-driven 3 tons forklift that can service one or two deep racks and can lift up to 7.62 meters in addition to downloading and uploading pallets from trucks
- Avoid temperature fluctuations inside the warehouse especially for vulnerable products such as tropical fruits and vegetables that can be subject to chilling injury or deterioration.

Recommendation 4: Cost reduction tips

The increasing trend in operating costs of a refrigerated warehouse has created a need for implementing more innovative and cost efficient solutions. The two major operating expenses in a cold storage facility are labor and energy costs. Standardization, technology investment, and alteration of business processes are the solutions to achieve improved energy efficiency, optimized labor, and ultimately to reduce costs.

Cold storage facility operators must find a balance between automation and labor since 100% automation is costly and hard to achieve, and relying only on labor reduces the firm's competitiveness. The proliferation of the stock-keeping units reduces picking efficiency and ultimately constrains automation; in addition the biggest obstacle to automation remains its cost. In order to achieve cube optimization in cold areas the firm must automate where it make sense by taking into consideration the return on investment.

The following procedures must be undertaken:

- Automate the consistent and predictable part of operations such as long-term customers' tasks or specific package types.

- Automate in harsh sub-zero environments where turnover rates are high and labor productivity is low.
- Automate reverse logistics functions for improved performance and operational accuracy.
- Automate palletizing activity
- Use led lights to reduce heat inside the facility and electricity costs.
- Use ammonia for refrigeration since it is considered the typical refrigerant mainly used in the food and beverage industry. Ammonia is accepted by the Lebanese laws and regulations and is cost effective, however it requires specific safety procedures and has detrimental effects on global warming and ozone depletion in case of emissions.
- Use variable frequency drives on: Fans, Condenser fans, Screw, compressors, and Pumps to reduce electricity consumption
- Think about introducing a conveyor based zone picking and zone routing to reduce walking if applicable.
- Do not use automated Storage & Retrieval System (AS/RS) because of its high initial costs that will yield a negative return on investment.

CHAPTER VIII

CONCLUSION

This project investigates Third Party Logistics companies providing refrigerated warehousing services and assesses the viability of the project in the Lebanese market in general and in the Beirut port free zone in particular.

The project provides insights and recommendations for the cold storage facility being implemented in Beirut port in terms of best practices and key performance indicators in addition to a competitive market analysis, and provides the company with an approach for estimating the size of each temperature segment within the warehouse. Many assumptions taken to develop the model can be validated through market research; however this step was not performed due to time limitations, and can be easily achieved by the cold storage company.

There are many challenges facing the establishment of a cold storage facility in emerging markets mainly because of the political situation and underdeveloped infrastructure. However, the economic growth prospects for emerging markets remain high compared to other developed economies, and thus a careful implementation of such project is critical and presents a great business opportunity.

APPENDIX I

BEIRUT PORT IMPORTS BY CHAPTER

- Chapter 2: Meat and edible meat offal

Imports									
#	Heading HS4	2010		2011		2012		2013	
		000,000 LBP	Net tons	000,000 LBP	Net tons	000,000 LBP	Net tons	000,000 LBP	Net tons
2.01	Meat of bovine animals, fresh or chilled.	182,319	22,589	178,167	18,672	128,882	13,798	121,295	13,763
2.02	Meat of bovine animals, frozen.	54,919	11,143	46,295	8,330	46,376	7,595	48,582	8,733
2.03	Meat of swine, fresh, chilled or frozen.	262	53	1,038	185	803	149	1,054	188
2.04	Meat of sheep or goats, fresh, chilled or frozen.	3,566	472	2,721	289	3,055	380	2,482	448
2.06	Edible offal of bovine animals, swine, sheep, goats, horses, asses, mules or hinnies, fresh, chilled or frozen.	1,381	514	1,545	470	1,265	423	1,585	505
2.07	Meat and edible offal, of the poultry of heading No. 01.05, fresh, chilled or frozen.	27,393	7,148	13,998	3,338	39,167	9,971	47,450	11,010
2.08	Other meat and edible meat offal, fresh, chilled or frozen.	426	57	268	34	241	31	360	44
2.10	Meat and edible meat offal, salted, in brine, dried or smoked; edible flours and meals of meat or meat offal.	1,055	60	733	43	598	42	861	42
Total		**271,321**	**42,036**	**244,765**	**31,361**	**220,387**	**32,389**	**223,669**	**34,733**

- Chapter 3: Fish and crustaceans, mollusks

Imports									
#	Heading HS4	2010		2011		2012		2013	
		000,000 LBP	Net tons	000,000 LBP	Net tons	000,000 LBP	Net tons	000,000 LBP	Net tons
3.02	Fish, fresh or chilled, excluding fish fillets and other fish meat of heading No. 03.04.	31	3	0	0	0	0	91	11
3.03	Fish, frozen, excluding fish fillets and other fish meat of heading No. 03.04.	7,242	3,030	9,675	3,309	7,265	2,390	9,880	3,262
3.04	Fish fillets and other fish meat (whether or not minced), fresh, chilled or frozen.	19,278	5,463	21,897	5,659	18,387	4,816	17,254	4,742
3.05	Fish, dried, salted or in brine; smoked fish, whether or not cooked before or during the smoking process; flours, meals and pellets of fish, fit for human consumption.	83	11	37	5	124	11	37	6
3.06	Crustaceans, whether in shell or not, live, fresh, chilled, frozen, dried, salted or in brine; smoked crustaceans whether in shell or not, whether or not cooked before or during the smoking process; crustaceans, in shell, cooked by steaming or by boiling in water, whether or not chilled, frozen, dried, salted or in brine; flours, meals and pellets of crustaceans, fit for human consumption.	14,725	1,371	22,448	1,822	19,774	1,575	17,300	1,267
3.07	mollusks, whether in shell or not, live, fresh, chilled, frozen, dried, salted or in brine; smoked mollusks, whether in shell or not, whether or not cooked before or during the smoking process; flours, meals and pellets of mollusks, fit for human consumption.	2,155	429	2,856	471	3,561	554	2,042	398
3.08	Aquatic invertebrates other than crustaceans and mollusks, live, fresh, chilled, frozen, dried, salted or in brine; smoked aquatic invertebrates other than crustaceans and mollusks, whether or not cooked before or during the smoking process; flours, meals and pellets of mollusks, fit for human consumption.	0	0	0	0	6	0	70	15
Total		**43,514**	**10,307**	**56,913**	**11,266**	**49,117**	**9,346**	**46,674**	**9,701**

- Chapter 4: Dairy produce; birds' eggs; natural honey

Imports									
#	Heading HS4	2010		2011		2012		2013	
		000,000 LBP	Net tons	000,000 LBP	Net tons	000,000 LBP	Net tons	000,000 LBP	Net tons
4.01	Milk and cream, not concentrated nor containing added sugar or other sweetening matter.	16,546	7,676	13,767	2,792	13,722	2,795	15,138	3,086
4.02	Milk and cream, concentrated or containing added sugar or other sweetening matter.	116,789	19,870	131,903	18,450	140,376	21,135	169,256	22,760
4.03	Buttermilk, curdled milk and cream, yogurt, kephir and other fermented or acidified milk and cream, whether or not concentrated or containing added sugar or other sweetening matter or flavored or containing added fruit, nuts or cocoa.	170	33	340	62	1	1	387	116
4.04	Whey, whether or not concentrated or containing added sugar or other sweetening matter; products consisting of natural milk constituents, whether or not containing added sugar or other sweetening matter, not elsewhere specified or included.	1,422	697	1,278	392	947	345	2,135	692
4.05	Butter and other fats and oils derived from milk; dairy spreads.	48,378	5,736	55,882	5,885	47,874	5,701	54,538	6,019
4.06	Cheese and curd.	137,250	20,018	152,437	20,331	182,523	25,397	226,369	32,125
4.07	Birds' eggs, in shell, fresh, preserved or cooked.	0	0	0	0	0	0	19	3
4.08	Birds' eggs, not in shell, and egg yolks, fresh, dried, cooked by steaming or by boiling in water, molded, frozen or otherwise preserved, whether or not containing added sugar or other sweetening matter.	304	87	206	42	420	68	554	73
4.09	Natural honey.	1,006	97	1,021	76	724	58	1,056	90
4.10	Edible products of animal origin, not elsewhere specified or included.	1	0	0	0	0	0	0	0
Total		**321,866**	**54,214**	**356,834**	**48,030**	**386,587**	**55,500**	**469,452**	**64,964**

- Chapter 7:Edible vegetables and certain roots and tubers

Imports									
#	Heading HS4	2010		2011		2012		2013	
		000,000 LBP	Net tons	000,000 LBP	Net tons	000,000 LBP	Net tons	000,000 LBP	Net tons
7.01	Potatoes, fresh or chilled.	36,223	45,326	35,025	35,809	36,324	45,659	58,636	65,173
7.02	Tomatoes, fresh or chilled.	0	0	2	1	0	0	0	0
7.03	Onions, shallots, garlic, leeks and other alliaceous vegetables, fresh or chilled.	14,661	18,763	13,767	16,637	9,835	12,069	13,978	17,533
7.04	Cabbages, cauliflowers, kohlrabi, kale and similar edible brassicas, fresh or chilled.	1	0	0	0	3	2	3	2
7.05	Lettuce (Lactuca sativa) and chicory (Cichorium spp.), fresh or chilled.	354	204	250	162	430	297	546	474
7.06	Carrots, turnips, salad beetroot, salsify, celeriac, radishes and similar edible roots, fresh or chilled.	11	2	0	0	6	5	146	152
7.08	Leguminous vegetables, shelled or unshelled, fresh or chilled.	122	43	72	26	147	51	18	18
7.09	Other vegetables, fresh or chilled.	290	110	292	118	538	295	666	340
7.10	Vegetables (uncooked or cooked by steaming or boiling in water), frozen.	6,287	2,666	7,915	3,270	7,022	2,897	9,163	3,625
7.14	Manioc, arrowroot, salep, Jerusalem artichokes, sweet potatoes and similar roots and tubers with high starch or inulin content, fresh, chilled, frozen or dried, whether or not sliced or in the form of pellets; sago pith.	1,143	1,184	1,885	1,704	1,267	1,193	1,206	1,565
Total		**59,092**	**68,298**	**59,208**	**57,727**	**55,572**	**62,468**	**84,362**	**88,882**

- Chapter 8: Edible fruit and nuts; peel of citrus fruit

Imports									
#	Heading HS4	2010		2011		2012		2013	
		000,000 LBP	Net tons	000,000 LBP	Net tons	000,000 LBP	Net tons	000,000 LBP	Net tons
8.04	Dates, figs, pineapples, avocados, guavas, mangoes and mangosteens, fresh or dried.	2,695	1,431	3,913	1,781	4,509	1,843	9,664	3,659
8.05	Citrus fruit, fresh or dried.	22	7	25	10	42	14	42	17
8.06	Grapes, fresh or dried.	918	203	890	259	2,228	664	2,548	634
8.07	Melons (including watermelons) and papaws (papayas), fresh.	288	215	112	37	114	73	3,861	3,176
8.08	Apples, pears and quinces, fresh.	491	348	1,416	1,115	1,367	1,022	1,294	994
8.09	Apricots, cherries, peaches (including nectarines), plums and sloes, fresh.	57	41	19	21	12	10	19	20
8.10	Other fruit, fresh.	356	239	770	564	1,527	1,112	2,678	1,800
8.11	Fruit and nuts, uncooked or cooked by steaming or boiling in water, frozen, whether or not containing added sugar or other sweetening matter.	655	399	905	524	513	207	1,184	604
8.14	Peel of citrus fruit or melons (including watermelons), fresh, frozen, dried or provisionally preserved in brine, in sulfur water or in other preservative solutions.	0	0	5	1	5	2	13	4
Total		**5,482**	**2,883**	**8,055**	**4,312**	**10,317**	**4,947**	**21,303**	**10,908**

- Chapter 16: Preparations of meat, of fish or of crustaceans

Imports									
#	Heading HS4	2010		2011		2012		2013	
		000,000 LBP	Net tons	000,000 LBP	Net tons	000,000 LBP	Net tons	000,000 LBP	Net tons
16.01	Sausages and similar products, of meat, meat offal or blood; food preparations based on these products.	21,771	3,621	20,416	3,366	19,892	3,334	21,465	3,325
16.02	Other prepared or preserved meat, meat offal or blood.	37,854	7,223	39,618	6,475	37,133	5,736	50,456	7,763
16.04	Prepared or preserved fish; caviar and caviar substitutes prepared from fish eggs.	49,026	8,319	46,108	7,011	70,581	9,369	73,024	9,887
16.05	Crustaceans, mollusks and other aquatic invertebrates, prepared or preserved.	9,194	933	9,710	900	10,493	986	9,368	898
Total		**117,845**	**20,096**	**115,852**	**17,752**	**138,099**	**19,425**	**154,313**	**21,873**

- Chapter 21: Miscellaneous edible preparations

Imports									
#	Heading HS4	2010		2011		2012		2013	
		000,000 LBP	Net tons	000,000 LBP	Net tons	000,000 LBP	Net tons	000,000 LBP	Net tons
21.04	Soups and broths and preparations therefor; homogenized composite food preparations.	11,051	1,315	13,398	1,645	14,296	1,581	12,821	1,578
21.05	Ice cream and other edible ice, whether or not containing cocoa.	4,047	360	4,543	358	4,030	361	4,962	526
21.06	Food preparations not elsewhere specified or included.	78,839	9,372	94,129	11,061	128,137	12,059	134,983	12,209
Total		**93,937**	**11,047**	**112,070**	**13,064**	**146,463**	**14,001**	**152,766**	**14,313**

- Chapter 22: Beverages, spirits and vinegar

Imports								
#	Heading HS4	2010		2011		2012		2013	
		000,000 LBP	Net tons	000,000 LBP	Net tons	000,000 LBP	Net tons	000,000 LBP	Net tons
22.03	Beer made from malt.	21,358	23,513	16,679	17,217	14,259	14,457	15,295	14,254
22.04	Wine of fresh grapes, including fortified wines; grape must other than that of heading No. 20.09.	18,093	1,112	17,341	1,058	17,306	1,141	17,908	1,108
22.05	Vermouth and other wine of fresh grapes flavored with plants or aromatic substances.	379	45	303	46	273	37	331	41
22.06	Other fermented beverages (for example, cider, perry, mead); mixtures of fermented beverages and mixtures of fermented beverages and non-alcoholic beverages, not elsewhere specified or included.	87	24	63	29	56	22	103	27
22.07	Un-denatured ethyl alcohol of an alcoholic strength by volume of 80 % vol or higher; ethyl alcohol and other spirits, denatured, of any strength.	2,812	1,644	5,273	3,168	6,449	3,379	5,556	3,233
22.08	Un-denatured ethyl alcohol of an alcoholic strength by volume of less than 80 % vol; spirits, liqueurs and other spirituous beverages.	81,827	13,388	103,629	20,852	97,315	18,222	90,287	16,238
22.09	Vinegar and substitutes for vinegar obtained from acetic acid.	507	180	637	201	664	223	828	339
Total		**125,063**	**39,906**	**143,925**	**42,571**	**136,322**	**37,481**	**130,308**	**35,240**

- Chapter 30: Pharmaceutical products

Imports								
#	Heading HS4	2010		2011		2012		2013	
		000,000 LBP	Net tons	000,000 LBP	Net tons	000,000 LBP	Net tons	000,000 LBP	Net tons
30.02	Human blood; animal blood prepared for therapeutic, prophylactic or diagnostic uses; antisera, other blood fractions and immunological products, whether or not modified or obtained by means of biotechnological processes; vaccines, toxins, cultures of micro-organisms (excluding yeasts) and similar products.	0	0	235	7	771	10	491	7
30.03	Medicaments (excluding goods of heading No. 30.02, 30.05 or 30.06) consisting of two or more constituents which have been mixed together for therapeutic or prophylactic uses, not put up in measured doses or in forms or packing for retail sale.	1,321	20	262	12	1,646	43	363	9
30.04	Medicaments (excluding goods of heading 30.02, 30.05 or 30.06) consisting of mixed or unmixed products for therapeutic or prophylactic uses, put up in measured doses (including those in the form of transdermal administration systems) or in forms or packing for retail sale.	422,440	5,885	456,943	5,661	400,668	5,289	470,285	6,051
30.05	Wadding, gauze, bandages and similar articles (for example, dressings, adhesive plasters, poultices), impregnated or coated with pharmaceutical substances or put up in forms or packing for retail sale for medical, surgical, dental or veterinary purposes.	6,404	432	12,069	706	8,805	513	11,339	577
30.06	Pharmaceutical goods specified in Note 4 to this Chapter.	4,653	92	3,947	80	3,064	125	4,692	97
Total		**434,818**	**6,429**	**473,456**	**6,466**	**414,954**	**5,980**	**487,170**	**6,741**

APPENDIX II

BEIRUT PORT EXPORTS BY CHAPTER

- Chapter 2: Meat and edible meat offal

Exports									
#	Heading HS4	2010		2011		2012		2013	
		000,000 LBP	Net tons	000,000 LBP	Net tons	000,000 LBP	Net tons	000,000 LBP	Net tons
2.01	Meat of bovine animals, fresh or chilled.	220	26	34	2	18	1	29	1
2.02	Meat of bovine animals, frozen.	1	0	5	0	477	28	298	40
2.03	Meat of swine, fresh, chilled or frozen.	8	0	8	0	16	1	10	0
2.04	Meat of sheep or goats, fresh, chilled or frozen.	11	1	33	2	81	5	27	3
2.06	Edible offal of bovine animals, swine, sheep, goats, horses, asses, mules or hinnies, fresh, chilled or frozen.	1	0	27	27	120	107	0	0
2.07	Meat and edible offal, of the poultry of heading No. 01.05, fresh, chilled or frozen.	758	1,478	1,905	2,245	2,011	2,025	1,536	1,535
2.08	Other meat and edible meat offal, fresh, chilled or frozen.	0	0	0	0	35	29	60	56
2.10	Meat and edible meat offal, salted, in brine, dried or smoked; edible flours and meals of meat or meat offal.	10	2	10	1	478	420	1,027	869
Total		**1,009**	**1,507**	**2,022**	**2,277**	**3,236**	**2,616**	**2,987**	**2,504**

- Chapter 3: Fish and crustaceans, mollusks

Exports									
#	Heading HS4	2010		2011		2012		2013	
		000,000 LBP	Net tons	000,000 LBP	Net tons	000,000 LBP	Net tons	000,000 LBP	Net tons
3.02	Fish, fresh or chilled, excluding fish fillets and other fish meat of heading No. 03.04.	8	1	13	3	18	4	1	0
3.03	Fish, frozen, excluding fish fillets and other fish meat of heading No. 03.04.	43	24	93	27	86	51	98	78
3.04	Fish fillets and other fish meat (whether or not minced), fresh, chilled or frozen.	108	10	7	1	81	11	16	1
3.05	Fish, dried, salted or in brine; smoked fish, whether or not cooked before or during the smoking process; flours, meals and pellets of fish, fit for human consumption.	0	0	0	0	30	2	78	9
3.06	Crustaceans, whether in shell or not, live, fresh, chilled, frozen, dried, salted or in brine; smoked crustaceans whether in shell or not, whether or not cooked before or during the smoking process; crustaceans, in shell, cooked by steaming or by boiling in water, whether or not chilled, frozen, dried, salted or in brine; flours, meals and pellets of crustaceans, fit for human consumption.	26	1	17	2	107	7	0	0
3.07	mollusks, whether in shell or not, live, fresh, chilled, frozen, dried, salted or in brine; smoked mollusks, whether in shell or not, whether or not cooked before or during the smoking process; flours, meals and pellets of mollusks, fit for human consumption.	0	0	0	0	9	1	0	0
3.08	Aquatic invertebrates other than crustaceans and mollusks, live, fresh, chilled, frozen, dried, salted or in brine; smoked aquatic invertebrates other than crustaceans and mollusks, whether or not cooked before or during the smoking process; flours, meals and pellets of mollusks, fit for human consumption.	0	0	0	0	0	0	0	0
Total		**185**	**36**	**130**	**33**	**331**	**76**	**193**	**88**

- Chapter 4: Dairy produce; birds' eggs; natural honey

Exports									
#	Heading HS4	2010		2011		2012		2013	
		000,000 LBP	Net tons	000,000 LBP	Net tons	000,000 LBP	Net tons	000,000 LBP	Net tons
4.01	Milk and cream, not concentrated nor containing added sugar or other sweetening matter.	15	3	7	1	3	1	15	2
4.02	Milk and cream, concentrated or containing added sugar or other sweetening matter.	667	94	860	132	489	61	690	100
4.03	Buttermilk, curdled milk and cream, yogurt, kephir and other fermented or acidified milk and cream, whether or not concentrated or containing added sugar or other sweetening matter or flavored or containing added fruit, nuts or cocoa.	291	35	194	20	31	4	79	24
4.04	Whey, whether or not concentrated or containing added sugar or other sweetening matter; products consisting of natural milk constituents, whether or not containing added sugar or other sweetening matter, not elsewhere specified or included.	37	5	2	0	3	1	5	1
4.05	Butter and other fats and oils derived from milk; dairy spreads.	212	38	353	59	225	39	454	86
4.06	Cheese and curd.	1,903	240	2,596	358	2,006	318	2,369	319
4.07	Birds' eggs, in shell, fresh, preserved or cooked.	5	9	1	0	0	0	0	0
4.08	Birds' eggs, not in shell, and egg yolks, fresh, dried, cooked by steaming or by boiling in water, molded, frozen or otherwise preserved, whether or not containing added sugar or other sweetening matter.	27	3	1	0	1	0	0	0
4.09	Natural honey.	203	16	90	7	103	15	614	34
4.10	Edible products of animal origin, not elsewhere specified or included.	0	0	1	0	0	0	0	0
Total		**3,360**	**443**	**4,105**	**577**	**2,861**	**439**	**4,226**	**566**

- Chapter 7:Edible vegetables and certain roots and tubers

Exports									
#	Heading HS4	2010		2011		2012		2013	
		000,000 LBP	Net tons	000,000 LBP	Net tons	000,000 LBP	Net tons	000,000 LBP	Net tons
7.01	Potatoes, fresh or chilled.	3,891	10,169	9,184	27,404	10,861	36,257	29,585	80,657
7.02	Tomatoes, fresh or chilled.	0	0	0	0	0	0	0	0
7.03	Onions, shallots, garlic, leeks and other alliaceous vegetables, fresh or chilled.	42	103	24	72	198	1,016	613	2,056
7.04	Cabbages, cauliflowers, kohlrabi, kale and similar edible brassicas, fresh or chilled.	0	0	1	0	0	0	0	0
7.05	Lettuce (Lactuca sativa) and chicory (Cichorium spp.), fresh or chilled.	14	6	0	0	10	10	826	659
7.06	Carrots, turnips, salad beetroot, salsify, celeriac, radishes and similar edible roots, fresh or chilled.	0	0	3	2	0	0	2	0
7.08	Leguminous vegetables, shelled or unshelled, fresh or chilled.	45	20	136	58	83	36	81	43
7.09	Other vegetables, fresh or chilled.	48	17	140	46	124	31	184	61
7.10	Vegetables (uncooked or cooked by steaming or boiling in water), frozen.	29	8	26	7	131	32	265	422
7.14	Manioc, arrowroot, salep, Jerusalem artichokes, sweet potatoes and similar roots and tubers with high starch or inulin content, fresh, chilled, frozen or dried, whether or not sliced or in the form of pellets; sago pith.	69	170	0	0	0	0	21	30
Total		**4,138**	**10,493**	**9,514**	**27,589**	**11,407**	**37,382**	**31,577**	**83,928**

- Chapter 8: Edible fruit and nuts; peel of citrus fruit

Exports									
#	Heading HS4	2010		2011		2012		2013	
		000,000 LBP	Net tons	000,000 LBP	Net tons	000,000 LBP	Net tons	000,000 LBP	Net tons
8.04	Dates, figs, pineapples, avocados, guavas, mangoes and mangosteens, fresh or dried.	846	165	1,583	370	953	221	1,054	211
8.05	Citrus fruit, fresh or dried.	107	71	25	29	110	179	1,027	3,371
8.06	Grapes, fresh or dried.	1,182	578	1,289	749	2,933	1,394	5,084	3,301
8.07	Melons (including watermelons) and papaws (papayas), fresh.	0	0	0	0	0	0	0	0
8.08	Apples, pears and quinces, fresh.	5,142	13,743	4,112	9,617	10,541	28,337	13,622	37,755
8.09	Apricots, cherries, peaches (including nectarines), plums and sloes, fresh.	115	76	141	123	222	514	1,190	3,258
8.10	Other fruit, fresh.	3	1	0	0	0	0	73	90
8.11	Fruit and nuts, uncooked or cooked by steaming or boiling in water, frozen, whether or not containing added sugar or other sweetening matter.	1	0	5	1	0	0	0	0
8.14	Peel of citrus fruit or melons (including watermelons), fresh, frozen, dried or provisionally preserved in brine, in sulfur water or in other preservative solutions.	0	0	0	0	0	0	0	0
Total		**7,396**	**14,634**	**7,155**	**10,889**	**14,759**	**30,645**	**22,050**	**47,986**

- Chapter 16: Preparations of meat, of fish or of crustaceans

Exports									
#	Heading HS4	2010		2011		2012		2013	
		000,000 LBP	Net tons	000,000 LBP	Net tons	000,000 LBP	Net tons	000,000 LBP	Net tons
16.01	Sausages and similar products, of meat, meat offal or blood; food preparations based on these products.	114	20	206	35	403	68	3,354	398
16.02	Other prepared or preserved meat, meat offal or blood.	4,696	877	5,166	1,255	11,512	2,656	19,133	4,415
16.04	Prepared or preserved fish; caviar and caviar substitutes prepared from fish eggs.	1,336	249	2,033	348	1,751	284	1,688	245
16.05	Crustaceans, mollusks and other aquatic invertebrates, prepared or preserved.	26	4	78	11	107	7	3	0
Total		**6,172**	**1,150**	**7,483**	**1,649**	**13,773**	**3,015**	**24,178**	**5,058**

- Chapter 21: Miscellaneous edible preparations

Exports									
#	Heading HS4	2010		2011		2012		2013	
		000,000 LBP	Net tons	000,000 LBP	Net tons	000,000 LBP	Net tons	000,000 LBP	Net tons
21.04	Soups and broths and preparations therefor; homogenized composite food preparations.	991	164	941	167	1,147	146	1,227	156
21.05	Ice cream and other edible ice, whether or not containing cocoa.	135	30	36	4	83	8	36	5
21.06	Food preparations not elsewhere specified or included.	14,379	4,874	13,868	4,119	14,246	4,073	25,075	7,489
Total		**15,505**	**5,068**	**14,845**	**4,290**	**15,476**	**4,227**	**26,338**	**7,650**

- Chapter 22: Beverages, spirits and vinegar

Exports									
#	Heading HS4	2010		2011		2012		2013	
		000,000 LBP	Net tons	000,000 LBP	Net tons	000,000 LBP	Net tons	000,000 LBP	Net tons
22.03	Beer made from malt.	1,476	740	2,146	1,046	3,209	1,560	3,936	1,877
22.04	Wine of fresh grapes, including fortified wines; grape must other than that of heading No. 20.09.	16,195	1,755	17,506	1,780	20,109	1,819	20,240	1,719
22.05	Vermouth and other wine of fresh grapes flavored with plants or aromatic substances.	139	21	14	3	0	0	0	0
22.06	Other fermented beverages (for example, cider, perry, mead); mixtures of fermented beverages and mixtures of fermented beverages and non-alcoholic beverages, not elsewhere specified or included.	4	2	12	2	12	3	0	0
22.07	Un-denatured ethyl alcohol of an alcoholic strength by volume of 80 % vol or higher; ethyl alcohol and other spirits, denatured, of any strength.	14	2	2	1	15	6	35	7
22.08	Un-denatured ethyl alcohol of an alcoholic strength by volume of less than 80 % vol; spirits, liqueurs and other spirituous beverages.	3,581	390	3,439	587	6,071	1,664	8,062	2,458
22.09	Vinegar and substitutes for vinegar obtained from acetic acid.	652	562	653	500	809	730	1,367	956
Total		**22,061**	**3,472**	**23,772**	**3,919**	**30,225**	**5,782**	**33,640**	**7,017**

- Chapter 30: Pharmaceutical products

Exports									
#	Heading HS4	2010		2011		2012		2013	
		000,000 LBP	Net tons	000,000 LBP	Net tons	000,000 LBP	Net tons	000,000 LBP	Net tons
30.02	Human blood; animal blood prepared for therapeutic, prophylactic or diagnostic uses; antisera, other blood fractions and immunological products, whether or not modified or obtained by means of biotechnological processes; vaccines, toxins, cultures of micro-organisms (excluding yeasts) and similar products.	1	0	27	17	27	18	0	0
30.03	Medicaments (excluding goods of heading No. 30.02, 30.05 or 30.06) consisting of two or more constituents which have been mixed together for therapeutic or prophylactic uses, not put up in measured doses or in forms or packing for retail sale.	0	0	823	4	93	0	0	0
30.04	Medicaments (excluding goods of heading 30.02, 30.05 or 30.06) consisting of mixed or unmixed products for therapeutic or prophylactic uses, put up in measured doses (including those in the form of transdermal administration systems) or in forms or packing for retail sale.	2,082	84	14,310	214	2,779	165	6,388	301
30.05	Wadding, gauze, bandages and similar articles (for example, dressings, adhesive plasters, poultices), impregnated or coated with pharmaceutical substances or put up in forms or packing for retail sale for medical, surgical, dental or veterinary purposes.	2	0	14	1	9	12	1	1
30.06	Pharmaceutical goods specified in Note 4 to this Chapter.	1	0	6	0	0	0	1	0
Total		**2,086**	**84**	**15,180**	**236**	**2,908**	**195**	**6,390**	**302**

APPENDIX III

RECOMMENDED TEMPERATURES FOR FOOD PRODUCTS

	T°	Foods
Cold storage	12.8 to 17.8°C	Ginger, Pumpkin, Tomato, mature green, Cassava, Sweet potato, Taro, Yam, Breadfruit, Grapefruit
	7.2 to 10°C	Basil, Eggplant, Long bean, Okra, Squash, Watermelon, Capsicum (bell pepper), Cranberry, Grapefruit, Lemon, Lime, Pineapple, Tamarillo, Tangelo, Ugli fruit
	3.9 to 7.2°C	Beans, Cactus leaves, Cucumber, Chilli, Potato, Southern peas, Tomatillo, Blood orange, Prickly pear, Jujube, Kumquat, Mandarin, Olive, Orange, Persimmon, Pomegranate, Tamarind, Tangerine, Meat carcase, side, quarter or bone-in, Game, Edible Offal, Vacuum Packed Goods, Poultry (5°C) , Eggs (5°C)
	0 to 3.9°C	Onion, Garlic, Asparagus, Bok choy, Broccolini, Broccoli, Brussels sprouts, Cabbage, Carrot, Cauliflower, Celery, Chard, Chicory, Chinese cabbage, Collards, Cut vegetables, Endive, Green onion, Herbs (not basil), Kailon, Kale, Leek, Lettuce, Mint, Mushroom, Mustard greens, Parsley, Parsnip, Snow pea, Spinach, Sweet pea, Turnip greens, Watercress, Artichoke, Bean Sprouts, Beet, Celeriac, Horseradish, Jerusalem, Artichoke, Kohlrabi, Radish, Rhubarb, Shallot, Sweet corn, Turnip, Water chestnut, Bitter melon, Blackberry, Blueberry, Cherry, Coconut, Currant, Date, Gooseberry, Grape, Longan, Loquat, Lychee, Orange, Raspberry, Strawberry, Apple, Apricot, Avocado (ripe), Rock melon, Cut fruits, Fig, Kiwifruit, Nectarine, Peach, Nashi Pear, Pear European, Plum, Prune, Quince, Milk, Yoghurt, Cream, Butter, Margarine, Cheese, Meat carcase, side, quarter or bone-in, Meat portions, bones, carton meat, Rabbit, Uncooked Processed Meat (e.g., sausages, rissoles), Cooked Processed Meat (e.g., Ham, Luncheon Meats) Fermented Uncooked Processed Meat (e.g., Salami, Mettwurst), Green or Cooked Seafood
Frozen Storage	-17.8 to 0°C	Poultry (-15°C)
	-30 to -17.8°C	Butter (-27.8 to -20°C), Cheese (-27.8 to -20°C), Ice cream (-30 to -22°C), Fresh Meat Product (- 12.8°C), Seafood (Abalone, Cockles, Crab, Fin fish, Lobsters, Marron, Octopus, Oysters, Prawns, Scallops, Shark, Squid, Tuna (except Sashimi), Yabbies) (<-17.8°C)

Source: (Lekov et al., 2009)

Appendix IV

LEBANESE CUSTOMS DISTRIBUTION OF GOODS

#	Section (HS1)	#	Chapter (HS2)
1	Live animals; animal products	1	Live animals.
		2	Meat and edible meat offal.
		3	Fish and crustaceans, mollusks
		4	Dairy produce; birds' eggs; natural honey
		5	Products of animal origin
2	Vegetable products	6	Live trees and other plants; bulbs, roots
		7	Edible vegetables and certain roots and tubers.
		8	Edible fruit and nuts; peel of citrus fruit
		9	Coffee, tea, mate and spices.
		10	Cereals.
		11	Products of the milling industry; malt; starches;
		12	Oil seeds and oleaginous fruits; seeds and fruit
		13	Lac; gums, resins and vegetable saps and extracts
		14	Vegetable plaiting materials; vegetable products
3	Animal or vegetable fats and oils	15	Animal or vegetable fats and oils
4	Prepared foodstuffs; beverages, tobacco	16	Preparations of meat, of fish or of crustaceans
		17	Sugars and sugar confectionery.
		18	Cocoa and cocoa preparations.
		19	Preparations of cereals, flour, starch or milk
		20	Preparations of vegetables, fruit, nuts
		21	Miscellaneous edible preparations.
		22	Beverages, spirits and vinegar.
		23	Residues and waste from the food industries
		24	Tobacco and manufactured tobacco substitutes.
5	Mineral products	25	Salt; sulfur; earths and stone; lime and cement
		26	Ores, slag and ash.
		27	Mineral fuels and oils and distillation products
6	Products of the chemical or allied industries	28	Inorganic chemicals; organic or inorganic compound
		29	Organic chemicals.
		30	Pharmaceutical products.
		31	Fertilizers.
		32	Tanning or dyeing extracts; tannins ...
		33	Essential oils and resinoids; perfumery, cosmetics
		34	Soap, organic surface-active agents, waxes
		35	Albuminoidal substances; modified starches; glues
		36	Explosives; pyrotechnic products; matches
		37	Photographic or cinematographic goods.
		38	Miscellaneous chemical products.
7	Plastics and articles thereof; rubber	39	Plastics and articles thereof.
		40	Rubber and articles thereof.
8	Raw hides and skins, leather, fur skins	41	Raw hides and skins (other than fur skins), leather
		42	Articles of leather; Travel goods.
		43	Fur skins and artificial fur; manufactures thereof.
9	Wood and articles of wood; wood charcoal; cork	44	Wood and articles of wood; wood charcoal.
		45	Cork and articles of cork.
		46	Manufactures of straw, of esparto
10	Pulp of wood; paper and paperboard	47	Pulp of wood; Recovered paper or paperboard
		48	Paper and paperboard; articles of paper pulp

		49	Printed books, newspapers, pictures...
11	Textiles and textile articles	50	Silk.
		51	Wool, fine or coarse animal hair; horsehair yarn
		52	Cotton.
		53	Other vegetable textile fibers; paper yarn
		54	Man-made filaments.
		55	Man-made staple fibers.
		56	Wadding, felt and nonwovens; special yarns; twine
		57	Carpets and other textile floor coverings.
		58	Special woven fabrics; tufted textile fabrics
		59	Impregnated, coated, covered or laminated textile
		60	Knitted or crocheted fabrics.
		61	Clothing accessories, knitted or crocheted
		62	Clothing accessories, not knitted or crocheted
		63	Other made up textile articles; sets
12	Footwear, umbrellas, artificial flowers	64	Footwear, gaiters and the like
		65	Headgear and parts thereof.
		66	Umbrellas, sun umbrellas, walking-sticks...
		67	Prepared feathers and down; artificial flowers
13	Articles of stone, plaster, cement, glass	68	Articles of stone, plaster, cement, asbestos, mica
		69	Ceramic products.
		70	Glass and glassware.
14	Pearls, precious stones and metals	71	Natural or cultured pearls; precious metals
15	Base metals and articles of base metal	72	Iron and steel.
		73	Articles of iron or steel.
		74	Copper and articles thereof.
		75	Nickel and articles thereof.
		76	Aluminum and articles thereof.
		78	Lead and articles thereof.
		79	Zinc and articles thereof.
		80	Tin and articles thereof.
		81	Other base metals; cermet; articles thereof.
		82	Tools, implements, cutlery, of base metal
		83	Miscellaneous articles of base metal.
16	Machinery; electrical instruments	84	Nuclear reactors, boilers, machinery...
		85	Electrical machinery and equipment and parts
17	Vehicles, aircraft, vessels, transport equipment	86	Railway or tramway locomotives, rolling-stock
		87	Vehicles other than railway or tramway
		88	Aircraft, spacecraft, and parts thereof.
		89	Ships, boats and floating structures.
18	Optical, photographic, medical, musical instruments	90	Optical, photographic, cinematographic instruments
		91	Clocks and watches and parts thereof.
		92	Musical instruments; parts and accessories
19	Arms and ammunition; parts and accessories	93	Arms and ammunition; parts and accessories thereof
20	Miscellaneous manufactured articles	94	Furniture; bedding, mattresses, mattress supports
		95	Toys, games and sports requisites...
		96	Miscellaneous manufactured articles.
21	Works of art, collectors' pieces and antiques	97	Works of art, collectors' pieces and antiques.

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