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Assignment

Establishing A Intermodal Freight Corridor

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Intermodal freight transport 7,5 hec

Abstract

This research paper is inspired by some of our classmates' work and also the overall trade relation between China and Taiwan. As China's relevant policy, many Taiwanese companies are now investing in the southwest inland cities of China. Together with the fact that China is now the biggest trading partner of Taiwan together with Taiwan's industrial layout, it is of interest to investigate the feasibility of building a new transport service from Taiwan directly to southwest China. We focus on introducing an intermodal option to link Taipei, the capital of Taiwan, and Chengdu, the largest city in Sichuan province. Our transshipment port in this project is Xiamen, which is one of the closest ports to Taiwan in China. The main target of this report is the electronics industry and its time sensitive goods associated with these products. Certain market forces are aligned and we believe there is a potential for a profitable trade corridor to be established. Detailed studies on cost analysis, system setup choice, market analysis and overall implementations are drawn to justify our idea and choice of this trade route.

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Introduction

After years of limited contact and tensions between the governments from Mainland China (China) and Taiwan, recently, non-governmental and semi-governmental exchanges between the two sides have been increasing. Since the official restoration of Three Links (postal, transportation and trade) in the December of 2008, freight and passengers can go directly to the opposite shore without any intermediate destinations such as Hong Kong or Macau. Meanwhile, the cross-strait investments have greatly increased in recent years. Predominantly, the increment involves Taiwanese firms moving to, or collaborating in joint ventures, in China. The collective body of Taiwanese investors in China is now a significant economic force for both China and Taiwan. (Xinhuanet, 2014) However, people still hold different ideas on whether the increasing economic tie will ensure a peaceful future, especially after taking other relative parties such as the United States into consideration. Though hard to make a convincing prediction in the future situation, we hereby take one mainstream view that the cross-strait relation will keep its status quo. We mean not to show any political preference in this research paper and both the terms of *China* and *Taiwan* in the research are only the economy entities or custom territories they are widely accepted as.

In this research, we will evaluate a direct link between Taipei and Chengdu. The transport methods we use are mainly sea and rail. The terminals we will choose are the Keelung port and Chengdu railway station, and the products will be transshipped in the port of Xiamen in Fujian province. The rationale will be discussed under the topic of system setup.

Bilateral trade

In 2013, the total trade volume between Taiwan and China was about 119.5 billion USD, 2.2% higher than the previous year. And China now is Taiwan's biggest trade partner and export destination (77.0 billion USD), second biggest source of import (34.5 billion USD, Japan 43.1 billion USD).

The main products exported from Taiwan to China were electrical machinery and equipment (HS code 84-85, 39.7%), optical, photographic, medical or surgical instruments, clocks and watches (HS code 90-92, 19.3%), chemical products (HS code 28-38, 13.8%) and plastics and rubber (HS code 39-40, 11.4%). The primary product exported to Taiwan was electrical

machinery and equipment (HS code 84-85, 53.5%). But the amount here was 22.7 million USD, less than the amount of 30.6 million USD imported from Taiwan. (MOFCOM, 2014)

Chengdu

Chengdu is the capital of Sichuan province in southwestern China. It is a historically important, culturally rich city located in a flat, extremely fertile inland delta. Chengdu is a key center in China's West China Development strategy. It serves as an industrial, financial, communications, logistics, and technology hub for southwest China. (Ye et al., 2013)

Western China Development Strategy

Since the reform and opening-up policy from early 1980s, the coastal regions of eastern China benefited greatly from these reforms, and their economies quickly raced ahead. The western half of China, however, lagged behind severely. In 2000, the Leadership Group for Western China Development Strategy was created and series of strategies were initiated on this topic. The Western China Development Strategy mainly comprises the development of infrastructure (transport, hydropower plants, energy, and telecommunications), enticement of foreign investment, increased efforts on ecological protection (such as reforestation), promotion of education, and retention of talent flowing to richer provinces. (Xinhuanet, 2014)

In 2011, the State Council of China passed the *Regional Plan of Chengdu-Chongqing Economic Zone*, in which Chongqing implied the selected area of the municipality of Chongqing, about 270 km from Chengdu. In this plan, both Chengdu and Chongqing would play as cores to lead the local development, due to their preferable natural endowment, industrial basis, transport infrastructure, labor resource, etc. In the end of 2011, under the plan, Chengdu launched the construction of Tianfu New Area; the first investment was 214.4 billion CNY (35.7 billion USD). The Tianfu New Area is planned as an expansion of its existing development zone, Chengdu Hi-tech Industrial Development Zone. (Xinhuanet, 2014) Up to 2011, 207 out of Fortune Global 500 companies (2011) invested in Chengdu. (Xinhuanet, 2012)

Local Trade and Industry

In 2012, Chengdu contributed 80.4% of the total international trade in Sichuan province, and 87% of the utilization of FDI. The import and export amounts were 20.7 and 38.5 billion USD respectively. The GDP of the electronic industry of the Chengdu Hi-tech Industrial Development

Zone was 172.9 billion CNY (28.8 billion USD) in 2012, while the number in 2008 was 22.5 billion CNY (3.8 billion USD). (Chengdu Bureau of Statistics, 2013)

As Chengdu made up a big proportion of Sichuan province's total trade volume, Sichuan province's specific trade condition can mostly represent Chengdu's. In the province's latest data (2014), in 2013, 8.6% of the import amount came from Taiwan (196 million USD), and the percentage of export amount was only 1.2% (46 million USD). The electronic integrated circuits and microassemblies (HS code 8542) made up 38% of the import amount and the automatic data processing machines and units (HS code 8471) had 31% of the total export amount.

From the date, we can see the importance of electronic industry in both Chengdu city and Sichuan province. Because of the low labor cost in this area, factories import hi-tech circuit and assemblies to assemble computers and export them. One example can be the Foxconn and their Apple product. They distribute assemblies from Taiwan, South Korea, etc. to their factory in Chengdu, and then export Apple products to the world. (Wang and Tung, 2013)

Infrastructure

Chengdu is the center of railway network in the west of China. In the Qingbaijiang logistics park, which is 18km from the center of Chengdu, it has China's biggest railway container terminal. In the terminal, there are daily special freight train drive from/to Beijing, Shanghai, Guangzhou, Xiamen, etc. In 2013, a direct rail link with the city of Lodz in Poland came into operate and it is the fastest way from China to Europe other than air transport. Chengdu also has direct flight to major cities in Asia and a railway link to Luzhou port (330km), to ship goods to destinations alongside the Yangzi River, East China Sea and the Pacific Ocean. (Fu, 2013)

There are two main alternatives for transporting packaged goods overseas. The goods can either be loaded into a standardized container that can be loaded on specialized container ships and onto train wagons. The other alternative is to load the goods into a swap-body or similar, which in turn also can be loaded onto a train wagon but requires some kind of trailer to be able to be transported on a vessel. But in that case will a so called RoRo vessel have to be used for the transport. The RoRo alternative is normally to prefer for such short route as from mainland China to Taiwan, mainly in terms of transport flexibility, since it is common to have daily departures of RoRo-vessels. The problem with all RoRo connections between mainland China and Taiwan is that none of the currently used RoRo terminals have railway connections. Since most of the RoRo vessels travelling over the strait of Taiwan are so called RoPax vessels (are combining RoRo freight and passenger traffic), are they normally calling specialized passenger

terminals which usually not are located in connection with freight terminals meaning that they do not have railway connections. The only alternative for our service is then to use standardized containers that are going through terminals with railway connections and are loaded onto container vessels.

Market Analysis

Since the signing of the Economic Cooperation Framework Agreement (ECFA) in 2010 by both sides of the Cross-Strait Service, the economic landscape has changed significantly. China is Taiwan's largest export market and this equates to Taiwan's largest single contributor to the trade surplus and also the largest share of Taiwan's overseas investment portfolio. This whole topic to do with the Cross-Strait Service has been a highly politicized one with Taiwan acting almost completely separate to the requests of Beijing and Mainland China. With China becoming an active member of the BRIC developing economies and the signing of the ECFA in 2010. It has been viewed as a major step towards Taiwan having the opportunity to participate in regional economic integration. With the borders being opened further and the possibility of Cross-Strait trade looking more and more optimistic there has been an influx of trade facilitators and logistics companies who are looking into possibly a bright future for Taiwan entering into the 'Golden Decade'. The points touched on above are simply the beginning of the market analysis for the potential route that we are exploring from Taipei City, Taiwan into Chengdu, South Western China. These political issues and the competitive nature of the freight industry will be discussed and justify why we believe there is an effective corridor of trade that can be profitable for a new entrant. (Chen-Lin Chien, Yu-Je Lee, 2007)

Political Openness

In 2008 the presidency of Taiwan changed with the appointment of Ma Ying-jeou, who since has progressed Taiwan and its cautious relationship with Mainland China. The president was instrumental in bringing the ECFA to fruition and the implementation of the Early Harvest Program which helped significantly reduce the tariff structures in place and to help open the service sector on both sides of the Cross-Strait. (Diplomat Magazine, 2014) Since the signing in 2010 Taiwan has built year upon year leading to two-way trade between China and Taiwan amounting to US\$168.96 billion in December 2012 which was a 5.6% increase from 2011. The General Administration of Customs spokesman was recently quoted as saying he was optimistic of future trade between Taiwan and Mainland China due to two factors. Firstly the development and implementation of the ECFA signed in 2010 and secondly to the linking of both The Golden Decade in Taiwan and China's 12th Five-Year Economic Development Plan that runs from 2011-2015. Trade is very much on an upswing and gives rise to potential new markets opening compared to the strict control political climate seen in the previous 60 years. (Diplomat Magazine, 2014) On the same day as the ECFA was signed in 2010 there were also a protective agreement formed in relation to intellectual property rights to help protect the two separate markets. China is starting to react to the growing scarcity of resources and the

evolution of globalization by trying to transform its industrial structure and develop new markets. These represent its two main pillars of their economic vision for the future namely transforming the industrial structure while balancing the development of this. One of our main reasons of choosing Chengdu as our final destination is the growth and increase in trade that will be seen in this geographical part of China seen over the next decade especially.

As mentioned previously China is entering into its 12th Five-Year Plan that concentrates a lot of its efforts on development of the structure towards the interior of China including Chengdu. This movement into the interior of China and away from the coastal manufacturing sites due to cost increases emphasizes the new trade route that is being created by China itself. They see the importance of smooth and well-used transit lines and freight corridors being in place and being developed to help the progression of the interior. These trade routes will help grow cities along the routes and give such exporters as Taiwan's electronic industry feeder networks and reduced costs of production. There are massive amounts of resources, which have been untapped to present in the interior of China, and this is the main aim of the five-year plan in Southwestern China. The opening of trade routes like the one we are suggesting will help add value to the transportation route and will help create jobs going further into the interior of China. Government subsidization on this particular route could be an option as the benefits seen by the region would be apparent and measurable by creating jobs along the transport corridor. Both China and Taiwan have been experiencing consistently high unemployment and the ECFA could be used as a platform or mechanism to collaborate with the aim of reducing these unemployment rates in both regions. One key topic being discussed is how can this movement into the Chinese interior can be leveraged to help strengthen the integration of the supply chains for both China and Taiwan. There is a possible win-win situation but the Cross-Strait ongoing negotiations play a huge roll if this can be reached. If succeeded then strong economic growth and some other social implications could be solved or improved. (Railway Gazette, 2013) (Diplomat Magazine, 2014)

Many economists believe both China and Taiwan have reached a critical point in their history with both having to make changes to their economies to move productively into the future. Taiwan is heavily reliant on its contract manufacturing but has to look at developing its brand awareness and brand recognition, while China has to change from being the 'factory to the world' into the 'market of the world'. This means China has to move away from its main drive of GDP growth, and instead look at its domestic market and concentrate on increasing its per capita income while achieving a more evenly distributed wealth structure. The ECFA gives the perfect platform where both sides can be mutually beneficial and can form a type of joint venture to increase both sides of the strait but this has to be dealt with cautiously. This changing

political agenda for both sides and almost to the point of reliance will all help with the development of interior trade routes by adding capacity and utilization. There is a positive chance of an outcome that will benefit both sides of the ECFA negotiations with both parties having to dramatically transform their local economies. All things point to the ECFA as the perfect starting point for both sides to exploit one another's expertise and to grasp the opportunity that they are faced with. There is a very high reliance of the effectiveness of this potential trade corridor on political circumstances, and this is the single biggest risk found in the market analysis of our idea. (Yih-Ching Juang,2014) (Diplomat Magazine, 2014)

Market Competition

China has one of the worlds busiest rail networks with 3.967 billion tons of freight carried with 2,917 billion cargo tons-kilometers generated. The freight capacity has consistently been increasing and utilized more effectively, more recently the government has budgeted a massive \$105.9 billion for railway investment in 2013. Long-term plans include increasing the network to 270,000km and further accessibility into the Sichuan province. (Railway Gazette, 2013). DHL have opened up a joint venture with YHF Logistics who are the main players in the Sichuan province. DHL have invested in temperature sensitive carriages from Chengdu into Europe through the Western corridor ending in Poland. We may have to set up a similar joint venture to become competitive on this leg of the journey aiming at becoming the new strategic partner with an existing player. (YHF Logistics, 2014)

Chengdu as a city and one of the main pillars of the province are reliant on some of the main exporting markets that Taiwan have to offer including electrical componentry. Due to the time sensitivity of these products and also the high value and high level of technology these were previously sent by air freight as the network structure previously did not have the ability to deliver within a certain window. Of course if a product is needed in a 48-hour window then airfreight is the only option over such great distances. The investment in the rail network in recent years and the connectivity of main logistics hubs helps our option of intermodal freight becoming more and more attractive in both cost and time analysis. There are already some existing big players in the freight industry that are present in similar routes but not this intermodal option to the shores of Taipei, and this is where we see our opportunity to enter.

There is already an existing competition with other logistic providers in active operation in Mainland China with links to Taiwan. However we have not seen a logistics provider that encompasses the entire corridor all the way to Chengdu. We see the current rail development and government spending the opening up of the trade route with important links opening up to

the interior of China. This development of the network during the five-year plan coincides nicely with our entry into the market and gives us a competitive step in setting up this desired corridor. If the timing is correct then competing logistics providers like Kerry Logistics, DHL, Rainbow Logistics and will not have much of an advantage over us. The market is not saturated and gives the perfect opportunity for us to compete against current providers in the region of China. Air transport will always be used on this leg due to its time advantage but comes with a price tag associated with it. Our aim is to make the time factor less important is the decision process with the suppliers as they know they will be able to forecast the goods and receive them within a week. Knowing that the highly time sensitive goods will be air freighted we aim to catch a small portion of this sector but realize that it has an advantage we cannot directly compete with.
(Logistics Taiwan, 2014)

System Setup

Suitable routes

The main target of the service is to provide an efficient transport corridor for mainly electronic products and components from Taiwan to the region of Chengdu, in mainland China. Taiwan is an island without bridges or tunnels connecting it to mainland China, and Chengdu is located within inland China, without direct waterway connections to the sea. The Yangtze river is although stretching into the region of Sichuan, where Chengdu is located, and shipping services are provided into the region today. But as such transports taking more than a week from the Chinese east coast, and it would still require a transshipment before the goods could reach the city of Chengdu. (Chengdu High Tech, 2014) Estimating from the transport time on waterway from Luzhou to Shanghai is about 7 days; the total time from Chengdu to Keelung would be about 15 days including transshipments. And the time may be longer when going from a diverse direction, because the ships are traveling upstream in that direction. Air transport is the only possible mode of transport for direct shipments between the two cities. Air transport is however expensive and causes major negative impacts on the environment. A combination of other modes of transport is preferable for this corridor (i.e. intermodal transports).

Even though the corridor is intended to only include transports going westbound (from Taipei to Chengdu) are we describing the best suitable route from the other way around, from Chengdu to Taipei. That is because the leg between Chengdu and the Chinese East coast is the longest and most time consuming, and therefore that part of the corridor is the most important, and will thereby heavily affect how the leg between the Chinese east coast and Taipei shall look like.

The distance between Chengdu and the east coast of China, facing Taiwan, is about 2100 km, travelling by road (Google maps, 2014). That means that it would take almost 30 hours to travel that distance by truck, if driving non-stop. In reality would that time probably be at least 50 percent longer due to that the driver will require time for resting and sleeping for such a long journey. This would result in road transport being very expensive. The time for transporting goods by railway between the same areas would be a little less than 3 days according to Chinese National Railway Administration. Railway transport would thereby be a little slower than transportation by truck, but it is still the best option for the transports from the east coast of China to Chengdu, mainly because of the lower costs. The cost for using rail transports instead of road transports on the leg between Xiamen and Chengdu would be around half for the entire corridor, from Taipei to Chengdu. But also from reliability- and environmental perspectives is the railway option to prefer.

The first leg in the intermodal corridor has to be with sea transport over the strait of Taiwan from Taipei to the Chinese East coast. The question is then, which port on the Chinese east coast is best suited for transshipping the goods from Taipei. There are some regular container feeder services crossing the strait of Taiwan today. But they are only calling a few different ports, are having a low frequency and often do not go direct from Taipei to mainland China, but is calling other Taiwanese ports in between. But as an alternative are there instead some long distance container shipping operators calling ports on both sides of the straight on their routes to Europe and Americas. Since this region most often is at the end of these global routes, is normally the full capacity of the big container vessels not even close to be used in this region. Full capacity is normally only achieved on the long intercontinental leg of such shipping lines. This means that it most likely will be available capacity for our service and since supply most likely exceeds demand may also the carrying costs be at a relatively low level.

By handling all goods in standardized containers are the options many when it comes to selecting a suitable port on the Chinese east coast. It is crucial to choose a port with as short a distance as possible to Taipei. At the same time is it also necessary to select a port which has multiple container freight connections with Taipei (both feeder and ocean going operators). It is also important to choose a port to which a high frequency of trains today are going to Chengdu from, since the idea is to buy capacity from existing railway operators. With all these aspects in mind fell our choice of transshipment hub on the Port of Xiamen. That means that the route we find most suitable for our transport corridor is Taipei-Xiamen-Chengdu, and that all goods will be transported in standardized containers.

Time consumption (time table)

Sea leg

Cosco Line is the only ocean going shipping line that is operating a container service between the ports in Taipei and Xiamen (as part of a liner service over the Pacific Ocean). According to Cosco Lines timetable (2014) is the sea journey from Taipei to Xiamen taking 15 hours for their container vessels. Cosco Lines time table also shows that the times consumed at berth, in port are 16 hours in Taipei and 22 hours in Xiamen. Assuming that the lay times in port can be divided by two, half the time for loading and the other half for discharging, the total transport time of the sea leg including loading and discharging would then be 34 hours (15+8+11 hours), in each direction. The disadvantage by only buying capacity from Cosco Line would be that the frequency for shipments in our corridor would be only one departure per week (Thursdays

12:00). It is therefore necessary to also buy capacity on the regional feeder vessels. There are some regional container feeder departures going from Taipei to Xiamen per week. Wan Hai Lines is the most lucrative one of the regional feeder lines since it is going directly from Taipei to Xiamen, meaning that their weekly departures from Taipei on Tuesdays arrives in Xiamen already on Wednesdays (Wan Hai Lines, 2014). The disadvantage by using any of the other regional feeder lines are that none of them goes directly from Taipei to Xiamen. They have all at least one port in between on their loops, meaning that it takes considerably longer time. But the fastest one of them is anyway with the Taiwanese company Sinolines which takes 2 days to ship the containers from Taipei to Xiamen, compared to 34 hours on the departure with Cosco Line on Thursdays. Sinolines have two departures per week from Taipei to Xiamen, and those are on Mondays and Fridays. (Sinoline, 2014) Since all the other regional container feeders are taking at least 3-4 days before arriving in Xiamen will we to begin with buying capacity at Cosco Line, Wan Hai Lines and Sinoline, which means that we can offer four weekly departures (Mondays, Tuesdays, Thursdays and Fridays). The departure with Cosco Line on Thursdays and with Wan Hai Lines on Tuesdays will be considerably faster than the two other weekly departures with Sinoline, and we will therefore refer to those faster departures as our “express departures”, and hence also be able to charge a premium price on those departures compared to our slower weekly departures.

Rail leg

There are daily departures with freight trains going from the Port of Xiamen to Chengdu. The only operator on this service is the National Railway Administration itself (NRA, 2014). According to their timetable is the voyage between Xiamen and Chengdu taking about 64 hours. (Reference!) That is a number that hopefully can be reduced in the future due to railway developments in the area as a consequence of that the Chinese government wants to stimulate both inland regions, like Sichuan but also because they are developing the hinterland transports in general. (Monios, 2014)

In total does this mean that the time consumed for transporting goods in the corridor from Taipei to Chengdu takes 98 hours (plus transshipment time in Xiamen) with the express departures from Taipei on Tuesdays (with Wan Hai Lines) and Thursdays (with Cosco Line), and about 115 hours (plus transshipment time in Xiamen) with the slower Sinoline departures on Mondays and Fridays.

Frequency

The numbers of container vessel departures between Xiamen and Taipei per week are limited, which is a disadvantage of using container vessels instead of RoRo vessels that normally operate at a higher frequency. But by adding up Cosco Line's and Wan Hai Line's departures with Sinolline's two weekly departures from Taipei to Xiamen will we be able to offer four weekly departures, out of two are defined as an "express departures" and the other two are also going relatively fast. Having the departures that evenly spread over the week with departures from Taipei on Mondays, Tuesdays, Thursdays and Fridays, out of the Tuesday and Thursday departure is about one day faster, means that we are offering an even frequency of the service over the week.

Infrastructure and Technology

The points of we regarding infrastructure are merely descriptive and help to show the capacity and potential abilities of these ports and railway systems to handle movement of goods. With all things held constant we assume that the better the infrastructure and equipment, the more efficient the handling of containers becomes. Below is an infrastructural and technological breakdown of the ports of Keelung, Xiamen and the railway system in Xiamen. Our business proposal involves the handling of containers and hence the infrastructure sections will concentrate on issues concerning the movement of containers.

Port of Keelung

Design and Construction of port

The port of Keelung is our port of destination and is surrounded by mountains to its west, east and south, it is located on the Southeast tip of Taiwan. The waterway is approximately 2km in length and has a width of 0.4km. The port covers a total area of 627 hectares of which 20 hectares is reserved for the container yard area; these are subdivided into 22 container yards. There is a container station which covers 7.5 hectares and has a capacity of 8 700 tons. (Shipping Online, 2009). A further 17 hectares is dedicated for warehousing. The diagram below shows the container operations and how the gantry cranes are located in relation to the container yard. The blue lines are gantry cranes and the spaces behind them are container holding areas

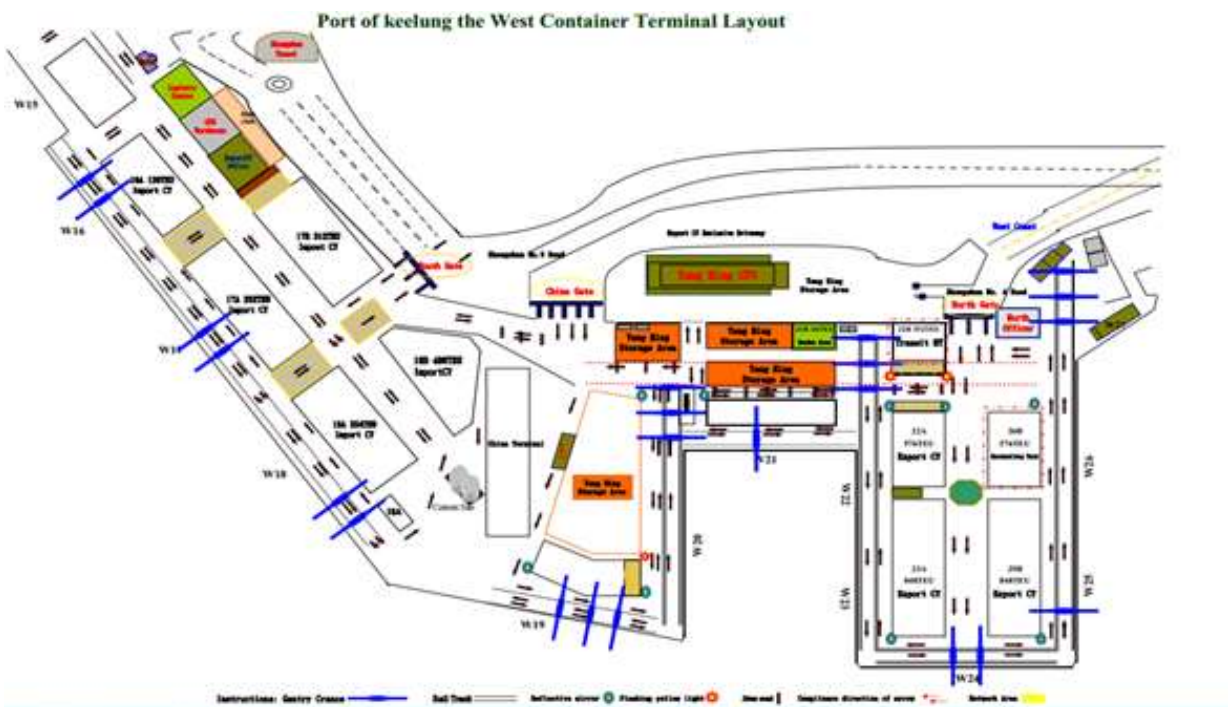


Diagram 1 (Port of Keelung, 2014)

Port Facilities

Port depth is 12.5 meters and can handle vessels over 500 meters in length (Sea Rates, 2014). The port offers 15 quays ranging from 4 – 15 meters in depth. The west coast has a berthing capacity of 454 000 tons. There is a total of 56 sets wharfs of which 15 are assigned to containers. The port has 30 Gantry cranes in operation which guarantee an efficiency/movement of 25 containers per hour per crane (Port of Keelung, 2014) as well as 1 floating crane, 10 straddle carriers on the North Yard and 3 container stackers on the same side. On the South yard there are 10 straddle carriers (Port of Keelung, 2014). For navigational

purposes along the waterway the port has a total of 8 tug boats plus 1 line boat and a barge (Port of Keelung, 2014). The port is capable of moving massive amounts of containers at any given time and has been able to reach high efficiency levels. The terminal is so efficient such that they offer a congestion guarantee which states that any extra dockage charges incurred through the port failing to offer an efficiency rate of 25 moves per gantry crane per hour then the charges will not apply. (TIPS, 2006)

The online Port application system

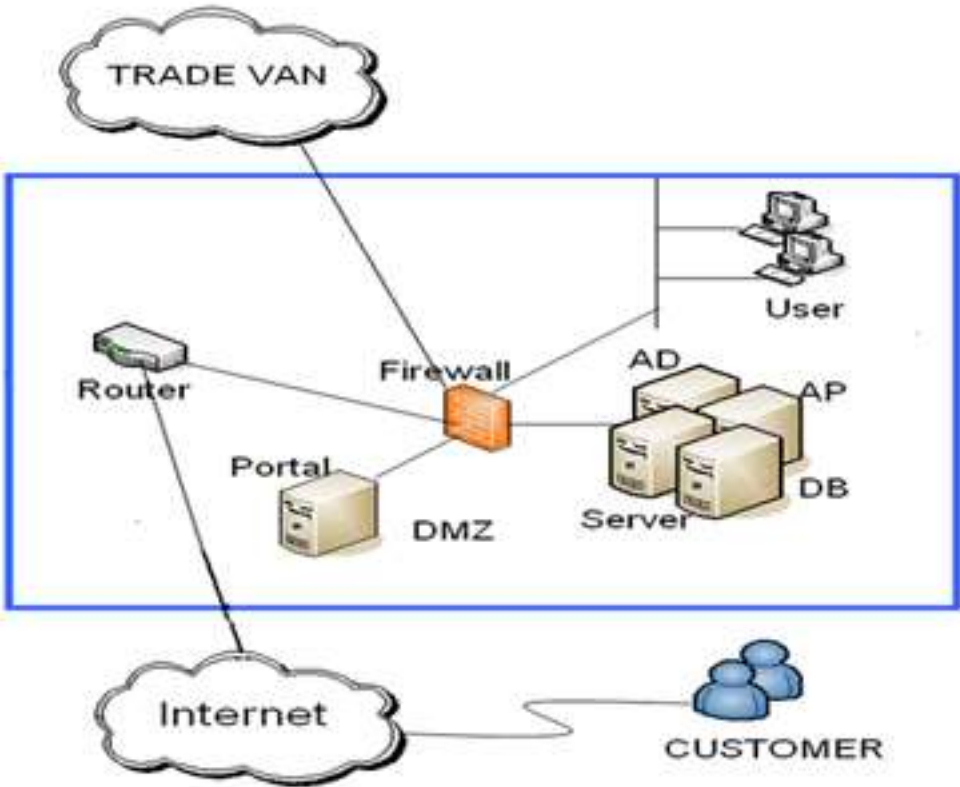


Diagram 2 (Port of Keelung,2014)

The port runs and maintains an online application which helps to streamline information flow. With this system, customers are able to acquire information on among other things expected arrival of vessels as well as expected departure. The system also allows the customer to make a joint inspection application as well as applying for goods release notice. With this system in place the customer has access to a whole host of information and is able to make applications as well as declarations. (Port of Keelung, 2014)

The port of Keelung is truly a modern port equipped with all the necessary equipment to ensure efficient movement of goods. (Containerisation international 2013) ranked Port of Keelung as the 49th best port in the world (Containerisation, 2014). This ranking was based on the capacity handled at the port and additionally the equipment at the port. Future developments are planned both technologically through IT investment and physically through continued dredging.

Port of Xiamen

Design and construction

The port is a modern deep sea port born through the amalgamation of Xiamen port and Zhangzhou port which can receive vessels of up to 18 000 TEU. The port is located in the south east of China. The port is situated at the mouth of the Julongjiang River on the south coast of Fujian province in China (Hutchingson Ports, 2014). The port is surrounded by hills and there are islands scattered around the area. The port is ranked as the 8th largest container port in China and the 19th largest in the world in terms of volumes (Containerisation, 2014). The port comprises of 12 areas in the Tong'an District (Hutchingson Ports, 2014). It yields an average of 470 port calls every month. The port has an average water depth of 12 meters and the length of the coastline is a staggering 64 km (World Port Source, 2014). The diagram below shows the location of the port as well as the hinterland.

Location of Xiamen in China



Diagram 3 (KPMG, 2010)

Port Facilities

The port has both floating cranes as well as mobile cranes. The overhead cranes are able to lift weights between 50/100 tonnes in one go (Sea Rates, 2014). The port has 37 deep births from

a total of 122 berths and plays host to 53 international container shipping lines (World Ports source, 2014). The dry-dock size is considered to be medium in size while moderate ship repairs also happen at the port. Pilotage is compulsory and is handled by the numerous tug boats the port owns. The port has a total of 31 rubber tyre gantry cranes and an additional 11 container quay cranes. The port also has 2 general cargo quay cranes. On the goods side, the port has a total of 9 front loaders as well as 15 forklifts.



Diagram 4 (Hutchinson Port, 2014)

The Xiamen EDI system

The port has undergone heavy investment in implementing the Electronic Data Interchange system (Alibaba, 2010). In 2009 the port automated their information management through the implementation of the EDI system (SourceJuice, 2009). Like all leading container ports, the port of Xiamen aims to manage its data and information from a central place. Investing in a modern information system has led to better information management. The port adopted the 1757 project which insured a fresh investment on computer hardware for port staff as well as educating staff on the usage of the new equipment. Up to 80% of the management staff received a computer and training. The system consists of freight forwarding information, customs, banking services, Quarantine information and shipping agency information. The system is managed by a Hong Kong based company. The implementation of the information system has led to a decrease in costs for both the terminal and the customers that use the platform, it has however ultimately led to an increase in throughput by over 200%

The Hinterland in Xiamen region

The hinterland of the Xiamen port includes mainly Longyan, Zhangzhou, Quanzhou, Xiamen itself and other parts of the Fujian province. There is a railway line that runs across the coast or port as the port consists of various terminals. The Chinese government in 2013 invested just under CYN 600 billion. The Xiamen region is well connected to the port through the Yingtan-Xiamen Railway (Sea Rates, 2014). This connection links up with national railway grid and at Gaoqi, the Xiamen North railway station has been extended to accommodate transport of import and export goods. The region is mountainous and poses a problem for an efficient rail network. This problem has however been addressed through the huge government funding of the national railway system to allow a more efficient flow of goods.

Cost analysis

Cost Unit

As most of these hi-tech products are transferred in containers, and also many of the logistics providers' offers are base on containers, we use one 20 ft. standard container as one unit in our cost analysis. If we cannot access a price of one 20 ft. standard container, the gross weight is estimated as 20 ton and the cost is calculated base on price per ton.

The transport price is collected from an online transport-trading platform (jctrans.com). And the operation cost is reached from the terminals' homepages (portxiamen.gov.cn, kl.twport.com.tw, lzict.com).

Assumptions

We made list of assumptions to simplify the analysis,

- We compared the transport cost only. In which the insurance fee is excluded and assumed as a same rate in different options. The transport cost covers all the fees from the container's handling fee in Keelung port to the transport fee of last model. The receiver pays the handling fee in the destination port.
- We calculate only variable cost in transport. The fixed cost and intangible cost such opportunity cost or time cost are not discussed.
- We buy capacity from forwarders or operators in the beginning of our business, so we use first-hand data as much as possible. But as many operators not willing to publish their tariff, the estimated values are based on the distance and offers in surrounding areas or ports.
- Investment in equipment and other facilities is not included in the cost analysis
- Lay-up cost in any places is not included
- All the costs are calculated in CNY, the exchange rate is set as, USD/CNY=1/6, NTD/CNY=5/1
- Incidental costs are estimated at a rate of 10% if needed.
- Container's gross weight is 20 ton of which the 18 ton is the weight of the goods

Comparison

Our research focuses on the transportation of electronic products and components from Keelung to Chengdu. In this area both the cost and time are important and the transport time

need to try to meet up the requirement of the production plan. In this consideration, we minimize our leg on ships and use land transport as soon as possible.

In this section, we will compare different transport options through same terminals and also an option of air transport. Except air transport, the first process of the service is transporting the container from Keelung port to Xiamen port. Then three different second processes will be discussed, including rail, road and inland waterway. So we name the above three choices as sea-rail, sea-road and sea-river options.

Due to the sea-river option, other than shipping directly to the Luzhou port near Chengdu, there will be at least one transshipment in Xiamen port because only limited vessels are permitted to operate directly between Taiwan and China and none of those vessels go to inland China. Where the transshipment takes place will not influence the total time and cost a big deal because those ports to transfer are mainly alongside the southeast China and the total distance to Chengdu is almost same. So we set Xiamen as a must choice in this section to present the data in a comparable way.

Air option

Taipei has a direct flight to Chengdu. The CIF cost offered from logistic company is 5 CNY/kg. We count this price approximately as the CFR price.

Air option cost= $5 \times 18000 = 90,000$ CNY

Total cost from Taipei to Xiamen= $90,000$ CNY

Cost from Keelung to Xiamen

Cost in Keelung port

Handling fee= 498 NTD/Container (100 CNY)

Equipment fee= 188 NTD/Ton (38 CNY)

Incidental fees may exist if handled in holidays.

Total cost in Keelung: $(100 + 38 \times 20) \times 110\% = 946$ CNY/Container

Transport cost from Keelung port to Xiamen port

Limited first hand data can be found in the cost. But due to the online transport-trading platform in China, the cost is approximately 80 USD/20 ft. Container.

Transport cost from Keelung port to Xiamen port= 480 CNY/Container

Cost in Xiamen port

Handling fee=425CNY/Container

Port operation fee (including handling fee to next model)=300CNY/Container

Port fee (construction, security, etc.)=165CNY/Container

Custom clearance agency fee=200CNY/Container

Total cost in Xiamen=425+300+165+200=1090CNY/Container

Total cost from Keelung to Xiamen=2516CNY

Sea-rail option

Railway transport cost can be calculated on the website of China Railway Customer Service Center (2014).

Railway transport cost=8937CNY/Container

Total cost from Keelung to Chengdu=11453CNY

Sea-road option

The container truck's price is about 10~15CNY/km, this is depending on road distance and selection (e.g. high way or not). We use the price 10CNY/km in calculation.

Road transport cost=10*2100=21,000CNY

Total cost from Keelung to Chengdu=23516CNY

Sea-river option

River transport cost from Xiamen to Luzhou=3600CNY/Container

Luzhou port's information is limited online, so we estimate the price basing on Chongqing port (cqg.com.cn), which has similar distance to Chengdu.

Handling fee=370CNY/Container

Port operation fee (including handling fee to next model)=195CNY/Container

Port fee (construction, security, etc.)=100CNY/Container

Transport cost from Luzhou port to Chengdu=1959CNY/Container

Total cost from Xiamen to Chengdu=6224CNY

Total cost from Keelung to Chengdu=8740CNY

Analysis

We assume that the transport time of the sea-rail option is 6 days. And the air, sea-road, sea-river options are 1, 4, 15 days respectively. The diagram 5 is a cost-time figure, which shows each option's time and cost respectively. The sea-rail option we choose has advantages on the cost when comparing with air and sea-road options. The speed of sea-rail option is little slower but has potential to enhance. We also find that the sea-river option's cost is not as low as we imagined. This is mainly because the operation fee of the one more terminal, Luzhou port. And the sea-river transport option is much slower than our sea-rail option.

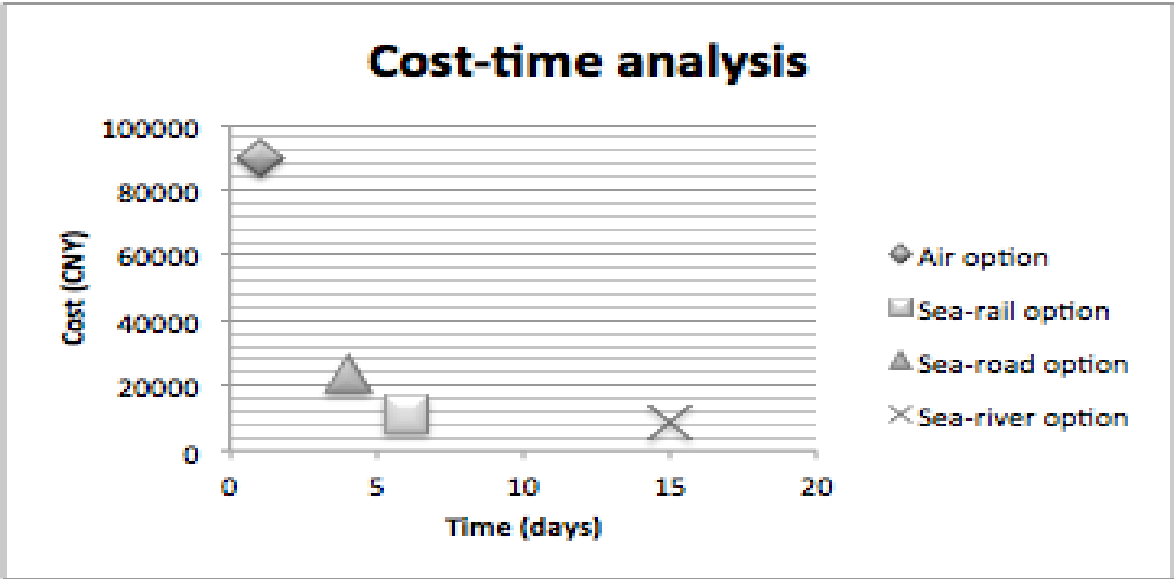


Diagram 5, Cost-Time analysis, source, compiled by authors from various data sources

The overall implementation plan

Our whole project can be divided into four stages, which are preparation, start-up, expansion and maturity, transformation and quit. In each stage we have to face different tasks, achieve different goals, while taking different risks. Risk management and supporting processes are listed below. Actually, CIRIS implementation plan in 2006 gives us benchmark for our project.

Stage one. Preparation

In this stage, we start with the initiating processes, which should encompass:

- Verifying the market acceptance, potential and competitive advantages.
- Analyzing industry, trade, policy and supply chain.
- Designing physical system.
- Verifying the qualification of capacity providers and terminal operators for high competitive and reliable service.

We aim to establish an intermodal transport corridor for electronic machineries in containerized cargoes between Chengdu and Taipei. The cargoes we deliver from Taipei to Chengdu are machineries components and the corridor system is a one-way system. The details of corridor system, cost analysis and market analysis are illustrated above. According to the market analysis, we can conclude that there are already some existing big players in the freight industry that are present in similar routes but not this intermodal option to the shores of Taipei, and this is where we see our opportunity to enter. We take the cost-leader strategy here. Compared to sea-road or air option, sea-rail option shows much cost-efficiency. Sea-river option is time-consuming while cannot save much cost compared to sea-rail option.

As the cargoes we deliver are electronic machineries, we should analyze electronic industry in Taiwan before we start the implementation. Electronic industry is the pillar industry in Taiwan's national economy. Under governmental guidance and support, Taiwan electronic industry is one of the major players in global IT industries.(Xu,2014)

In the current bilateral trade, electronic machineries are the primary products exported from Taiwan to China. The increasing westbound good flow gives us the opportunity to enter the market and policy analysis above shows the long-term market potential.

From supply chain perspective, we deliver electronic components from Taipei to Chengdu for assembling. Therefore, gaining knowledge and experience for certain product cycle time is one of the key factors in service set-up, especially in service frequency and time schedule.

Based on the outsourcing strategy, we decide to buy capacities rather than purchasing own assets through the whole lane. Both the end terminals' operation are controlled by the terminal operators but we take charge of the transshipment terminal in port of Xiamen. Therefore, verifying the qualification of capacity providers and terminal operators is of great significance. This involves several dimensions, such as service standards, rate level, punctuality, corporation credit and cooperative risks. Considering the assumption that we are an existing company, so we don't have to worry about funding issues.

Stage two. Start-up

In this stage we will put the project plan into reality, but in a start-up level. Totally speaking, the task is to set up the corridor system and make it work normally. Therefore, several tasks are as follows:

- Form relationships with providers and operators
- Service set-up.
- Transshipment operation

As mentioned above, we decide to buy transport capacities initially, so our company should form relationships with providers and operators. They are mainly shipping companies (such as COSCO), railway providers (such as National Railway Administration), port authorities (such as Xiamen Port Holding Group Co) and other forwarders or agencies. Besides the monopoly operator, reliable and competitive providers are preferred choices based on the verified results in the stage one. At the same time, the cooperation level is another big issue.

Reaching agreements on service standards, rate and volume is another important issue here. Signing contracts give us commitment on these aspects. As for contracts validity, the competitive static is mix short-term validity with medium-term validity. This strategy dues to two reasons. On one hand, positive growth assumption. Before we carry out the intermodal corridor system, we make one optimistic assumption that our intermodal corridor service would develop consistently and it would expand in the long-term run. So the increasing bargain power would let us gain advantages in the future negotiation. What's more, in the startup level, the capacity we need is in a lower level, so signing long-term contracts would be a potential limitation in the future. On the other hand, risk control. As we all know, the transport markets are volatile

especially in shipping market. Signing long-term contracts or short-term contracts will lead us to take the risks in aspects of either freight rate or transport volume. Therefore, medium-term contracts are necessary.

In the startup level, the vessels departure is four times per week from Keelung to Xiamen, while the national railway can offer daily departure from Xiamen to Chengdu. The freight trains from Xiamen to Chengdu have 70 carriages and each carriage can hold two 20-foot container(CRCS,2014), which means each freight train can take approximately 140 containers. In this stage, the capacity we lease is in a small scale. Therefore, we decide to lease 5% capacities of the whole train initially, which are 7 containers daily. Due to the disparity between vessel departure and rail departure, we can deliver 20 containers via vessel from Keelung to Xiamen and the extra part for warehousing. The distinction for this is based on order urgency. The scale would expand gradually.

We set the Xiamen port as transshipment port and we will handle the transshipment operation by ourselves. In order to complete this idea, analysis on port, infrastructure, equipment and relevant terms is necessary. The operation involves loading and unloading, customer clearance, transloading, warehousing, equipment and facilities leasing.

Stage three. Expansion and maturity

Based on the optimistic assumption, after the start-up level, our corridor service would develop gradually and become maturity finally. Therefore, management strategy should be changed in order to adapt to the expanded service level and mature market condition.

The changes are in these aspects:

- Long-term capacity acquisition.
- Corridor revision.
- Service expansion.

In this stage, long-term capacity acquisition would be one of the most significant issues for the whole project. Options contain purchasing own assets or leasing capacity as before.

In the startup level, we implemented outsourcing strategy and the capacity acquisition was mainly via leasing. For the long-term operation, purchasing own assets and buying wagons would be another efficient choice for more flexibility, frequency and safety. Furthermore, in the

future development, we would handle the operation in both two end terminals (Chengdu and Taipei).

In addition, when it comes to expansion and maturity stage, the intermodal corridor would need revision owing to the changed external environment. Taking the port as an example. The terminal port we selected was the port of Keelung, but the port of Taipei seems to be a better choice in the long-term run. The port of Taipei has a larger space than the port of Keelung, which means it can set up more infrastructure and facilities for more throughput. Considering the crowded circumstance in the port of Keelung now, we believe the port of Taipei would show great potential, thus taking place of Keelung's status and becoming the largest cargo port in the north of Taiwan.

In the long-term run, we would deliver 20 containers from Xiamen to Chengdu per day. The vessel departure frequency might increase to daily departure. Then our intermodal corridor would be more immediately and smoothly for there is no warehousing more.

Stage four. Transformation and Exit

After the expansion and maturity stage, our intermodal corridor would be confronted with saturated market situation. As more and more new market entrants offer the similar corridor service, our service needs transformation to retain competitive edge. The transformation should base on the specific problems or dilemma. For instance, extending the corridor lane and adding door-to-door service is a good way to attract potential customers.

Market exit strategy is common in the worse market situation. The external environment might be turbulent in some cases, such as financial crisis or political conflicts between China and Taiwan. Withdrawing from the market is the only way to minimize the losses. Short-term contracts give us flexibility on this issue and outsourcing strategy prevents us from the assets losses.

Risk management

In the real implementation, risks may occur in different stages and processes. Risk management is indispensable in the overall plan. In the intermodal corridor, risks are mainly in two types:

-Cargoes security.

-Market risk.

In the intermodal corridor, cargoes would be delivered for a long distance via different transport modes and through multiple processes. As a consequence, cargoes security may suffer from losses in quality and quantity. In order to control the cargoes security risk, we can use intermodal insurance. This is a good way to guarantee cargoes security, which can gain competitive advantages in intermodal corridor. (IIC,2014)

Market risk is another common risk in intermodal market, such as the volatile shipping market. The risk dues to various reasons in political, economic and cultural aspects. Making accurate market forecast is the foundation of risk control. Based on it, we can use mixed tools to manage market risk:

- Signing mixed validity contracts.
- Outsourcing strategy.
- Setting up efficient information system.

Supporting Processes

In order to offer a high-quality intermodal service, some supporting processes are necessary:

- Data collection.
- Performance evaluation

In the intermodal corridor, data types include geography data (such as port, railroad and waterway), market data (such as cargo flow) and implementation data. Data can be gathered via multiple ways, such as GIS system, telephone interview, field research and other IT systems.

Performance evaluation contains two parts: suppliers performance evaluation; and corridor performance evaluation. The former is aiming at verifying the qualification of capacity providers and terminal operators for high competitive and reliable service, while the latter is focused on feedback for corridor revision or service transformation. This process is based on data collection while the output from it is data too.

Conclusion

We conclude that there is a potential profitable trade route that is currently untapped and relatively unsecured by the existing players in the market. The recent political actions with the signing of a trade agreement or relaxation of trade restrictions lead us to believe that trade volumes between the island of Taiwan and the interior of the Mainland China will grow substantially. The timing of the 12th 5 year plan in Mainland China with the Golden Decade in Taiwan leads us to believe that market forces will lead to an increase in demand, this will be filled with an increase in the supply needed and the streamlining of future supply lines.

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