PRE-FEASIBILITY STUDY

UNLOCKING ETHIOPIA'S FRUIT & VEGETABLE INDUSTRY

NETHERLANDS – ETHIOPIA – DJIBOUTI PARTNERSHIP FOR COOL LOGISTICS

This study is a follow-up to the Proposal to Co-operate that laid out the foundation for a partnership between Ethiopia, Djibouti and the Netherlands. In this partnership, we aim to develop a National Cool Logistics Network that unlocks the Ethiopia's full fruit & vegetable industry potential. This study covers all relevant investment components for the phase 1 corridor: Addis Ababa – Djibouti.

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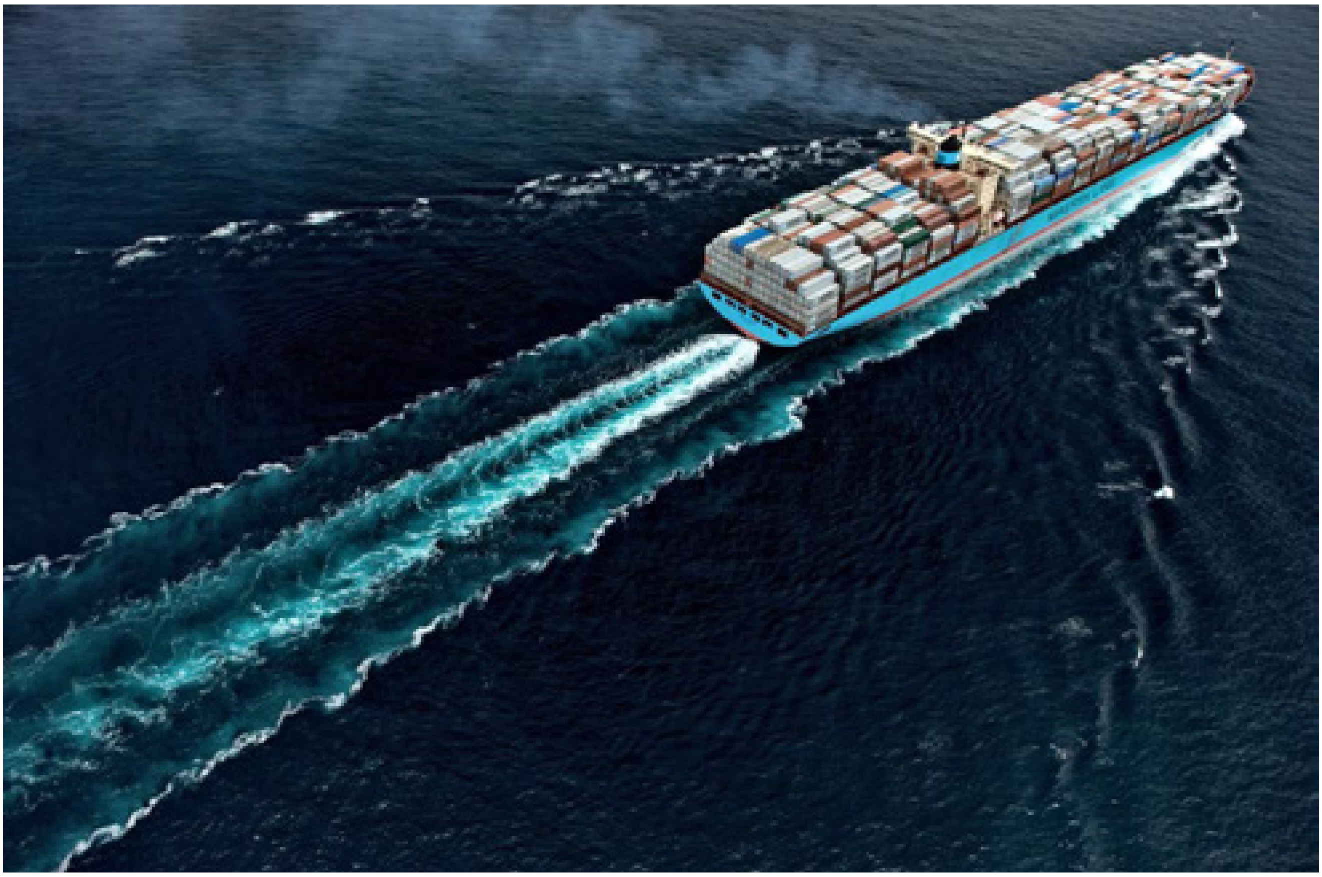


CHAPTER 0

EXECUTIVE SUMMARY

0.1 ETHIOPIA'S FRUIT & VEGETABLE INDUSTRY POTENTIAL

Fruit & vegetables comprise 22% of the total agricultural export from developing countries. Ethiopia has 15.3 million ha of arable land available; the 6th largest total area of Africa. An abundance of river basins and natural lakes can potentially provide water for 10 million ha of irrigable land. The Rift Valley alone offers 3.7 million ha of irrigable land suitable for fruit & vegetable production. Less than 1% of the available land is currently irrigated. Production and export of fruits & vegetables offers a tremendous yet untapped opportunity for growth.

Production and consumption have shown robust growth rates over the past decades. For the past decade, production growth averaged at 4.5% per year - outpacing population growth. This means consumption per capita is increasing. Though many people still consume less than the 400g per day recommended by the WHO and FAO, changes in demographics, rising incomes and behavioural changes are expected to further boost production and consumption.

International trade of fruit & vegetables is growing at an even faster rate; from 56 billion USD to 140 billion USD in the last 10 years. We estimate that Ethiopia has the potential to increase its yearly exports to over 1 million ton in the next years. Eventually this could grow to volumes of 3 million ton or more by supplying international markets with a wide range of fruit & vegetable products.

Besides Ethiopia's production advantages, the country is also strategically located to serve both Europe and Asia. Europe is the largest importer of fruit & vegetables, followed by the United States. Together they import over 50% of world-wide fruit & vegetables exports. The nearby Arabian Peninsula could even be considered a captive market. Partly because of water supply issues, Gulf Cooperation Council countries have already increased their imports of fruit & vegetable to 4.6 billion USD (> 10 million ton) per year, with South Africa being one of their major suppliers (0.5 billion USD, mainly citrus).

The Netherlands would like to support Ethiopia in achieving its full economic potential. Many Dutch importers have shown a keen interest in acquiring fruit & vegetable products from Ethiopia.

The Netherlands is seeking to establish a partnership with Ethiopia. Together we can realise the projects along the entire value chain needed to get Ethiopia's fruit & vegetable export industry to the next level.

The Dutch government has allocated development funding for such projects. Additionally, key players from the Dutch fruit & vegetable industry joined forces and formed the Flying Swans consortium. This consortium provides the necessary organisational capacity and aligns with the Dutch Ministry of Agriculture's goals to promote the production of sustainable, accessible and nutritious crops in developing countries.

0.2 COOL LOGISTICS OVERLAY TO REALISE HORTICULTURAL AMBITIONS

Ethiopia's fruit & vegetable industry growth is impeded mainly by a lack of cost-effective, temperature controlled logistic solutions. Airfreight transport currently offers Ethiopia's only access to global markets. Airfreight is only suited for high-end, high margin products (e.g. green beans).

Establishing competitive logistics should be possible. Large containerships sailing between Asia and Europe can call at export ports like Djibouti with limited deviation costs. Recent multi-billion USD investments by Ethiopia and Djibouti in basic rail, road, port and energy infrastructure already provide a solid foundation to establish competitive logistics chains to various markets. Most notable are the road connections from producers to ports, the transition of Modjo dry port into a full-fledge hinterland hub, the National Railway Network across Ethiopia and the new deep-sea container terminal in Djibouti.

A National Cool Logistics Network (figure 1) will facilitate the export of fruit & vegetables from all potential production regions across the country. Its primary function would be unlocking Ethiopia's fruit & vegetable potential. As a secondary benefit the facilities will be designed to serve other value chains and cargo flows such as the export of meat, flowers and the import of fish, medication, etc.

The development of a National Cool Logistics Network requires a substantial project development effort. The Netherlands has outlined a Proposal to Co-operate. The proposal encompasses a multi-annual program for all necessary projects that cover production, logistics and marketing.
Examples of such projects are:

1. **Fruit & vegetable production and marketing** support in product portfolio strategies, production process improvement, compliance with European regulations on food safety, product marketing for various markets, etc.
2. **Cool Ports all over the country** co-development and co-investment in cold storage facilities; fully integrated in dry ports along the railway network and near fruit & vegetable production regions.
3. **Cool Rails between Cool Ports** co-development of rail connections for perishables from production to consumption centres; domestic, regional and global.
4. **Djibouti deep-sea terminal** participation in the development and construction of the new Djibouti container terminal. This ensures the quantitative and qualitative capacity for significant fruit & vegetable volumes.
5. **Cross-dock Djibouti** co-development and co-investment in a cross-docking facility, fully integrated in the Djibouti container terminal to avoid expensive empty leg transports.

FIGURE 1: NATIONAL COOL LOGISTICS NETWORK

0.3 BIG DEVELOPMENTAL IMPACT ON ETHIOPIA AND THE REGION

A National Cool Logistics Network in addition to the basic rail logistics currently under development will have a big positive impact on Ethiopia in many ways. A National Cool Logistics Network will boost all perishable trade flows. This can be illustrated by fruit & vegetable export flows alone. Ultimately the overall positive impact will most likely be many times greater. Cool logistics stimulates the export of other perishables as well as agricultural import substitution.

CREATE A LOW-CARBON LOGISTICAL NETWORK THAT REDUCES CO_2 EMISSIONS 70%-80%

From experience we know that rail transport of perishables reduces CO_2 emissions by 70%-80% compared to road transport. On top of that Ethiopia's logistics footprint will be positively influenced by the fact that the rail's energy requirement is provided by hydropower.

CREATE BETWEEN TWO AND FOUR MILLION JOBS IN THE FRUIT & VEGETABLE INDUSTRY

The fruit & vegetable industry is labour-intensive and creates many jobs. An annual volume of around 1 million ton would require a land area of around 100,000 ha and generate between 1 and 1.5 million jobs. The jobs would be created directly in production and indirectly in packaging, logistics, etc. A future volume of 3 million ton would generate between 2 and 4.5 million jobs. Developing fruit & vegetable value addition industries (salads, juices) would further increase this potential for Ethiopia.

GENERATE A FOREX INCOME OF UP TO 3 BILLION USD PER YEAR

Horticultural crop production generates high economic returns per unit of land compared to most other agricultural products. CIF market price thresholds differ per product, per season, etc. Average prices to Europe range between high value products (e.g. avocados, around 2,000 USD per ton) and lower value products (e.g. bananas, around 500 USD per ton). With an assumed average value of around 1,000 USD per ton a Forex generation of 1 billion USD within ten years (1 million ton) is possible. In the long run 3 billion USD also lies within in the realm of possibilities.

DRASTICALLY IMPROVE AVAILABILITY OF FRUITS & VEGETABLES TO VULNERABLE POPULATIONS

Increasing fruit & vegetable production will also improve availability of these products within all of Ethiopia. More importantly, seamless cool logistics systems will sharply decrease post-harvest losses. This would further increase fruit & vegetable availability, lower prices, etc. Bringing down the current post-harvest losses (between 15-70% depending on product and region) will have an immediate effect on people's livelihood and the economy of the entire country.

0.4 COOL LOGISTICS INVESTMENTS TO FOLLOW RAIL NETWORK PLANNING

The development of a National Railway Network is of vital importance to the fruit & vegetable industry. Distances from production to consumption or export port destinations are vast in Ethiopia. This makes rail transport a pre-requisite for cost-efficient logistics. The Addis-Djibouti rail connection has been operational since early 2018 and would be the logical corridor to start with setting up an overlay of cool logistics supra structure. Three investment components have been identified that enable this corridor to also accommodate perishables:

1. Cool Rail Ethiopia
2. Cool Port Addis
3. Cross-dock Djibouti

COOL RAIL ETHIOPIA

This would be a dedicated train connection for perishables between the production areas around Addis Ababa and the port of Djibouti. A full train of refrigerated containers could transport fruit & vegetable as well as meat, flowers and other perishables destined for export. The dedicated train solution would achieve the lowest costs and guarantee temperature control in a demanding environment of lowland Ethiopia and Djibouti (hot temperatures, especially in summer). Estimated investment for these additions are between 0.9 and 1.2 million USD per set of around forty wagons.

If turnaround times can be achieved that are on par with similar rail connections in Africa a total volume of 200,000 ton of fruit & vegetables with an export value of between 200 and 300 million USD per year becomes a possibility.

COOL PORT ADDIS

Fruit producers need cold store facilities for the time between harvest train departure. Cool Port Addis is such a third-party facility that offers cool storage inside the newly refurbished Modjo dry port. It can handle both fresh and frozen products. The cold store is located inside the dry port to avoid expensive truck transport between port, rail terminal and the cold store.

Cold store capacity is designed to be able to serve a daily train connection between Addis and Djibouti.

An annual throughput of 150,000-200,000 ton with an on average storage time of 3.5 days, requires room for 2,000 pallets. A similar pallet capacity is anticipated to cater the perishables import in Addis area.

Attached to the cold store operations is the Container Freight Station (CFS) which has room for a total of total 4,000 pallets. This functionality is akin to Cross-dock Djibouti and stores the dry import goods. These dry goods are cross-docked into reefer containers to eliminate empty legs which halves logistics costs. Ethiopian importers can pick up their import goods at the storage facility and avoid expensive demurrage or detention claims for using the container.

Total investment required for this facility with its fresh, frozen CFS storage facilities is between 15-25 million USD. The challenge for the Ethiopian context is to grow the total volume. Because current fruit & vegetable volumes are limited, Cool Port Addis will probably be underutilised in its first years of operation.

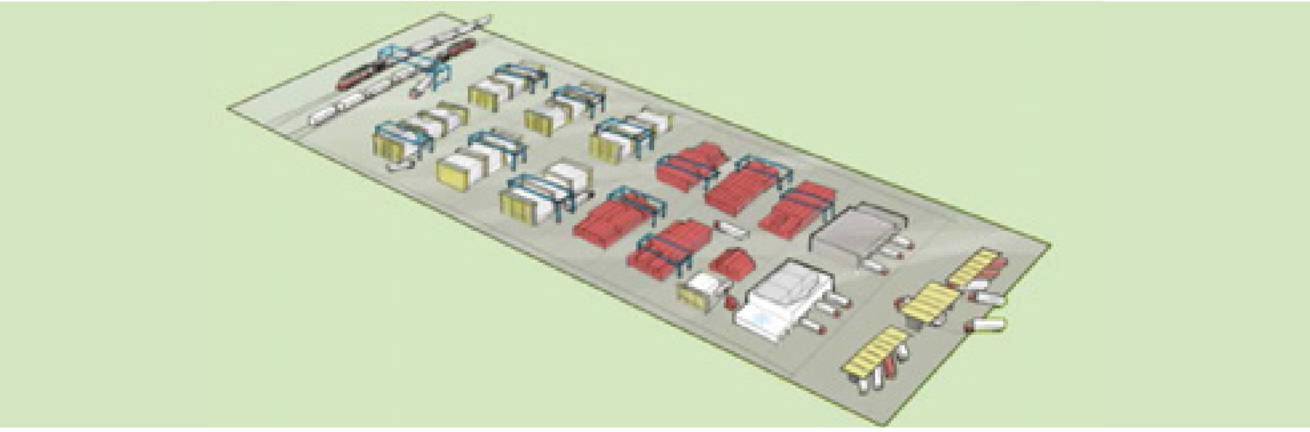


FIGURE 2: COOL PORT ADDIS

CROSS-DOCK DJIBOUTI
Ethiopia is experiencing container transport imbalances similar to many other African countries. Export production flows are dwarfed by imports. Containers typically arrive full of import goods, but mostly leave the country empty. Under these conditions importers are paying twice as much as they would in a balanced system, as they are paying for the empty transport.

When Ethiopia fruit & vegetable industry gains momentum exporters will face a similar challenge in reverse. Reefer imports will be far less than fruit & vegetable exports. This also results in exporters paying double the amount. To eliminate these empty legs a Cross-dock facility is proposed near the new Djibouti terminal. Here dry goods from import containers will be cross-docked into empty reefer containers. In consultation with DPFZA and China Merchants, the Flying Swans consortium has already worked out proposals to integrate the Cross-dock Djibouti into the new DICT design.

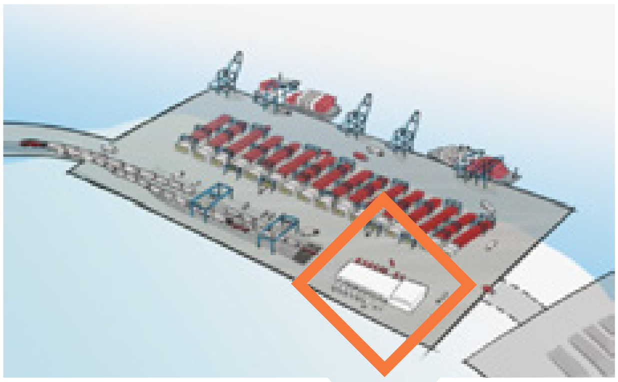
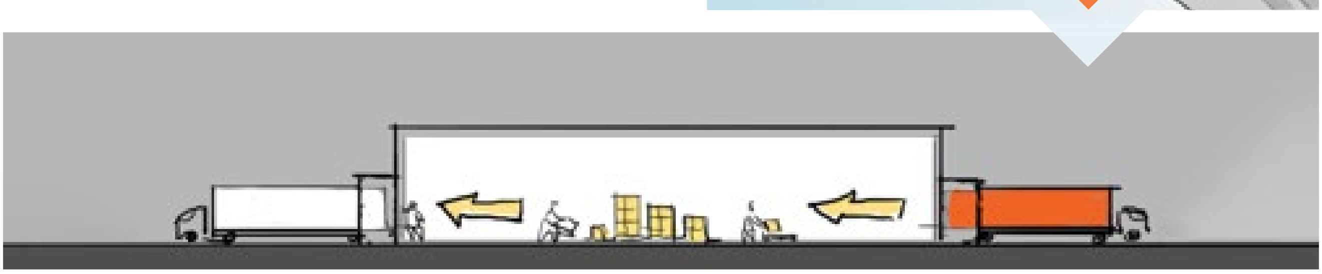


FIGURE 3: CROSS DOCK DJIBOUTI



0.5 PUBLIC INVESTMENTS UNLOCKING PRIVATE INVESTMENTS

The pre-feasibility study identifies a total of around 25-40 million USD investments necessary to make the Addis-Djibouti corridor suitable for transport of perishables. The total amount split into three components:

1. **Cool Rail Ethiopia: 1.0-1.2 million USD**
2. **Cool Port Addis: 15-25 million USD ***
3. **Cross-dock Djibouti: 7.5-15 million USD ***

* Definitive investment requirements depend on final scope of the investment. Among other factors groundwork expenditures may vary depending on what work has already been done in earlier stages of the general Modjoand DICT construction process for Cool Port Addis and Cross-dock Djibouti.

In principle, all three investments meet standard criteria of (private) investors and commercial financial institutions when running at normal utilization rates. The scenarios run in the pre-feasibility study show between 20%-25% returns on equity. Ethiopia's current overseas horticultural export volumes are still very limited causing underutilization for the first years of cool logistics operation.

It must be noted that without these types of cool logistics facilities it will be extremely difficult for Ethiopia to become a significant fruit & vegetable producer and exporter. Relative to the multi-billion investments already done in basic infrastructure (rail, road, energy, etc.), these investment requirements are moderate. The resulting product flows generate a substantial foreign expenditure of 200-300 million USD every year.

In our view these investments will be instrumental for kick-starting fruit & vegetable exports. Cool Port Modjo has a lot of similarities with the cold store at the Bahir Dar airport which served as catalyst for the development of the production region surrounding it. It is very likely volumes will grow even faster at a central location like Modjo than the more remotely located Bahir Dar.

Nevertheless, the investment in these facilities should best be supported by concessional finance. In addition to project development support, the Netherlands have concessional financing instruments in the form of grant arrangements in place. Of course, certain requirements for concessional financing must be met. Input for final decision-making on this will have to come from a more detailed feasibility study phase.

The Netherlands is committed to unlock Ethiopia's horticultural potential and is ready to do business. The next step will be technical and financial feasibility studies, starting with Cool Port Modjo that prepare for financial closing and implementation. This final project development phase before construction should be governed by a high-level Steering Committee with participants of both Ethiopia and the Netherlands. From our side, the Dutch government will be represented by the Dutch Ambassador and the Agriculture Counsellor. All Flying Swans parties will participate through high-level representatives as well. From the side of Ethiopia, we propose participation of relevant high-level decision-makers that represent the entire value chain.

The Flying Swans Consortium represents the Dutch horticulture and logistics industry. The consortium partners offer access to a wide range of Dutch producers, traders, engineers and contractors. The Flying Swans Consortium is supported by the Dutch government and it is committed to implementation of projects along the entire value chain that get Ethiopia's fruit & vegetable export industry to the next level.

CHAPTER 1

FRUIT & VEGETABLE INDUSTRY POTENTIAL IN ETHIOPIA

1.1 AMPLE AVAILABILITY OF ARABLE LAND WITH OPTIMAL CLIMATIC CONDITIONS

Ethiopia's landscape, hydrology and climate offer tremendous agricultural potential. Variations in altitude, rainfall and mean daily temperatures divide the country into 49 agro climatic zones, suitable to produce at least 146 different crops. Ethiopia is the tenth largest country in Africa, comparable in size to South-Africa. Measured in arable land Ethiopia takes 6th place with 15.3 million ha, beating South-Africa's 12.5 million ha, 12 river basins, 18 natural lakes and ground water provide ample irrigation potential for 10 million ha. For example, the Rift valley has a potential of 3.7 million ha irrigable land. Currently less than 1% of all arable land is irrigated.

The Government of Ethiopia designated agriculture as a key driver for Ethiopia's long-term economic growth and a pillar of food security. Horticulture is top priority because the country's geology offers almost no fossil fuel and limited mineral reserves. Besides manufacturing, agricultural commodities offer an obvious strategic export opportunity and an important source of foreign currency.

Ethiopia's first Growth and Transformation Plan (GTP, 2010-2015) aims boosting agricultural production with an annual average of 8%, via expansion of the amount of land under irrigation, stimulation of mechanised agriculture and designated agricultural growth regions. GTP2 (2016-2020) stimulates the same agricultural transformation agenda, with accelerated growth, improved food security, rural employment and development of national markets. It also emphasises gradual contribution of the agricultural sector to the economy with a shift towards strategic crops and livestock as high value commodities

1.2 SECOND-LARGEST POPULATION IN AFRICA AND ROBUST ECONOMIC GROWTH RATES

The Ethiopian population has been growing at a steady pace from approximately 57 million in 1995 via 74 million in 2007 to 107.5 million in 2018, now ranking the second-most populous country of Africa after Nigeria and the most populous landlocked country in Africa. With an annual growth rate of 2-3%, it is projected to surpass 150 million by 2040, possibly hitting 210 million by 2060. Ethiopia is one of the fastest growing countries in the world and will make a significant contribution to the continent's expected population doubling in the coming decades.

Like other African countries Ethiopia's population age structure shows a very high percentage of young people. The age group of 0-14 years represents 43%, while 15-24 years make up 20%. The median age is 18 years. Although the country mostly has a rural profile, urbanization (now at 20%) is steadily increasing with an annual growth average of 4 to 5%. The largest city, Addis Ababa, has a population of 4.6 million in the city proper and metropolitan area.

Multi-annual economic growth performance marks Ethiopia as one of the ten emerging markets of the future. Ethiopia has experienced rapid and stable economic expansion over the past decade, unaffected by headwinds in the world economy post 2008. Its development outpaces many other low-income countries, averaging 10.3% per year from 2006 to 2016, compared to a regional average of 5.4%. Average GDP growth reached 10.9% per year from 2004 to 2014.

Economic development produced a significant reduction in poverty rates, falling from 44% in 2000 to 30% in 2011. Prevalence of undernourishment is down from 75% in the early nineties to 35% in 2014. Life expectancy rose from 52 to 63 years in the same decade. The number of households with access to electricity and piped water doubled.

Dynamic demography and steady economic expansion predict a future big consumer base, stimulated by rising incomes and behavioural change from urbanization. For example, income elasticity for fruit is high and is positively affected by only slight increases in income. Over the past 10 years, household expenditure on fruits increased from 1.4% to 2.3%.

1.3 STRATEGICALLY LOCATED BETWEEN MAJOR EXPORT MARKETS

The Indian Ocean is rapidly becoming a new centre of economic gravity. The ocean strategically links three continents: Asia, Africa and Europe. Being a landlocked nation, more than 95% of Ethiopia's imports and exports pass the port of Djibouti. Half of the worlds shipping lines pass by. The country hosts military bases from the US, Japan, France, Great Britain, Saudi Arabia and recently China.

Ethiopia's neighbour is one of Africa's tiniest countries, but its location at the entrance of the Red sea and the doorway to the Suez Canal lends it strategic powers: in logistics and in geopolitics. Djibouti is also one of China's critical nodes in the one belt-one road initiative. Large Chinese led investments in Djibouti port, terminals, railroads and a free trade zone, propel this politically and socially stable state into a gateway to 500 million consumers of COMESA, the Common Market for Eastern and Southern Africa. The Ethiopia-Djibouti corridor is a crucial asset for both countries. It helps Djibouti develop into the gateway to Africa and it provides Ethiopia access to world markets for its manufacturing and agricultural commodities. It also positions the country as transit hub for neighbouring states.

Currently Europe is the most important destination for Ethiopia's horticultural products. These are mainly flowers, but there is plenty of room for growth in fruit & vegetables. Furthermore, demand from the Arabian Peninsula is expected to rise sharply, due to projected population growth and developments in food preferences in countries like Saudi Arabia, Kuwait, Oman and Qatar. Geography, climate and scarcity of fresh water in the Arabian Peninsula severely limit growth in domestic agricultural production. Import will become crucial to meet demand.

1.4 ALONG THE ASIA-EUROPE SEAFREIGHT CONTAINER TRUNK LINE

Ethiopian trade statistics between 2000 and 2015 show a five-fold increase of exports and an eight-fold increase of imports. Further strong growth is projected under GTP 2 until 2020. The Ethiopia-Djibouti corridor is Ethiopia's dominant route for trade, as it handles 95% of imports and exports (over 11 million ton in total in 2015). Containers to and from Ethiopian destinations cover 80% of all cargo handling in the Port of Djibouti. Over 90% of inbound containers is destined for Addis Ababa, more specifically for Modjo dry port.

Each day on average more than 15 of the largest containerships pass Djibouti from Asia to Europe. With limited port capacity, elsewhere along the East African coast make the Port of Djibouti an obvious future container shipping hub. The Port of Djibouti is a natural deep water port, with a 18 m deep container terminal. Because it is favourably positioned along shipping routes, it has low deviation costs. These factors enable advantageous gateway and transhipment business cases for the port.

Development of the Ethiopia-Djibouti corridor is an obvious focus of the Government of Ethiopia, with support of the World Bank in joint commission with

Djibouti. Initial completion of road and rail infrastructure has significantly reduced transport time from Addis Ababa to the Port of Djibouti. Additional improvement of transport efficiency further inland is part of Ethiopia's National Logistics Strategy. The Ethiopian strategy emphasises efficient transportation and storage services for effective trading and improvement of its trade balance.

Recent Chinese-led investments have improved transport efficiency and capacity in Djibouti. With the construction of Doraleh International Container Terminal (DICT) the Djibouti Ports & Free Zones Authority have started the development of an international free trade zone. The port has a capacity of 1.25 million TUE at the current Doraleh Container Terminal. 2.4 million TEU will be added in the initial development phase and 4 million TEU total will be added in the future. The first phase is set for completion in 24 months. Djibouti International Free Trade Zone requires a total investment of 3.5 billion USD and over ten years to fully develop. Once completed it will the biggest free zone in Africa, spanning 4,800 ha.

1.5 BILLIONS OF INVESTMENTS IN LOGISTICS INFRA AT GLOBAL STANDARDS

Ethiopia's success over the past two decades is grounded in its long term strategic vision, ambitious goals and rigorous planning and implementation. The country acts as a strong developmental state, in a style that is similar to China. The overarching goal of Ethiopia's national development strategy is to become a lower middle income country by 2025, through stable and broad economic growth, rapid industrialization and structural transformation.

Under GTP 2 broad investments are made to improve productivity and competitiveness of the agricultural sector and manufacturing industries. GTP 2 also aims at capacity building of the domestic construction industry, to ensure the quality of the country's infrastructure. These strategies meet domestic needs and developmental goals and offer new opportunities to exploit global demand through integration into the world economy.

Under GTP 1 large upgrades of the economic infrastructure have been made by large investments in energy, transport and telecommunication. Significant power generation capacity has been constructed. This power comes mainly from renewable resources; most notably hydropower, and to a lesser extend solar and wind. Ethiopia's hydropower potential is the second highest in Africa at an estimated 45,000 MW. Current installations exploit only 2.5% (3.98 TWh). Ethiopia's mountainous inland and the high annual rainfall (1,000 to 1,500 mm) in its Western regions are advantageous for further development in various formats (pico- and micro-hydropower). Hydropower offers Ethiopia a cheap source of energy. Generation costs of planned hydropower plants are estimated below 0.05 USD per kWh.

Renewable energy is already used for the electrification of newly built railways. In January 2018, a 3.4 billion USD, 800 km train connection between Addis Ababa and the Port of Djibouti was inaugurated. This is the first phase and backbone of the new Ethiopian National Railway Network which in the long run will extend to over 5,000 km.

The Addis-Djibouti railway gives Ethiopia a solid logistical foundation for further developments. Shifting from road to rail transport will slash current cargo transit time from the capital to Djibouti from three days to only six hours. The new fleet of 32 locomotives can move much larger volumes of cargo (180 TUE or 3,500 ton) in a single haul with less handling and delays. Rail transport is expected to significantly reduce transportation costs.

Rail transport will only reach its full potential in combination with development of hinterland logistics, such as connection to road corridors via intermodal freight handling at inland dry ports.

Next to rail, large investments in road networks will soon connect industrial parks via transport corridors to Modjo Dry Port and beyond that the Port of Djibouti. Investments are made in new road corridors via Galafi, Dire Dawa and Dewele.

Modjo is becoming the key node in Ethiopia's intermodal logistics system. It links industry parks via road corridors to rail. A rail track is completed at Modjo. Modjo envisioned to become Ethiopia's main dry port for imported goods from Djibouti and a transhipment hub for manufacturing goods and agricultural produce destined for export. Development of Modjo is backed by a 150 million USD World Bank investment for the development of an intermodal transfer facility with gantries, container yards, warehouses, offices and cargo handling equipment.

Regional economic integration via infrastructure development is key under GTP 2, and the Government of Ethiopia is explicitly seeking projects that attract foreign investments.

1.6 ATTRACTIVE INVESTMENT CLIMATE IN DJIBOUTI AND ETHIOPIA

Ethiopia's growth and transformation agenda generates a substantial stream of foreign investment. From 2007 to 2011 annual Foreign Direct Investment grew from 500 million USD to 1.2 billion USD. After 2011 annual Foreign Direct Investment tripled to 3,98 billion USD in 2016 and 3,58 billion USD in 2017. China is Ethiopia's main foreign investor, primarily in construction, textiles, leather, power generation and telecommunication. Agriculture also attracts significant Foreign Direct Investment flows, as well rental of agricultural land. Other big investor countries are Saudi Arabia, India, Turkey and the United States.

Ethiopia's government has a positive attitude towards foreign investments and meets investors with a strong incentive package. This includes exemption from import taxes on capital goods, zero export taxes and income tax exemptions for 1 to 9 years. The Ethiopian Investment Agency offers a one-stop shop service to assist investors in acquiring investment and business licenses, and facilitates land acquisition. All land that is state owned can be leased for up to 99 years.

1.7 HORTICULTURE INDUSTRY DEVELOPMENT IS ONE OF TOP PRIORITIES

Agriculture is a key strategic sector in both GTP 1 and GTP 2, with strong emphasis on attracting private investments around horticultural export ventures. The Ethiopian Horticulture Development Agency facilitates investments in the sector. Additionally, development of the sector has support of the Prime Minister, and is backed by a high-level steering group with the Minister of Transport, the Minister of Agriculture, the Director General Ethiopian Maritime Authority and the CEO of the Ethiopian Railway Corporation.

Ethiopia's excellent track record in floriculture demonstrates its full support to investors in new agribusiness. Twenty years ago, Ethiopia did not sell a single rose. In 2018, there are over 130 flower-growing farms in Ethiopia. Combined they make it the second biggest exporter of flowers in Africa, after Kenya. Ethiopia is now the fourth largest non-EU exporter of cut-flower to the European Union, mainly via airfreight to the Netherlands. The sector has been expanding steadily, from 28.5 million USD in 2004-2005 to 275 million USD in 2015-2016. The sector provides approximately 183,000 jobs and is Ethiopia's fifth largest foreign revenue generator.

1.8 MARKET APPETITE TO BUY ETHIOPIAN HORTICULTURE PRODUCTS

All over Ethiopia fruit & vegetable activities are taking place. Most produce is destined for local distribution and consumption. Only a small part of the total production is destined for export. Ethiopia's main export destination is nearby Djibouti. Djibouti is close by, it has strong historic trade relations with Ethiopia and its quality requirements are less stringent than those of other markets. The Djibouti export volume of 50,000-60,000 ton per year has an export value of around 12 million USD.

Overseas exports to Europe are still limited to approximately 2,000 ton per year. Ethiopia's main export product is the French bean, a relatively high-value product that can absorb the relatively high transport costs of airfreight. Some companies are exporting to Saudi Arabia, United Arab Emirates, etc., also through airfreight, but others already use sea-freight solutions to offer more competitive value propositions. In terms of volume the same is true for Europe, export volumes are still limited.

Ethiopian fruit & vegetable products are on many wish lists. In a first market consultation among Dutch trading companies Ethiopia came out on top of the list of countries for sourcing products. Arab countries as well are actively looking to feed their populations with nutritious fruit & vegetable products. Driven by water scarcity they have a keen interest in countries like Ethiopia, Sudan, etc.

The key to success is to develop a Ethiopian value proposition for low and medium value fruit & vegetable products (melons, citrus, etc.) in addition to high-value products like cut flowers, French beans, etc. This entails developing a sea-freight value chain in addition to the already well functioning air-freight chain that meets CIF market price thresholds in Europe, the Arabian Peninsula, and perhaps in Asia.

1.9 PARTNERSHIP WITH THE NETHERLANDS FOR HORTICULTURE INDUSTRY DEVELOPMENT

Ethiopia is an agricultural sleeping giant. The Netherlands has excellent horticultural knowledge, logistical expertise and offers access to world markets. Currently a quarter of all horticultural world trade is in Dutch hands, as well as over half of all floricultural trade. The Netherlands is the world's second largest exporter of agriculture products, with a total market value of 7.8 billion EUR. Its imports are close to 5 billion EUR. Pairing the resources and experience of the two countries would help this sector to truly bloom on Ethiopian soil.

Agribusiness is as much about land, water and first class varieties as it is about logistics. In most cases logistics may even be more important, as it constitutes the biggest chunk of the cost of sale. Perishability of fruits & vegetables require reliable cool logistics and high service levels. This drives the sector towards continued logistical improvements. In the Netherlands, the interplay between its mainports (Port of Rotterdam, Schiphol Airport) and green-ports (production and logistical service providers) is strengthening and boosting continuous innovation of the sector.

With decades of experience, there is no need to reinvent the wheel. It is relatively straightforward to envision an Ethiopian cool logistics system based on Dutch best practices. In the Netherlands, Cool Rail and Cool Port form the building blocks of the Dutch Food Hub cluster. Cool Rail stimulated a shift from truck to train, resulting in cost reduction and lower greenhouse gas emissions. The intermodal container terminal Cool Port offers low cost efficient way of handling cool flows. The proposed projects can implement these proven concepts in the Ethiopia-Djibouti corridor.

The two countries already share a long-standing history of cooperation. There has been a Dutch embassy in Addis Ababa since 1950. Ethiopia is one of the Netherlands' 15 development cooperation partner countries. This eliminates the need to ferment an entirely new relationship. Direct aid from the Netherlands to Ethiopia amounted to 68 million EUR in 2014. The total flow of Dutch development funding through multilateral channels, non-governmental organizations and the private sector is even much greater. The Netherlands is Europe's biggest investor in Ethiopia. Many Dutch agricultural and horticultural entrepreneurs have already started businesses in the country.

A number of high-level visits in recent years have further strengthened bilateral ties, resulting in Flying Swans, a 5-year program backed by governmental support from Ethiopia, Djibouti and the Netherlands. Linking aid and trade in new policies, Flying Swans embodies an innovative approach to cooperation.

Over the past three years, several Dutch businesses such as Fresh Produce Centre, Port of Rotterdam, Boskalis, FMO and Mercator Novus, along with Ministries and Embassies have worked closely together. Under the banner of "Flying Swans for Going Global" the aim is to translate a shared vision into developmental impact and joint business development. Cross-industry consortia of Dutch businesses offer a total solution package; a tailor-made concept that covers the entire value chain. Best practices and building blocks from the Dutch economic cluster are adapted to the local context.

The Flying Swans method has already been adapted for a cool logistics solution in cooperation between major fruit exporter South Africa and the Netherlands. We propose a similar approach as a starting point for the tripartite cooperation between Ethiopia, Djibouti and Netherlands for the development of the cool logistics overlay and port connection.

CHAPTER 2

COOL LOGISTICS OVERLAY TO REALISE HORTICULTURE AMBITIONS

2.1 LOGISTICS IS KEY IN COUNTRY AND INDUSTRY DEVELOPMENT

Logistics is a large part of the horticulture prices-to-market. In the sector transport is considered an integral part of the product-proposition. In figure 4 an average break down of costs is depicted of import fruit to global markets. This figure provides a rough insight in the importance of cool logistics within the total horticulture value chain. The relative importance of each part of the value chain may differ per product, market supplied, etc. in all cases, efficient logistics is elementary to reach markets.

This is true for fruit & vegetable value chains as well as other low to medium value chains Ethiopia is focusing on, e.g. light-manufacturing, garments, etc. Abundantly available low-cost labour provides Ethiopia with a comparative advantage in less skilled, labour intensive sectors such as light manufacturing. Factory floor costs in Ethiopia for products such as garments, footwear, other leather products and processed food is said to be lower than those in China and India. These competitive advantages are complemented by the tariff preferences that Ethiopia enjoys in key markets such as the US and EU. However, studies conclude that the potential to export such products is constrained by several key supply side factors. Despite low labour costs the unit value of Ethiopia's exports of light manufacturing products at the point of export are considerably higher than those of China and other competitors. For product categories such as knitted or crocheted cotton dresses the unit value

12%	12%	21%	13%	42%
PLANTATION	**TRANSPORT** Producing country	**SEA-TRANSPORT**	**DISTRUBUTION** Consumption country	**SUPERMARKET** And DC Logistics

FIGURE 4: 'AVERAGE' FRUIT& VEGETABLE VALUE: BREAK DOWN OF COSTS IN PERCENTAGES

was 47% higher in 2015 than that of China while those of Cambodia and Vietnam were 26% above those of China.

A key factor undermining international competitiveness is poor trade logistics. Recent reports pointed to the trade logistics sector in Ethiopia as being a critical constraint to current trade flows and a bottleneck to further economic growth and development.

The table below benchmarks perceptions of Ethiopia's logistics performance using the Logistics Performance Index. Ethiopia's logistics sector appears to be considerably behind those of competitor countries in Asia as well as certain other landlocked countries in Africa, such as Uganda. For a twenty-foot container of garment exports to Germany, Ethiopia's logistics costs are 247% higher than those of Vietnam and 72% higher than those of Bangladesh.

Logistics are an important part of the value chains because they provide access to markets. Logistics either create or limits economic opportunities depending on whether market thresholds are met such as costs, transit time, etc. Logistics paves the way into new markets for the whole industry.

Ethiopia and Djibouti recognise the challenge to improve their logistics to create an attractive investment climate for industry development. Massive investments in basic logistics infrastructure have already been made, with further investments underway or planned.

	2016		**2014**	
	Global ranking	**LPI Index**	**Global Ranking**	**LPI Index**
Bangladesh	87	2.66	108	2.56
Botswana	57	3.05	120	2.49
Cambodia	73	2.80	83	2.74
China	27	3.66	28	3.53
Uganda	58	3.04	na	na
Vietnam	64	2.98	48	3.15
Ethiopia	**126**	**2.38**	**104**	**2.59**

FIGURE 5: BENCH MARKING LOGISTICS - LOGISTICS PERFORMANCE INDEX (INDEX=1-5, 5 BEING HIGH)

2.2 HUGE INVESTMENTS IN BASIC LOGISTICS INFRASTRUCTURE

Both Ethiopia and Djibouti have started development, and in some cases already finished infrastructure construction, in all parts of the logistics chain: a deep-sea port, road and rail infrastructure and hinterland ports.

NATIONAL RAILWAY NETWORK

Ethiopia and Djibouti have started investing in a National Rail Network connecting the main economic centres in Ethiopia to each other, and to Djibouti deep-sea port. This railway network should help in overcoming long hinterland distances. Setting up a nation-wide railway network takes decades in developing countries where foreign currency is often scarce. Development is therefore phased line-by-line. Ultimately the railway network will be 5,000 km long along four main axes. The network will span the entire country and connect all potential production regions to domestic and regional markets as well as deep-sea ports for overseas markets (figure 6). This includes railway tracks, stations and terminals to accommodate both passengers and cargo as is common around the world. The main nodes and locations of railway stations and terminals are depicted in figure 6. This requires a total investment of over 10 billion USD. The bulk will be financed by Ethiopia as most railway tracks are on its territory, and only a small part runs through Djibouti.

The first corridor developed is the Addis-Djibouti corridor. Both passenger and cargo trains have been running along this railway line since the beginning of 2018. In the first months of operations 10,000-12,000 TEU of containers were successfully transported Ethiopia and Djibouti already. The second corridor under development runs from Awash via Weldiya to Mekele. All construction contracts have been granted and the line is planned to be operational in 2019. Work at the side-branch of the Awash-Mekele line from Weldiya to Djibouti has not yet been granted to a contractor. The same applies to the remaining two main axes: Addis-Moyale and Addis-Dima. A definite time will be decided at a later stage by Ethiopia. Economic growth and forex earnings will partly determine the planning of the remaining railway lines.

Ethiopia's National Railway Network, with special attention to the Addis-Djibouti line, is described in more detail in the paragraph 'Ethiopian Rail Context Assessment', chapter 5. This includes information on technical specifications, rolling stock availability, freight volume forecasts, etc.

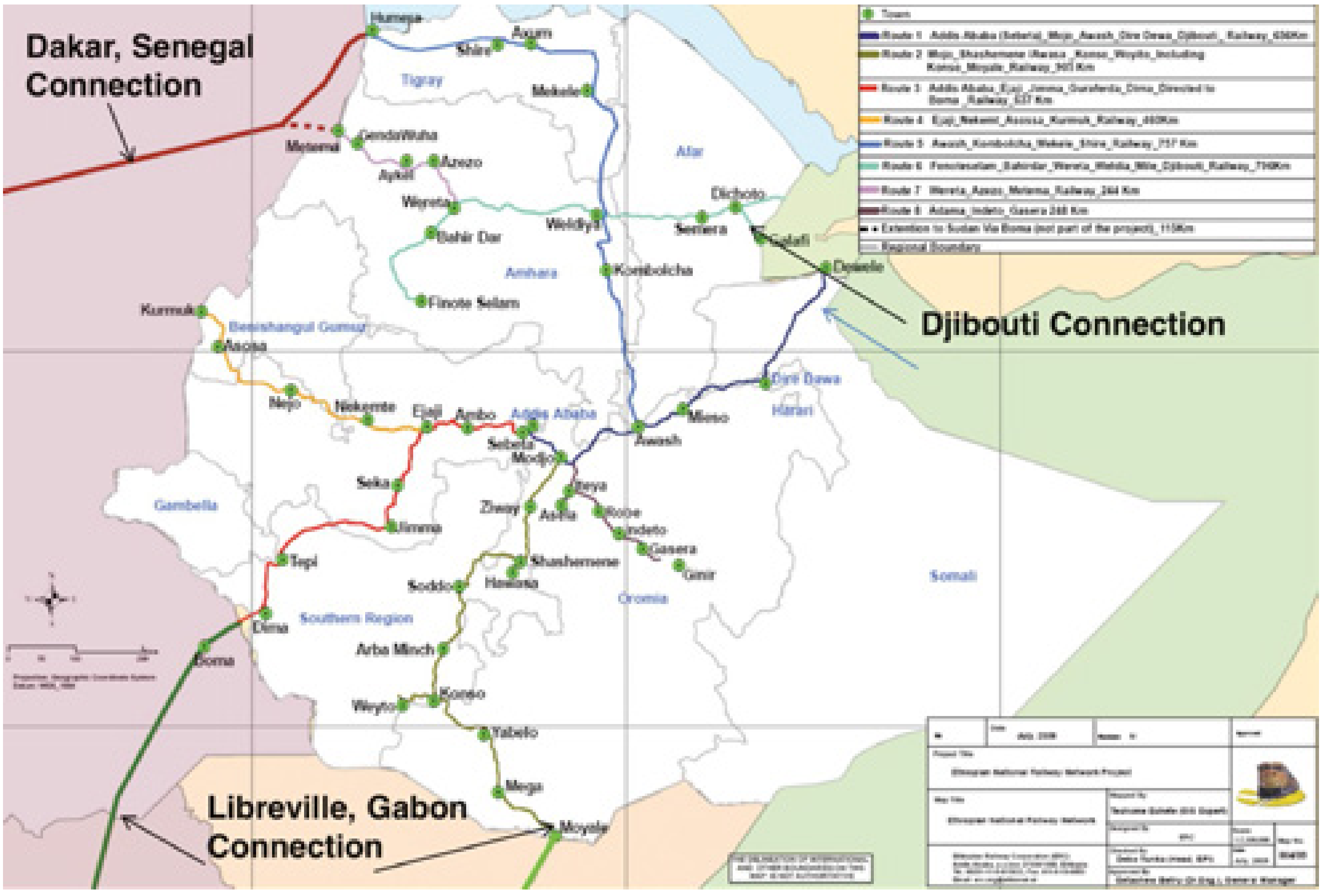


FIGURE 6: NATIONAL RAILWAY NETWORK

DEEP-SEA & HINTERLAND TERMINALS

A lot of efforts and investments are put into the development of hinterland ports. The National Railway Network plan includes hinterland terminals at all main rail nodes of the country. The first of which will be realised along the Addis Djibouti line. Those that are most important for cool logistics are described below. Two hinterland terminals around Addis, and the port/rail context in Djibouti.

Currently all trains make use of Modjo Dry port, 70 km from Addis. A rail terminal is already in place that services trains to and from Djibouti. Modjo is centrally located at the intersection of many (new) express highways; to Hawassa, to Addis/Adama, to Djibouti, etc. This hinterland hub receives almost 80% of all import cargo; more than 125,000 TEU per year with average growth of 30% per year.

Expansion plans allow Modjo to an annual volume of 2 million TEU in 2030. The dry port is converted to a rubber tired gantry operation with new IT terminal operating systems that substantially boost productivity per square meter. Additionally, the dry port will be positioned as a multi-user hinterland port that accommodates all kind of Value Added Service providers. This planned expansion is already underway and has received funding by the World Bank in the form of a 150 million USD loan.

Another rail terminal is anticipated for the Greater Addis region at Sebeta/Indode, approximately 20 km from Addis. In contrast to Modjo this is a green field development. This means less information is available about this terminal. Sebeta station is located at the beginning of the line and has a full train length rail terminal is. Cargo forecasts in the initial stage are 50,000 ton, 70,000 ton in the short term 90,000 for the long term. Cargo will be a combination of bulk, containers and other cargo.

Its proximity to Addis will have probable consequences for pre- and onward trucking. The travel distance to Addis will be shorter, but there will also be possible congestion to deal with. The Sebeta/Indode terminal investments are backed by Chinese loans. They cover the entire Addis-Djibouti line and will be implemented by the Ethiopian Railway Corporation.

Djibouti is investing heavily in its sea port. The past years a series of investments was made in a new multi-purpose terminal (600 million USD), the biggest free zone in Africa (4,800 ha, 3.5 billion USD, phase 1: 240 ha), etc. Two terminals are important for rail and cool logistics: the deep-sea container terminals DCT and DICT.

The current terminal (DCT) has been up and running since 2006. It has a quay capacity of 1.6 million TEU. High dwell times and limited stack capacity make reaching maximum capacity difficult. Several (limited) investments were made to increase stack capacity. Current throughput volumes are around 900,000 TEU. A larger increase of stack capacity would require reclaiming land from the sea. This is relatively costly. Djibouti also opted for an off-dock rail terminal near the start of the causeway instead of a far costlier on-dock variant.

With capacity expansion at the current terminal difficult and expensive, Djibouti is about to start investing in a new container terminal (DICT). Its planned capacity is 4 million TEU. Total investment for phase 1 would be around 700 million USD and would offer a capacity of 2.5 million TEU. The project is going through its final feasibility phase. Many international parties are interested to participate and operations are likely to start within two to three years.

SHIPPING CONNECTIONS

Shipping connections out of a port are dynamic by nature. This is true for all ports, as container carriers continuously change their networks and lines. This pre-feasibility study made use of a high-level non-exhaustive quick scan on shipping connections to and from Djibouti. This provides a general insight on current and expected sea-freight performance.

Several deep-sea carriers run services out of Djibouti: CMA CGM, Maersk, MSC, PIL, Cosco, Messina, and others. Cosco and PIL only offer services to Asia, while the others offer services to Europe too. Most are not direct connections yet, but run via hubs in the region: King Abdullah (MSC), Salalah (Maersk), Marsaxlokk (CMA CGM). This results in much longer transit times (sometimes even close to 30 days) when compared to direct services. The fastest connection to Europe is around 15 to 16 days, CMA CGM via Rotterdam, and MSC via Antwerp (which has a direct connection).
DCT is one of the most modern deep-sea container terminals in Africa. The new DICT terminal will increase Djibouti's total capacity two- to fourfold. Djibouti's role in shipping networks will become far more important. It has a clear potential to grow into a major East Africa hub; it is located at the entrance of the Red Sea (limited ship deviation) and very close to Ethiopia, Africa's second biggest country. Current investments seem to anticipate higher volumes flowing from the Ethiopia-Djibouti corridor, direct services to the main markets in Europe and Asia as well as high frequency shortsea services to countries on the Arabian Peninsula.

The first signs of more frequent and cost-effective connections out of Djibouti Ethiopia are already visible. Many freight forwarders and container carriers are very interested to make major investments in Ethiopia when the logistics industry in Ethiopia opens to private investments. For example, CMA CGM want to invest in the new DICT terminal in Djibouti via its daughter company Terminal Link.

FIGURE 7: NATIONAL COOL LOGISTICS NETWORK (ARTIST IMPRESSION)

FIGURE 8: COOL PORTS IN ETHIOPIA (ARTIST IMPRESSION)

2.3 COOL LOGISTICS OVERLAY FOR PERISHABLES

Ethiopia and Djibouti are both investing billions of dollars in upgrading their basic logistics infrastructure. This will improve performance in terms of price, transit time and frequency. On top of these, perishables have additional requirements; temperature control, shelf life, reliability, contingency, etc.

Together with the Netherlands a National Cool Logistics Network is under development which can deliver the required services for various kind of perishables. Infrastructure and facilities will have to be put in place to make long-distance train transport possible for perishables from production regions to domestic markets (Addis), regional markets (Djibouti, Sudan, etc.) and global markets (Europe, Asia, Arabian Peninsula.) Rail terminals, dry ports, the port of Djibouti but also the trains themselves each require will directed investments. Figure 7 offers an artist impression of the envisioned cool logistics overlay and how it could develop in the upcoming decades.

Most designated agricultural growth regions are situated near important rail nodes or projected dry ports. At these ports, general container logistics facilities are already in place or are planned as investments: rail terminals, stacking area, terminal equipment, etc. The Ethiopian authorities and its partners ensure a world-class quality.

Perishables require cool logistics infrastructure and handling capacity on top of these facilities. Figure 8 depicts a typical dry port in Ethiopia with all relevant cool logistics facilities. Trucks bring produce via dedicated truck gates to a cold store where the containers will be stuffed. When stuffed these containers go to the container stack. Reefer plugs keep the perishable cargo at the right temperature, before they are loaded onto the trains that bring them to their destinations. The design is intentionally compact to keep distances between the facilities as short as possible for efficient and cost effective handling.

Cool Ports are envisioned at all dry ports near agriculture production and processing regions and near domestic markets such as Sebeta, Modjo, Dire Dawa, Arba Minch, etc. In principle, all Cool Ports will have very similar cool logistics facilities and layout: reefer plugs, cold store, dedicated truck gate, etc. The details of these facilities may differ as each dry or cool port serves another production region with specific characteristics and demands based on the types of products, commercial farming vs smallholders, etc.

The dry and cool ports around Addis (Modjo, Sebeta) will serve a unique role. They will form the central nodes in the National Railway and Cool Logistics Network (biggest dry port and cool port in figure 7). This hinterland port will be setup in such a way that it is being able to efficiently accommodate rail-rail transport, besides the truck-rail logistics chains the other dry ports are serving. The Addis hinterland port will also process cargo that arrives by train and leaves on another train shortly afterwards. This provides the opportunity to create a double-hub system between Addis and Djibouti port, similar to successful high-performance train systems in Europe. It offers several advantages:

- Lower costs per unit transported via rail between Addis and Djibouti
- Higher frequency and lower transit time via rail between Addis and Djibouti
- Improved risk profile of development of new rail connections behind Addis hub (e.g. Arba Minch)

Djibouti port is a very important part of the (cool) logistics value chains. Specific attention is given to its container terminal(s) in the process of designing the cool logistics overlay. An artist impression is made for a new deep-sea terminal including relevant cool facilities and a compact interface between the railway line and the deep-sea terminal (figure 9). The rail terminal is located on-dock (on the deep-sea terminal) to keep handlings between rail terminals and deep-sea terminals efficient and the break-up of the cold chain as short as possible. Between the rail terminal and the deep-sea container stack a cross-docking facility is envisioned to reduce empty legs and make imports and exports more cost-efficient. Cross-docking eliminates empty transport of northbound dry containers back to Djibouti as well as empty southbound containers back to Ethiopia. More details on the workings of this facility can be found in chapter 6.

This cool logistics overlay concept is part of the Proposal to Co-operate and forms the basis of the partnership between Ethiopia, Djibouti and the Netherlands on the roadmap for horticulture industry development. The artist impressions are high-level sketches combining Dutch best practices with local specifics. This pre-feasibility details the first building blocks of phase 1 of the National Cool Logistics Network (Cool Rail Ethiopia: chapter 4; Cool Port Addis: chapter 5; Cross-dock Djibouti: chapter 6.)

2.4 HORTICULTURE INDUSTRY DEVELOPMENT GOALS

A cool logistics system on top of existing container logistics investments and improvements should help Ethiopia meet market thresholds for many perishables; not only for higher value products such as flowers and green beans that are already being produced, for also for medium value products such as melons and mangoes and perhaps also lower value products such as bananas and oranges.

Ethiopia is centrally located, right between large fruit & vegetable markets. It should be able to serve both European and Asian markets besides the Arabian Peninsula. Market size in terms of volume and value is described in more detail in chapter 3.

Ethiopia has the potential to grow into a major player in fruit & vegetable exports. Market demand for Ethiopian fruit & vegetable products should be a limit, once product quality and cost-to-market are met. Ethiopia has ample irrigable land and many agro-ecological zones to provide these markets with a variety of products across the year.

South Africa is the biggest seaborne fruit & vegetable exporter, growing in terms of export volume from 1.1 million ton (1990) to over 3 million ton in 2018. Recent newcomers like Peru and Costa

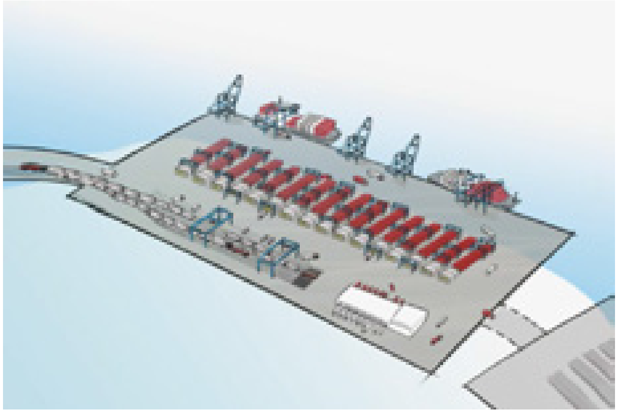


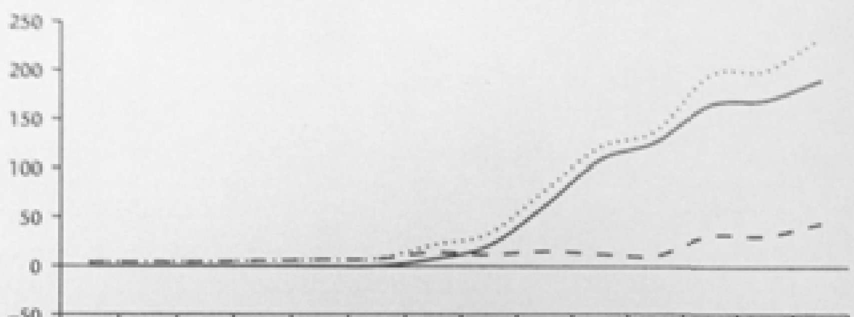
FIGURE 9: CROSS-DOCK DJIBOUTI (ARTIST IMPRESSION)

Rica show that the fruit & vegetable market has the capacity to take in new volumes. Peru has built a fruit & vegetable export industry of 1.3 million ton (2 billion USD) within a decade. Avocados are the main contributor to this success; exports rose from 60,000 to 180,000 ton in five years. Costa Rica has had similar success in growing its pineapple industry to 1.5 million ton and a value of over 1 billion USD within a decade. Entrepreneurial governments played a vital role in both cases and particularly Costa Rica.

Ethiopia has the potential to match the success of these countries at least. It could grow to 1 million ton of exports within a decade. Providing various markets with a wide range of fruit & vegetable products would even put volumes of 3 million ton or more within the realm of possibilities. Besides its comparative production advantages, the country is also strategically located right in between the large markets of Europe and Asia. Neighbouring Arabian Peninsula are obvious, almost captive, markets too. The Gulf Cooperation Council countries have seen a steep increase of fruit & vegetable imports due to own water supply issues to a current level already of 6.8 billion USD (> 10 million ton). Currently South Africa is one of their major providers (0.5 billion USD, mainly citrus fruits).

In Floriculture Ethiopia has demonstrated its ability to grow a new industry from almost zero to a multi-million industry within just a decade. Starting with almost no export volume in 1998, export volume rose close to 200 million USD in 2011. Here an entrepreneurial government played a vital role in achieving this success with various measures and incentives for required airfreight solutions and pricing amongst other initiatives.

At the moment, the Ethiopian fruit & vegetable industry is still in its infancy in terms of volumes. It is also imbalanced; most active industry players are still in subsistence farming together with a few international



	1998/99	1999/00	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12
Non-floriculture	3.73	4.17	4.2	5.59	6.73	7.54	14.57	12.73	16.16	13.66	11.91	31.73	31.5	44.69
Floriculture	0.2	0.13	0.3	0.15	0.04	0.32	7.72	21.97	63.61	111.8	130.7	170.2	175.3	197
Horticulture	3.93	4.3	4.5	5.74	6.77	7.86	22.29	34.7	79.77	125.4	142.6	201.9	206.8	241.7

FIGURE 10: EXPORT VALUE OF FLORICULTURE AND HORTICULTURE 1998-2011

players serving the international commercial markets. Other industry segments are still relatively small: shortsea exports (e.g. Arabian Peninsula), overland exports (e.g. Djibouti) and national distribution (e.g. Addis). The industry would function optimally with a balanced industry pyramid fitted to the local context. In such a context synergies between industry segments would present themselves; knowledge dissemination from top segment to others, economies of scale in ancillary industries (logistics, seeds, packaging), maximization of forex generation, etc.

The National Cool Logistics Network would serve all parts of Ethiopia's fruit & vegetable pyramid. With the support of the Dutch Embassies, the Ethiopian Horticulture Producer Exporters Association has detailed a roadmap in which specific adjustments to serve specific market segments are proposed. The roadmap has been an important input for this study. The cool logistics development process is phased with the depicted development path in mind.

Fruit & vegetable production and export to overseas markets in Europe and the Arabian Peninsula are a logical first step, as these markets are willing to pay the prices necessary to repay the investments in cool logistics infrastructure and part of the basic rail and port infrastructure. The ultimate aim is a balanced logistics system serving all markets with active participation of smallholders too. No irrevocable decisions in this first cool logistics development phase should be taken that would prevent the realisation of such a future system (e.g. right spatial planning). This is one of the reasons that at Cool Port Addis space is reserved for the export flow to Djibouti. (see chapter 5)

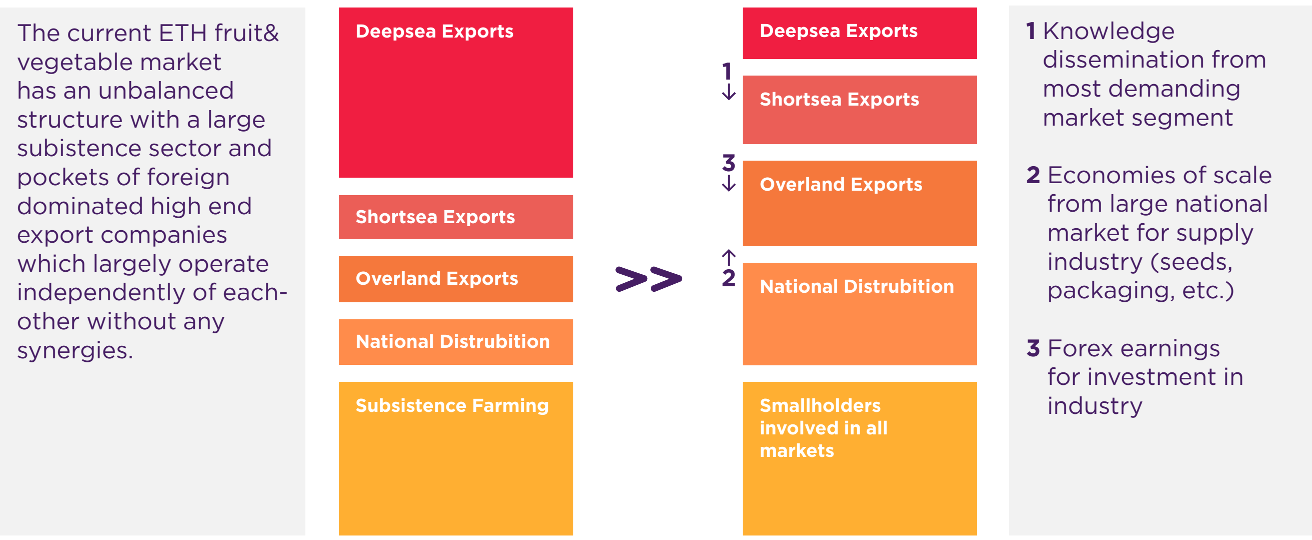


FIGURE 11: TRANSITION TOWARDS BALANCED ETHIOPIAN FRUIT INDUSTRY

2.5 BIG DEVELOPMENT IMPACT ON ETHIOPIA, DJIBOUTI AND THE REGION

A National Cool Logistics Network on top of all the basic rail logistics infrastructure currently under development will have a huge positive impact on Ethiopia in many ways. It lays the foundation for:

- A low carbon, low cost logistics system which makes it possible for all kind of perishable flows to become competitive in world-wide markets
- Unlocking new industries (e.g. fruit & vegetable) which generates many new jobs along the entire value chain (production, value addition, logistics) for both white and blue collar workers
- Generating billions of foreign currencies with perishables, which selling markets are big and still growing
- And at the same time improving food security in Ethiopia and its surrounding countries through reducing post-harvest losses and facilitating connections between production and local markets

The National Cool Logistics Network will have a substantial positive impact on all perishable flows. Below we have tried to quantify the advantages purely for fruit & vegetable (export) flows. Total impact will probably be much larger as cool logistics influences exports of flowers, meat etc and plays a role in import substitution of food flows. All possible flows will boost job creation, value addition industries, forex generation and food security.

LOW CARBON, LOW COST LOGISTICS TO REACH MARKET THRESHOLDS

The cool logistics system is designed in such a way, among others through various Cool Ports at hinterland terminals across the country close to all fruit & vegetable production areas, to minimise expensive long distance trucking.

The rail-based system will also help Ethiopia limit its CO_2 footprint. From experience, we learn that perishables transported by train show 70%-80% CO_2 reduction compared to trucks in general. Ethiopia's footprint will be reduced even more because most rail energy comes from hydropower.

MANY NEW JOBS IN NEW INDUSTRIES

A high performance logistics system will provide the opportunity to export fruit & vegetable products at a much larger scale. Countries like Peru and Costa Rica showed what is in the realm of possibilities within 10 years (1,000,000 ton) South African volumes (3,000,000 ton) are not unrealistic within 20-30 years, taking Ethiopia's climatic conditions and its centrality to markets into account.

Fruit & vegetable industries are large employers. An annual volume of around 3,000,000 ton would require 300,000 ha of land (assumption: 10 ton per ha) and would employ 4.5 million people both directly in production as well as indirectly in packaging, logistics, etc. (assumption: 7.5 direct jobs per ha based on current Ethiopian statistics, same amount of indirect jobs assumed based on global best practices). Of course, the types of jobs created would depend on the type of products exported, efficiency across the value chain, etc.

Fruit & vegetable production and export, and the National Cool Logistics Network it pays for, will also serve as a stepping stone to further value addition, e.g.: juices, soups, salads, etc. The number of jobs generated in these value addition industries could potentially be even higher.

FOREX GENERATION

Horticultural crop production generates high economic returns per unit of land compared to many other agricultural products. CIF market price thresholds differ per product, per season, etc. Average prices for Europe range between high value products (e.g. avocados, around 2,000 USD per ton) and lower value products (e.g. bananas, around 500 USD per ton).

Market price thresholds will be used to fine-tune the system and increase its competitiveness. It makes sense to start with exports of higher value products (avocados, mangoes, etc.) and further improve the logistics system to levels in which it is also capable of exporting lower value products in later years.

These USD values imply significant forex generation. Actual generation depends on the portfolio of products exported (spread in high-medium-low value products). An average value of around 1,000 USD per ton would add up to 3 billion USD per year, assuming 3,000,000 ton of exports in the ultimate scenario. Should the 1,000,000-ton marker be reached in the next decade, an annual forex generation of 1 billion USD is possible.

To come to a net forex generation all costs paid to international service providers, e.g. container shipping to Maersk, MSC, etc. must be deducted. With shipping prices most likely coming down with growing export and import volumes these costs should not exceed 10%-15%

FOOD SECURITY AND POST-HARVEST LOSSES

Besides monetary and job creation value fruits & vegetables also have a great role to play in improving Ethiopian diets. Current average consumption is far less than 100g per day per person. The WHO and FAO recommend a minimum of 400 g of fruit & vegetables per day per person. (This excludes starchy root crops. Minimum to prevent chronic diseases such as heart disease, cancer, diabetes and obesity and alleviation of several micronutrient deficiencies.)

Fruits & vegetables provide an abundant, cheap source of fibre and several vitamins and minerals. Fruits & vegetables play an important part in general health. They provide antioxidants such as vitamin A, C and E that are important in neutralizing free radicals (oxidants) known to cause cancer, cataracts, heart disease, hypertension, stroke and diabetes.

The WHO estimates that low fruit & vegetable intake contributes to approximately 16 million disability-adjusted life years around the world (DALYs, a measure of the potential life lost through premature mortality and the years of productive life lost through disability.) 1.7 million deaths worldwide can be attributed to low fruit & vegetable consumption.

Ethiopia's cereal based food habit largely affects children in most part of the country. Many research reports indicate that an estimated five million people are suffering from lack of vitamins and essential minerals. In general terms, 60 to 80% of health problems in Ethiopia are due to communicable diseases and nutritional problems. The amount of vegetables consumed is found to be the best predictor of over-all nutrient adequacy across multiple nutrients (Powell et al., 2012).

The same is true for Djibouti. In Djibouti fruit & vegetable consumption is far below 100g per capita because many of its close to a million residents cannot afford expensive fruit & vegetables imported from overseas (e.g. from France). Many children (approximately 109,000 under the age of five) are at risk of stunted growth, improper mental development and death due to malnourishment. It is estimated that around 30% of children under the age of five in Djibouti are underweight.

Increasing fruit & vegetable production and export will also improve availability of these products in both Ethiopia and Djibouti. Perhaps even more importantly, seamless cool logistics systems will sharply decrease post-harvest losses, which further increase fruit & vegetable availability, lower prices, etc. Bringing down the current post-harvest losses (between 15-70% depending on product and region) will have a direct positive effect on people's livelihood and the economy of the country as a whole.

CHAPTER 3

COOL LOGISTICS INVESTMENTS FOLLOW RAIL NETWORK DEVELOPMENT

3.1 SYNCHRONISE RAIL AND HORTICULTURE INVESTMENTS

Many promising potential production regions in Ethiopia are relatively far away from deep-sea ports. The same applies to the main consumption area, the greater Addis region, which is too far away to receive seaborne import products. Besides meeting food quality and safety standards, developing a fruit & vegetables industry is predominantly about getting a cost-efficient logistics solutions in place. A significant percentage of total product costs is transport cost from producer to final end-client. The sheer distances in Ethiopia make rail transport a vital transport mode for the fruit & vegetable industry, especially for low and medium value products from the more distant production locations.

Phasing and timing of rail investments is essential for the multi-annual overall planning of the fruit & vegetable industry development because it offers the only competitive mode of transport to far-away production regions. Given the importance of have a high-performance logistics systems in place it is highly recommended to synchronise its investments with the phasing of the railway network. In other words, first develop those production regions which would be able to use the Addis-Djibouti train connection, and from there develop the potential from the railway line going North.

Ethiopia, Djibouti and the Netherlands strive to have a mutually beneficial partnership for the development of the fruit & vegetable industry across Ethiopia. Although the geographical focus of this pre-feasibility report is on the Addis to and from Djibouti corridor and all the production regions which can be served via this line, it is relevant to look at the Northern line to Mekele too as it forms a connection to the promising Raya valley production region. The Raya valley has 10,000 ha of irrigable land designated for horticulture production, production locations are relatively close to Weldiya or Mekele railway stations, and running trains are foreseen for the upcoming years.

The Addis-Djibouti corridor is the obvious place to start with the development of the National Cool Logistics Network for many reasons:

- Trains haves been running along the line since this year already
- Dry port Modjo is converted into a world-class facility, with the help of >100 million USD World Bank funding
- Many promising fruit & vegetable production locations are located near the corridor from Modjo all the way up to Arba Minch
- Most current cut flower production and export takes places in Ziway, 90 km from Modjo
- An existing meat cluster already represent significant year-round flows to export markets
- Over 80% of all import cargo flows (dry and reefer) are destined for the densely populated greater Addis region
- Investments in several high-ways to and from Modjo enable cost-effective pre- and onward trucking
- Etc.

It makes sense to start along the Addis-Djibouti line as this is where most container cargo is concentrated. Ethiopia and the World Bank are investing tens of millions of dollars in terminal expansions, agro production from the Wayamba Minch corridor passes, etc.

The remainder of this pre-feasibility report focuses on what must be in place to enable cool logistics to and from Modjo dry port. Sebeta/Indode may also be an interesting node in the National Railway Network, in particular because of its proximity to Addis. We can imagine it could be worthwhile to consider setting up cool logistics here as well within the multi-annual partnership, especially for domestic distribution.

3.2 THREE LINKED INVESTMENTS ALONG ADDIS-DJIBOUTI CORRIDOR

Basic rail and port infrastructure are in place, and trains are already running with dry containers. In general, additional supra-structure investments are needed to get cargo flows shifted from truck to rail. For example, specific wagons or warehouses. This needs to be combined with significant efforts to let industries get used to the new way of workings. This is particularly true when considering perishable goods, shelf life, reliability and closed cold chain criteria.

Tapping from the extensive experience The Netherlands have with intermodal transport solutions for perishable goods, both in Europe as well as other continents like Africa, three specific investment components are identified. Together they are able to provide a high-performance cool logistics system along the Addis-Djibouti corridor:
1. Cool Port Addis
2. Cool Rail Ethiopia
3. Cross-dock Djibouti.

COOL PORT ADDIS

Cool Port Addis is a cold store facility where producers can store their products at the right temperature. The facility offesr both cold rooms for fresh (fruit, vegetable, flowers, etc.) as well as frozen (meat, fish, etc.) products. This facility is fully integrated into Modjo container terminal, avoiding expensive handlings of containers compared to off-dock facilities. Modjo being one of the central nodes in the railway network guarantees frequent trains to and from Djibouti and other relevant origins and destinations. Such a facility must be able to handle both export (of production regions along the Modjo-Arba Minch axis) as well as import of perishable goods (destined to the greater Addis region) to get robust occupancy rates and facilitate balancing import and export reefer transport.

COOL RAIL ETHIOPIA

Cool Rail Ethiopia offers train connections along the corridor specifically designed for perishable cargo with swift transit times and train routes in sync with ship departures times whenever possible. Reliability is a key performance indicator and contingency plans are in place in case something goes wrong. Goods are cooled all along the train transport by generators able to control the temperature of approximately 40 deep-sea containers at once.

CROSS-DOCK DJIBOUTI

Cross-dock Djibouti is an on-dock cross-docking facility at the deep-sea container terminal in Djibouti playing into imbalances of both dry containers (empty Northbound) and reefer containers (empty Southbound). At this facility goods from dry containers are moved cost-efficiently into a reefer container resulting in eliminating both empty legs. The dry goods transported in a reefer container from Djibouti to Addis will be unstuffed at Modjo into a Container Freight Station from where it will be picked up by the end-client or brought to the end-client by a logistics service provider. This Container Freight Station will be part of the same building as the Cool Port Addis operations to keep supply chain control and performance guarantees all along the value chain.

3.3 MARKETS TO BE ACCOMMODATED

All three investments along the Addis Djibouti line will be backed by cargo flows from similar value chains. Therefore, we have chosen to describe these flows first before going into detail into the specifics of the pre-feasibilities of each individual investment. Cross-dock Djibouti is different from Cool Port Addis and Cool Rail Ethiopia because it serves all production regions in Ethiopia while Cool Port Addis only serves the Addis area and hinterland.

Various cargo flows have been identified as relevant to the cool logistics investments along the corridor, all will be described below, most attention is given to the fruit & vegetable value chains, as this is the primary reason for setting up a cool infrastructure.

FRUIT TO EUROPE AND OTHER GLOBAL MARKETS

Fruit & vegetable production and consumption world-wide has shown robust growth rates over the last decades, in the last decade the average growth was 4.5% per year. This exceeds world population growth, resulting in an increase of per capita consumption which is still growing. While many people still consume less than 400g per day (recommended by WHO and FAO), changing demographics, rising incomes and behavioural change are expected to drive consumption figures up in the coming decades.

Worldwide production is above 1.7 billion ton: approximately 60% is vegetables, and 40% is fruit. Significant amounts of these volumes are consumed domestically or exported to nearby countries, while seaborne fruit & vegetable exports are estimated at around 50 to 60 million ton (total perishables: 112 million ton), which is showing robust growth each year. Shelf life characteristics cause fruit to be more often exported overseas than vegetables

International trade has grown even faster than production and consumption. During the last decade, this trade has increased from 56 billion USD to over 140 billion USD. The largest importer is Europe, followed by the United States. Together, they import over half of all fruit & vegetables traded internationally. At 11 billion USD China and other Asian countries are still lagging behind.

European imports are around 40 billion USD. This is equal to approximately 30 million ton of import per year. The Netherlands is the main fruit & vegetable trading hub for Europe and focusses mainly on the Northern part of the continent.

The European market could become a major customer for Ethiopian products. Given the sea-freight transit time, the focus will be mostly on fruits. In terms of market requirements, it is noteworthy that Europe is rapidly becoming more retail-dominated and demanding, with specific requirements for food safety, reliability, price, etc. Currently, European countries source from many countries on all continents. Global competition may be fierce, but its comparative advantages should help Ethiopia offer a promising value proposition.

FRUIT & VEGETABLE TO THE ARABIAN PENINSULA

Growing populations in the Arabian Peninsula are increasingly dependent on imported staple foods. Food imports are projected to grow to 53.1 billion USD by 2020. Major factors driving the Gulf Cooperation Council market include a growing domestic and expat population, rising health consciousness, changing tastes and preferences, and rising disposable income. These factors lead to higher consumption of nutritional foods as part of the stable diet.

The United Nations' figures reveal the Middle East population of GCC countries jumped by 18.9% over the last five years. In recent years birth rates have stabilised at an impressive 20% in countries like Saudi Arabia. According to a report published by the Economist Intelligence Unit, by 2020 the GCC population is forecast to reach 53.5 million, a 30% increase from 2000.

Falling groundwater and aquifer levels, limited rainfall, an arid climate, overreliance on imports and rising soil salinity are affecting the fruits & vegetables market in the Arabian Peninsula. The region's dependence on desalinated water means that its food requirements cannot be met by domestic production in the long term.

Currently, fruit & vegetable imports are already 4.6 billion USD (2016), with a 60%-40% fruit-vegetable ratio, coming from 3.2 billion USD (2013). This is a growth of 44% in only three years.

One of the major suppliers is South Africa. It supplies mainly citrus products. South African volumes to the Arabian Peninsula have risen steeply the last couple of years. The total current export value nowadays is already around 0.5 billion USD.

Compared to Europe the value chains are not as much dominated by large retail chains. A large percentage goes through wholesale markets located around large cities. This means product quality requirements are often less strict.

Saudi Arabia, United Arab Emirates and other countries in the region are very important for growing Ethiopia's fruit & vegetable industry. Their proximity and initially somewhat lower quality requirements offer Ethiopia a unique competitive edge for both fruit and vegetable exports.

FRUIT TO NEIGHBOURING COUNTRIES

Europe and the Arabian Peninsula will most likely be the two major fruit & vegetable export markets for Ethiopia. Their cargo flows would underpin the cool logistics infrastructure investments, as they ensure a substantial baseload volume. Smaller nearby markets may also be relevant, as these will be more or less captive markets for Ethiopian products once cool logistics solutions are in place.

For example, Djibouti, with around 1 million inhabitants has only 2% arable land of which only 0.5% is suitable for irrigation. Currently, Djibouti already imports 500 million USD of food each year, mostly from countries overseas via its port. Given the distances involved this is relatively expensive.

90% of its fruit & vegetable consumption is imported. Fruit & vegetable consumption is around 70 kg per capita per year. This is well below the recommended daily quantities by WHO and FAO (400 g per day). This is the result of an expensive supply and the limited financial capacity of its people.

Currently, Ethiopia exports between 50,000-60,000 ton of fruit & vegetables per year with a value of around 12 million USD. This leaves ample room for future growth should Ethiopia become capable of producing large quantities of affordable fruit & vegetable products. Ethiopia could provide a significant improvement of the availability of nutritious food products in Djibouti making it an attractive launching customer besides Europe and the Arabian Peninsula.

OTHER RELEVANT MARKETS AND CARGO FLOWS

Ethiopia is already a major cut flower exporter with around 50 million ton of cut flower exports per year. Most large exporters are clustered in and around the Ziway region which is relatively close to Modjo. 80% of all products are flown from Modjo to Aalsmeer, the Netherlands for further distribution. Ethiopia's main competitors are Colombia and Kenya.

The flower value chain is undergoing a transition from air to sea. Colombia already ships a significant percentage of its products (>25%) though their east coast ports near the Panama Canal via the busy shipping lanes from south America to Europe. Closed cold chain solutions, frequent shipping services and decent transit times to the major markets generate a qualitative and cost advantages over the competition.

Ethiopia is very well positioned along the China-Europe shipping lanes. Ethiopia's seaborne cut flower is expected keep growing significantly. High volumes, year-round character and the proximity to Modjo make the cut flower industry an interesting launching customer once the right logistics performance criteria are met (mainly transit time and reliability). Exporters are now paying airfreight prices which are much higher than regular shipping prices per kilogram. The average ton per container for cut flowers is much lower than for fruit & vegetable (10-13 ton vs 18-22 ton per container). This means cut flowers generate more containers for train transport per ton cargo. The current 50,000 ton of cargo per year would already requires about 5,000 containers per year or 100 containers per week.

Near Modjo dry port a thriving meat export cluster generates a current trade volume of around 50 ton per day (2-3 containers). This amounts to an export value of 100 million USD per year. Over ten slaughterhouses are active in the area. At least two of these have ambitious expansion plans, Frigorifico Boran Foods (part of Allana Group) and Verdi Beef (near Ziway).

Frigorifico has invested in an abattoir plant at Adam Tulu with a capacity of 3,000 cattle and over 6,000 sheep and goats per day. This would produce around 300 ton of meat per day. At an average payload of 20 ton per container this equals 15 containers per day, or 75-100 containers per week.

Verdi Beef has the ambition to become the largest cattle feedlot operation in Northern Africa. The company has an export target of 130,000 carcasses per year. This translates to about 15.600 ton (130,000 x 120 kg) or close to 8,000 containers per year (150 containers per week). Verdi plans to increase its herd from a current volume of 7,000 cattle to 70,000 cattle in the upcoming four years.

A train connection could serve the meat industry year-round. While these types of companies will use their own cold store facilities for the bulk of their cargo the facilities at Cool Port Addis could possibly prove very valuable during peak production.

Above we have described the most obvious export markets and value chain flows for the cool logistics infrastructure along the Addis-Djibouti corridor.

With nearly 4 million people living in nearby Addis, the same facilities are relevant for all kinds of import flows as well. Market participants estimate current (frozen) import flows like meat, fish, medicines, chocolate and the like at around 10-20 containers per month. Many of these products are now stored in small cold store facilities of hotels etc. These are relatively inefficient and maintenance intensive. With rising income levels these volumes will grow exponentially in almost any scenario in the coming decade. A third-party cold store would be very helpful to facilitate this growth.

Finally, driven by the same large consumer base in the Addis area, the cool logistics infrastructure would also be of use for domestic distribution. Current domestic perishable distribution flows are still limited. It is difficult to put a number on a specific forecast period, but these flows will certainly emerge.

CHAPTER 4

INVESTMENT COMPONENT 1: 'COOL RAIL ETHIOPIA'

4.1 RATIONALE

Ethiopia's main obstacle for setting up a horticulture industry are the large distances to the Djibouti export port. As most production centres are in the highlands with its more suitable climate, distances are vast. A relative nearby production location like Dire Dawa is still 400 km removed from the port. Most are much further away: Ziway at 785 km, Arba Minch at 1.100 km, etc.

Many main producing countries have horticulture production areas closer to the coast. This is evident for a small country like Costa Rica, but also a country like South Africa, which is similar in size to Ethiopia, has many production areas in proximity to its export ports in Cape Town and Port Elisabeth.

On the other hand, South Africa is also able to produce and export products from the remote Limpopo province using efficient truck and rail logistics solutions. Limpopo is 850 km removed from Durban yet they manage to successfully export competitive products like oranges that have a CIF threshold of around 15,000 USD per container.

Distances should not be a deal breaker for the development of the Ethiopian horticulture industry. Efficient hinterland logistics is a prerequisite, in particular for low and medium value products which form the bulk of total volumes traded around the world. To set up such a logistics system it is logical to focus on train solutions which are more cost-effective than trucking. In mature markets price differences between rail and truck are roughly 0.4-0.6 USD per container km for rail versus 0.9-1.1 per container km for trucking. Current prices of both trucking and railing in Ethiopia are higher for obvious reasons. Its logistics system is in a transition towards a world-class system and performance. Current volumes are still low.

Besides horticulture development, the same is true for the development of other industries in Ethiopia. The garment industry needs efficient logistic import and export solutions for their light manufacturing locations around Hawassa (950 km from Djibouti.) Discussions on making import and export logistics more efficient have already begun between garment manufacturing parties and relevant Ethiopian authorities.

Rail as a transport modality is far more complex than trucking for several reasons: door-to-door delivery requires other modalities, large investment requirements, penetration is dependent on network trajectories, etc.

Door-to-door rail solutions are made up from many subsequent steps in the logistics chain (figure 12), e.g. trucking from production site to rail, handling at the rail and deep-sea terminal, etc. One of the most important factors in getting a rail product right is managing the interactions between the different parts of the chain. Rail transport itself is the main cost component, especially in long-distance connections like in Ethiopia. So it all starts with making sure this part of the chain is cost-effective and performs optimally.

Rail transport is capital-intensive. Network infrastructure and equipment (locomotives and wagons) require large investments. Cost effective rail transport requires large cargo volumes. These ensure decent occupancy rates of these capital-intensive fixed assets to kick start the virtuous circle of more volume and better performance.

The volume-performance principle holds true for each corridor in each scenario. It is therefore an important design criteria for any rail concept. Within this framework, the effectiveness of rail solutions is also heavily dependent catering to local specifics, both in terms of rail characteristics, as well as requirement of shippers using rail transport. A successful synergy of these two components determines success, rail logistics performance and rail modal split percentages. The following paragraphs assesses these specifics (rail context and shipper requirements) for a rail concept suited for the Ethiopian context.

RAIL COSTS BREAKDOWN

VIARIABLE 20-40%	**ELECTRICITY**
(SEMI) FIXED 60-80%	**PERSONNEL**
	TERMINALS
	RAIL TRACKS
	WAGONS
	LOCOMOTIVES

FIGURE 13: RAIL COST BREAK DOWN: FIXED VS VARIABLE COSTS

BREAKDOWN OF SUPPLY CHAIN COSTS FOR LONGER DISTANCE FRUIT TRAINS

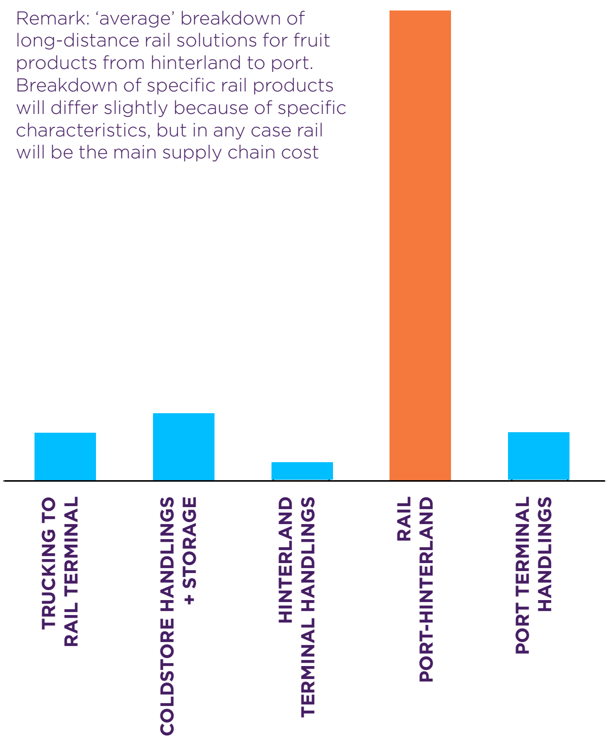


FIGURE 12: DOOR-TO-DOOR RAIL SOLUTIONS: OVERVIEW OF ALL SUPPLY CHAIN COMPONENTS

Note; next to the virtuous circle of volume and performance many railway undertakings in the world are all to familiair with the opposite vicious circle of low volume, leading to high cost, low frequency, high transit times etc. which again leads to lower volume etc.

1. Higher volume leads to lower **cost** per unit
2. Higher volume leads to the higher **frequency**
3. Higher volume leads to shorter **transit times**

4.2 ETHIOPIAN RAIL CONTEXT ASSESSMENT

A thorough assessment has been made of the Ethiopian rail context. Many stakeholders were consulted, and various relevant documents were studied, among others: feasibility study Addis Ababa/Sebeta-Djibouti railway project, feasibility study Djibouti International Container Terminal, etc. Below the relevant findings for the design of a perishables rail concept are described.

RAILWAY LINE TECHNICAL SPECIFICATIONS

The Addis-Djibouti line is the first operational part of a total of 5,000 km for the national railway network. The line is 752 km (82 km in Djibouti.) The line consists of a dual track between Addis Ababa and Adama and single track from Adama to Djibouti. It is electrified all the way, except for a 13 stretch inside the port area. This makes its energy consumption cost-efficient and sustainable with low CO_2 output (especially in combination with Ethiopia's hydropower.)

The railway is designed to have an operational speed of 120 km/h. This could in theory reduce transit time between the port and Addis Ababa to about 6 hours, compared to 3 days by road. In practice achieving such a transit time will take some time for fine tuning of a lot of operational parameters. Total transit time would not include actual transport time only, but also terminal handling times, in Addis and Djibouti. On average terminal time is around 50% of total train turnaround on train connections, depending on trajectory length, terminal handling capacity, etc.

Description	Sebeta-Adama	Adama-Djibouti
Nr. of main lines	Double-track	Single-track
Designed speed	120 km/h	
Minimum radius of curve	800 m	
Distance between centers of main line	4.0 m	
Gradient	Ruling grade: 9%; pusher grade: 18.5	
Effective length of receiving-departure track	Single-locomotive: 850 m Dual locomotive: 880 m	
Type of traction	Electric	
Type of locomotive	HXD series	
Traction mass	Short-term: 3,500 tons; long-term: 4,000 tons	
Type of block	Semi-automatic	

FIGURE 14: ADDIS-DJIBOUTI RAILWAY LINE: MAIN TECHNICAL STANDARDS

	Annual Import - Export Forecast of Railway Share (000 metric Tons)							Rolling Stock Operational Utilization and Fleet Size Assesment						
Rolling Stock Vehicle Type	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**	**2045**	**Train Per Day at 2015**	**Wagons Per Train**	**Assessed Single Trip Cycle Time (Hours)**	**Assessed Loading/ Unloading Time (hours)**	**Assumed Operatio-nal Availability**	**Number of Railway Wagons Required**	**Numbers of Wagons Required Allowing 10% Spare**
Container	6.59	9.03	11.99	14.20	16.41	18.62	20.83	7	40	16	8	80	330	363
Liquid Bulk/ Petroleum	2,82	3.64	4.47	5.29	6.12	6.94	7.76	6	30	16	8	80	212	233
Break Bulk	5.34	6.90	8.46	10.03	11.59	13.15	14.71	5	40	16	16	80	356	392
Dry Bulk	1.08	1.40	1.71	2.03	2.35	2.66	2.98	1	40	16	16	80	72	79
Imported Motor Vehicles (1)	1.98	2.57	3.15	3.73	4.31	4.89	6.90	4	40	16	8	80	198	218
Livestock (1)	0,35	0,45	0,56	0,66	0,76	0,87	0,97	1	20	16	8	80	18	19
Total	**18.160**	**23.990**	**30.340**	**35.940**	**77.480**	**47.130**	**54.150**							
Daily Operational rail Freight Train Demand & Total Rolling Stock Fleet Numbers Estimate	23	31	39	46	53	60	70	23						1303

FIGURE 15: FREIGHT TRAFFIC VOLUME ADDIS ABABA-DJIBOUTI

RAILWAY LINE CAPACITY AND AVAILABILITY OF PATHS

The Ethiopian context has some specific characteristics compared to other countries with long-distance rail network systems:

- Limited raw commodity extraction potential that would provide a rail base load volume
- Limited heavy industry which could serve as launching customers
- Bigger challenge to control port-hinterland integration (export port not within national borders)
- Population and economic activity in Highlands (700 km from port)

Railway development around the world is usually underpinned by dry and liquid bulk flows. In contrast the Ethiopian railway line heavily depends on container flows to be productive. This is reflected in the freight traffic volume scenarios that are part of the Addis Ababa-Djibouti railway line feasibility study (figure 15.)

Of all metric ton forecasted to be transported via rail in 2045 between 35%-40% is done through container trains (20.83 vs 54.15). A similar percentage is estimated for the first years of operations and the period in between. The feasibility study foresees 7 container trains per day initially, tripling to approximately 20 trains thirty years from now.

With a train setup of 40 wagons per train and each wagon carrying one 40ft container the annual container train capacity is around 200,000 TEU (280 containers or 560 TEU per day). With a current import volume of 170,000 TEU at Modjo this is more than enough, as not all flows will go via rail, certainly not the beginning, when shippers and railway operations still have to get used to each other.
However, import volumes are expected to increase to almost 2,000,000 TEU in ten years at Modjo, and to 2,500,000 TEU across the country. A rail capacity of around 14 trains a day there means a risk of rail capacity shortages; 14 trains correspond to a capacity. This would result in a rail modal split of 16%, while in Europe we see modal splits of over 80% on trajectories of similar distances.

The assumed modal split percentages by the Chinese feasibility consultant are modest: 66% for all cargo, 5%-15% for containers. These make sense with the Chinese context in mind: high level of heavy industry, population concentration along the coast. In our view, far higher percentages are likely for the Ethiopian context once the railway system is performing is well.

Capacity can likely be boosted through accelerating investments in rolling stock. Trucking alternatives will also be in place – and are in fact necessary for Ethiopia's industrial development. In any scenario, well-performing trains using rail networks connecting to incoming and outgoing container ships which give access to global markets will be in high demand.

Key parameter	Dimension
Loading capacity	70 t
Container loading	2 x 20 ft (total weight single container: 35 t) 1 x 40 ft (total weight single container: 35 t)
Dead weight	23 t
Design speed	100 km/h
Minimum curve radius	145 m
Vehicle length (coupler connection point)	< 13500 mm
Height (from container bearing surface to top of rail	< 1200mm
Height from center of coupler to top rail (empty vehicle)	880 mm

FIGURE 16: FLATBED WAGON: KEY PARAMETERS AND DIMENSION

ROLLING STOCK

Part of the total Ethiopian investment in the Addis-Djibouti railway line of 3.4 billion USD was directed at the acquisition of a fleet of locomotives and wagons. ERC currently owns around 32 locomotives and close to 1,100 wagons. About 990 wagons are designed for different cargo types, around 110 of these transport fuel. The technical specifications of these flatbed wagons are listed in figure 16.

The flatbed wagons acquired have a loading capacity of 70 ton and can carry two 20ft containers or one 40ft container. The loading capacity per container is the same in any scenario (two 20ft or one 40ft container), as rail crane limitations and other factors limit container weight to around 35 ton. Loading capacity of the wagons is ample for an average weight per container for produce of around 20-22 ton. Temperature control is not an integral part of this type of flatbed wagons and needs to be attached separately. Several options are available: clip-on per container, generator for many containers, etc. The right solution depends on the specific local context. The most optimal solution for the Ethiopian context is detailed in the rail concept paragraph.

In Europe lighter flatbed wagons are also used in combination with smaller loads per container to increase the number of wagons behind locomotives. Lower average fruit container weight allows for lighter wagons with less loading capacity that help extend train length and increase efficiency. As train length is an outcome of many other variables: wagon specifications, terminal track length, passing loops, signalling specifications, etc., fine-tuning the type of wagons used should be considered in the future.

Apart from the flatbed wagons for container cargo, the Ethiopian Railway Corporation also acquired several dedicated refrigerated carts. These carts are intended for domestic and regional transport flows. They are very similar to the carts used in France between Perpignan in the South (fresh produce) and Rungis near Paris (market). Refrigerated carts are equipped with a cooling device, a power generator, insulation materials, temperature measurement equipment and ventilation. It is unlikely that refrigerated carts will be used for export flows to seaborne export markets. They could be well-suited to serve the Djibouti market as their loading capacity is higher than containers on flatbed wagons. For detailed technical specifications, see figure 17.

These type of rail carts require a different kind of rail terminal setup. Containers on flatbed wagons can be loaded and unloaded by gantry cranes. Refrigerated carts require forklifts (for pallets) or manual handling capacity (for bulk).

Key parameter	Dimension
Vehicle length	21 m
Vehicle weight	40.5 t
Load weight	38 t
Load capacity	100 m^3
Inside temperature	-24/14 C
Outside temperature	40/-40 C
Generator power	120 km/h
Railway Gauge	1435 mm

FIGURE 17: REFRIGERATED CAR: TECHNICAL PARAMETERS AND DIMENSIONS


MAERSK

TERMINALS ALONG ADDIS-DJIBOUTI LINE

High-performance train connections are about running the trains well, smooth terminal operations and optimal connectivity to the main railway. World-wide experience teaches that terminal lay out and associated impossibilities have a substantial effect on train performance. Along the Addis-Djibouti line several (rail) terminals are of importance. All have been assessed and visited to gain insight on their possibilities and limitations.

Around Addis two (rail) hinterland terminals are relevant: Modjo and Sebeta/Indode. Modjo dry port is a brownfield terminal run by Ethiopian Shipping Lines which will be expanded to a 2 million TEU hinterland terminal with a full rail length rail terminal, while Sebeta/Indode is a greenfield terminal run by Ethiopian Railway Corporation with a future freight cargo forecast of around 90.000 ton.

Both terminals will likely play an important role in the National Cool Logistics Network. Modjo is closest to shippers (agro in Ziway-Arba Mich corridor, meat cluster around Modjo, garments in Hawassa) Sebeta/Indode is closest to Addis (relevant for domestic distribution to Addis).

This report focusses on Modjo dry port for the reasons mentioned before, because cool logistics facilities at Sebeta/ Modjo could also be worked out under the multi-annual partnership umbrella. The specifics of Modjo and its rail terminal are described in chapter 'Investment component 2: Cool Port Addis'.

Three terminals are relevant in Djibouti: Nagad rail terminal, DCT deep-sea container terminal, and the newly developed DICT deep-sea container terminal. Djibouti's Nagad rail terminal is located approximately 10 km away from Djibouti Port. Here the electric section of the railway line ends. From here two options are available to the Djibouti port area: diesel powered trains or trucks.

DCT is the current deep-sea terminal in Djibouti port. It is one of the most professional container terminals in Africa. The container terminal can be reached by land via a causeway. This means creating an on-dock rail terminal is expensive. It requires dredging and the current quay-stack ratio means the container stack is already the terminal's bottleneck. At the moment, a reach stacker operation rail terminal has been setup on land at the start of the causeway. Internal terminal transport to the DCT container stack covers a distance of 1.5-2 km. The rail terminal setup will most likely be changed once rail volumes increase. It could include other terminal facilities like gantry cranes.

DPFZA has started the development of a new 4 million TEU container terminal (DICT). They have progressed to advanced stages of negotiation with possible co-investors (China Merchants Group, Oman's State General Reserve Fund and CMA CGM/ Terminal Link). Its greenfield character allows for an on-dock rail terminal at the back of the container stack, like most high volume container terminals around the world. The operational and technical design model of this new terminal has not yet been finished, and the rail terminal has not been planned in detail as of yet. The Flying Swans parties as well as Ethiopia have emphasised the importance of an on-dock rail terminal for general container logistics and cold chain logistics in particular. The operational and technical design model that includes the final rail terminal setup is expected to be finished in 2019.

TRAIN OPERATIONS

Ethiopia and Djibouti have formed a joint venture company for their railway operations. This company granted a 7-year concession to the Chinese company CCECC for running trains on the Addis-Djibouti line.

Freight train operations at the Arddis-Djibouti line started in the first quarter of 2018. In the first four months a volume of around 10,000-12,000 TEU was transported using this railway line. Train length is around 800 meters at the moment: 1 or 2 locomotives (depending on part of stretch and its gradient) and 53 wagons (106 TEU).

Trains are (un)loaded at Modjo rail terminal which currently offers a track length of 250 m. They are assembled into full-length trains at the shunting yard. These trains run up and down to Djibouti's Nagad rail terminal. From there the cargo is transported to DCT by train or truck

Commerce of the rail slots available is taken care of by Ethiopian Shipping Lines in accordance with the import directive and its dry port Modjo operator position. Market parties have indicated prices for the different parts of the rail logistics chain are approximately 800 USD for 20ft imports, 1,200 USD for 40ft imports, 250-300 USD for empty returns and 100 USD for Nagad-Djibouti Port by rail, in total adding up the around 1,600 USD for a roundtrip.

In sum, Ethiopia and Djibouti have done an impressive job by developing a railway line in such a short period of time. The rail network infrastructure is in place, as well as the required locomotives and flatbed wagons for container trains. The first trains are already running. A lot of work remains to be done to increase efficiency, cost-effectiveness, etc., but the way these rail developments have been managed gives great confidence in Ethiopia and Djibouti's capacity to achieve this as well.

Similar efforts are needed to get railway operations right. Ethiopia does not have the advantage of building up volume using relatively simple point-point high-volume mining flows, but has generated more demanding container flows, of which perishables is an important one.

Ample rail capacity is available in the upcoming years in terms of railway paths, locomotives, wagons, etc. Horticulture flows can and should play an important role in growing rail volume and repaying loans on investments made. However, if container volumes increase in line with volume forecast, railway line capacity will be scarce in the future. If trains for perishables are not setup in the upcoming years the horticulture sectors runs the risk not getting access to rail services, as running trains tend to get priority over new trains. This has been the case with most rail operators world-wide as setting up new trains requires quite an effort.

While railway network development is by nature predominantly supply driven, setting up rail connections is demand driven. This is particularly true for container trains, since container flows always have road transport as an alternative. This is not the case for mining products due to weight limitations and safety concerns.

Understanding shipper requirements and the ability to translate these into tailor-made rail concepts is vital for container trains. This is especially true for perishables. The next paragraph gives an overview of perishable shipper requirements, gained from conversations with local parties, as well as lessons learned from other cool rail concepts around the world.

4.3 PERISHABLE SHIPPER REQUIREMENTS

Experience in other intermodal transport projects for perishables around the world show perishables have some specific needs compared to dry goods transported by rail. Below we have listed the most important ones as an outcome of explorations with local parties as well as lessons learned world-wide. When setting up actual trains in the upcoming years these generic requirements need to be detailed out per train connection in terms of train schedule, number of spare containers needed, spare truck capacity required for contingency, etc.

The shipper requirements for perishables can be categorised in four types of must-haves:

- Closed cold chain and temperature control
- Transit time & frequency
- Reliability & contingency plans
- Pricing & market thresholds

CLOSED COLD CHAIN AND TEMPERATURE CONTROL

The big difference with other cargo of course is the need for temperature control to maintain product quality levels. Different products require different temperature setups. The need for temperature control is applicable in all climates due to the perishable character of the products, but even more so in the harsh environment of the lower parts of Ethiopia and Djibouti with its hot temperatures, especially during Summers.

Shippers cannot afford the risk of their perishables being wasted through poor temperature control management because of the market value of the goods. In Europe for example, trains carrying perishable cargo have sensors measuring temperature inside the container that tell shippers via IT systems the temperature inside the container in real-time during transport.

A rail logistics chain from producer to the deep-sea ship transporting the produce to end markets contain different logistics parts. These are often operated by different parties: trucking from producer to rail terminal, handling from rail terminal onto train, railing from terminal to terminal, handling from train to deep-sea terminal, and handling from deep-sea terminal to ship. Moving cargo across the chain means disconnecting reefers from one power generator and connecting it to another, for example when a reefer is loaded onto a train at the rail terminal. These interruptions must be as short as possible, especially in hotter areas like Djibouti, because temperature difference hurt perishables badly and cause a significant decrease of market value. Fresh products like fruit, vegetables, and flowers are more challenging in this respect than frozen products like meat and fish. A container brought down to minus 5-15 degrees Celcius can survive on its own for a short period of time, a simply cooled container cannot.

TRANSIT TIME & FREQUENCY

Fresh produce has limited shelf or vase life. Though the maximum time of life may differ, time-to-market is essential for all products. The sooner the products reach their markets, the fresher they are, the better prices are paid by end clients. Therefore, transit time is a key element in decision-making processes of perishable shipper with regard to choosing logistics solutions. It is not about having a superfast transit time, but being able to find the optimal point of synergy between logistics costs and being able to reach certain shelf and vase life thresholds. In general, an average maximum transit time of 15-20 days for seaborne solutions would be a good aim.

Total transit time not only includes net transport time of the different modalities within a total logistics chain (truck, train, ship), but also waiting time to make the connection between the different parts of the chain. This makes connection frequency an important factor to achieve optimal transit time. In mature markets, perishables require daily connection to markets to achieve minimum total transit time and maximum flexibility to profit from price fluctuations.

At the moment, deep-sea shipping departures to markets from Djibouti with acceptable transit times that allow perishable shippers to reach shelf and vase life thresholds are few and far between. No deep-sea carrier offers direct connections between Djibouti-Rotterdam yet. All use feeder solutions via hubs (Jeddah, Salalah, Marsaxlokk, etc.) CMA-CGM is the only connection offering a total transit time below 20 days with a once per week service. In time, Djibouti will become a higher volume container port with many direct services of carriers like Maersk, MSC, etc. However, limited shipping departures with suitable transit times will most likely still be a reality for the immediate future.

In principle, perishable trains ought to have a daily connection. To minimise waiting times in the Ethiopia-Djibouti context this is even more important since shipping departures are infrequent. Avoiding low train occupancy rates means that trains will probably have a once or twice a week frequency in the initial stages. During this phase train schedules should be matched with shipping departures to achieve the shortest transit times possible.

RELIABILITY & CONTINGENCY PLANS

Most dry goods going from producer to their end client can be delayed for some days or even weeks or months without severe consequences. Of course, some products (garments, electronics, auto parts) have shorter time of life or are part of a JIT system and have more strict logistics demands.

For perishables, the situation is reversed. Unexpected delays will decrease product freshness and value, cause products to spoil or leave stores with empty shelfs. Reliability of the train connections to Djibouti is a critical success factor, especially when shipping departures to markets are still limited. Shippers cannot risk missing a shipping as this most likely means writing off the value of the cargo (15,000-45,000 USD per container, depending on type of products at stake.)

100% train reliability is not achievable in many places around the world for many reasons such as strikes, accidents, etc. This means trains for perishables must have contingency plans in place, in case railing produce to its destination is not an option for whatever reason. Emergency trucking could be used to get a container to its destination within the agreed time slot.

PRICING & MARKET THRESHOLDS

Besides the above-mentioned other variables of logistics performance (transit time, frequency and reliability) price is also of importance to shippers. In mature markets trucking prices are an excellent benchmark. Train products compensate the loss of flexibility with lowers prices and a lower CO_2 footprint.

The situation in Ethiopia is somewhat different. Many fruit & vegetable production areas are not in production yet as hinterland and deep-sea logistics prices combined are still too high to meet market thresholds. In principle, this means that CIF market thresholds minus prices paid for deep-sea shipping lead to maximum free on board prices; cost of production and all hinterland transport handling must not exceed these free on board prices for produce to be competitive in these markets. Different products have different CIF market thresholds, ranging from lower-value products like bananas, oranges (10,000-15,000 USD) to higher volume products like avocados or grapes (30,000-40,000 USD).

4.4 RAIL CONCEPT

As stated before perishable cargo requires a tailor-made concept for the horticulture industry to be able make the modal shift to rail. In this paragraph, the specifics of this concept are described. Its key components are derived from the specific Ethiopian rail context (paragraph 4.2) and perishable shipper requirements (paragraph 4.3). We elaborate on the rail concept at full capacity we are working towards and we explore its phasing and relevant milestones.

RAIL CONCEPT: 40FT FULL REEFER TRAIN WITH DAILY FREQUENCY

Transit time and frequency are key to be able to deliver perishables within challenging shelf (vase) life constraints. Perishables need logistics solutions with daily departures (as well as a next day back up) to guarantee freshness and provide the flexibility to react to market dynamics.

FIGURE 18: DEDICATED FULL REEFER TRAINS, SOUTH AFRICA EXAMPLE

The actual transit time is the time the container is moving with a certain modality (truck, train, ship) plus the waiting time between getting from one modality to the next. Pre- and onward trucking are relatively flexible, but trains and ships run on a fixed schedule with timeslots that are often allocated for long periods of time. Cool Rail Ethiopia should synchronise its train schedule to ship departures. This is vital in general, but even more important during the first years of operations when shipping departures to markets will still be less frequent.

Another key aspect is a closed cold chain with minimal risks of breaking it. This is even more important in the harsh (hot) environment of Djibouti and lowland areas in Ethiopia. Therefore, we opt for a full reefer train setup, a 40 container train of around 700-800 m length (assuming two locomotives at certain parts of the stretch). In this case, all containers are cooled with dedicated generators that are connected to all containers by power cables (via small adjustments integrated into a general flatbed wagon) Two generators per train are assumed for cold chain purposes, in case one generator stops working, a back-up is available to secure the cold chain.

The actual train length could of course be longer than 700-800 m, depending on the possibilities and limitations of the track. Currently trains are already 53 containers long. In a later stage train length and asset utilisation of locomotives, wagons, generators, etc. will have to be optimised in close cooperation with the Ethiopian Railway Corporation.

Another option would be to work with clip-on units. These are clipped on a container to cool the cargo inside. The advantage of this option is that it also works for just one container, and therefore is cost-effective with smaller volumes. Ultimately, we chose not to. Clip-on units have the habit of getting lost at terminals. Current units used in the corridor are expensive (100 USD per day) and less efficient in terms of price and CO_2 footprint reduction for the high-volume system we are working towards. A closed cold chains should be a priority at all parts of the chain. With only a few containers on a 40-50 container train this would be far more difficulty to achieve.

The standard maritime container will be used: a 40ft high cube reefer container. This is similar to what is used in South Africa, but differs from the 45ft container train between Spain and the Netherlands, as the latter was tailored to the European retail context which is not relevant in this respect. In principle, deep-sea container shipping lines don't mind shippers using their containers for hinterland transport, as this results in extra containers being shipped for them. Intermodal hinterland transport requires extra flexibility in terms of demurrage and detention days. Maersk, MSC, CMA CGM, etc. are all interested in tapping into Ethiopia's promising reefer market; Reefers are premium paying cargo. It is advisable to start conversations with them soon, as availability of containers has proved to be a key success factor for all cool train systems so far.

As previously stated, the total cool logistics chain consists of many different parts (truck, hinterland terminal, train, deep-sea terminal, ship.) Each part consists of different handlings. Each handling costs money, and could potentially break the cold chain, when the container is handed over from one part of the chain to the following. Interfaces between consecutive parts of the chain should be as smooth as possible. This requires compact container terminal design, both at the hinterland and deep-sea terminal. The rail terminal is preferably located on the terminal close to container stack, empty depots, cross-dock and cold store facilities, to make all movements between these functionalities cost-effective, more reliable and timely. This aspect of cool logistics is key to its effectiveness. The consequences of these requirements for container terminal design at Modjo near Addis and DICT in Djibouti are described in chapter 5 and 6.

Pre- and onward trucking is a key component for any rail concept. Intermodal concepts are about getting the train as close as possible to shipper locations, but trucking is always required between production location and the rail terminal. Doing this efficiently is essential for cost effective train concepts. It requires setting up smart dedicated pre- and onward trucking concepts where trucks make a maximum number of round trips every day. At a later stage in the Cool Rail Ethiopia development process, the trucking concept will have to be detailed further with involvement of the rail and terminal operator, trucking (freight forwarding) parties and the shippers. This plan should also lay out the role trucking plays in a contingency plan and how to act in emergency situations when a train is not capable of delivering containers on time.

The bigger fresh produce shippers have trucking capacity available (currently used to get products to Bole Airport) or have the financial resources available to get their own trucks. This way they control pre- and onward trucking performance and costs. For them a pure rail product without any trucking solutions attached to it probably is enough. Smaller producers, especially those that do not have a year-round production portfolio, depend on third-party trucking solutions. At the moment, market solutions for perishable cargo transport are still limited. One could imagine Ethiopian Railway Corporation offering these parties a door-to-door product (including trucking), to avoid losing this part of the market for reefer rail transport. This can perhaps be done in cooperation with a few freight forwarders in the form of a strategic partnership.

Finally, pricing is also a key element, and often the most sensitive one too. According to market participants current rail pricing is around 1,600 USD for a roundtrip between Modjo and Djibouti terminals. At roughly 1,600 km this corresponds to 1.0 USD per km for a 40ft container, which is significantly less than current two-way trucking prices, but higher than other higher volume perishable trains (Cool Rail Spain/ South Africa reefer trains: 0.4-0.5 USD per km). However, the benchmark in this case is not trucking in Ethiopia and trains around the world but CIF market thresholds to markets as current trucking prices combined with shipping have not allowed Ethiopia to sell its products yet. Getting prices right in terms of CIF market thresholds is a complex puzzle with several pieces: farm gate prices, pre- and onward trucking, terminal handlings at hinterland terminal, deep-sea terminal, train transport, shipping, etc., while CIF prices differ greatly per product and in different parts of the season. In general, strategic pricing policies should be applied to unlocking Ethiopia's horticulture potential and support its rail investment debt services.

Phasing of the railway network investments make pricing even more challenging. Many of the new horticultural growth regions are located South of Addis Ababa (e.g Arba Minch, 400km from Modjo), but the Southern stretches of the railway network will not be operational for the upcoming years. To get regions like Arba Minch competitive on the global fruit & vegetable market, it is advisable to develop tailor-made rail products for these regions and offer discounted rates during this transit period.

The same is true for capacity, rail paths and train schedules. Currently the railway line has ample capacity as volumes are still limited. Rolling stock equipment is also widely available. Should container rail volumes pick up in line with forecasts, capacity constraints are on the horizon, perhaps closer than many expect, especially when rail modal splits exceed predictions. Scheduling Cool Rail Ethiopia trains in sync with shipping departures is a strategic matter and multi-annual capacity planning with involvement of both rail and horticulture sector is highly advisable.

4.5 INVESTMENTS AND PHASING

Railway investments and the business cases to get these investments ready for decision-making have some specific characteristics. Before we get to the investments required to set up dedicated reefer trains , we shed some light on this dynamic as we expect it to have a part in this case as well.

At the risk of stereotyping, one could say that traditional railway operations were about trains running from a mine to a port, for one client, for a long period of time (decades) and multi-annual commitments from both sides. In such a model, a dedicated rail solution is feasible with specific investments in a cost-plus-model.

Container trains generally operate in a completely different context with multiple clients, shorter time horizons than rail equipment depreciation periods, etc. This has a significant impact on how railway companies model their business, approach pricing and make investment decisions. Pricing in such a context is not based on the specifics of a single connection but the average rail price (traction, personnel, infra) is derived from an average utilization rate of all rail connections in operation. Of course, shippers with more volume get better rates than those with only a few containers. Still the average price is a key determinant, mostly because it is difficult to unravel the impact of a specific connection, as locomotives, personnel, etc. are put to work at so many connections each year.

Only wagons are sometimes (or even often) judged on a case-by-case basis. Some railway companies do not own their own wagons, and general flatbed wagons are leased from wagon pool operators. This is particularly true when specific rolling stock is required. For example, for the car industry in Europe dedicated wagons are designed to maximise the load transport per train. Here specific business cases make sense; dedicated wagons need a certain longer-term commitment to get the risk-return balance right. All other elements (locomotives, personnel, etc.) are still considered flexible, when the specific connection is no longer operational, other connections are supposed to fill the gap.

WAGON ADJUSTMENT INVESTMENTS FOR DAILY CONNECTION

In the case of Cool Rail Ethiopia, we use specific rolling stock, to be more precise: general flatbed wagons are adjusted so they can support temperature control of the containers transported. Therefore, we have chosen to assess only the specific adjustment to the flatbed wagon (this includes the generators needed for power supply) since only this part of the total investment sum cannot be made productive. All other parts could in principle be diverted to other trains to make a return. The adjusted wagons could also be used for general container trains.

At the moment, Ethiopia has a large enough wagon pool for the necessary adjustments. At a certain moment in time all wagons will be deployed, meaning investment decisions must be made for new wagons. One could say that at that time, a more integral perspective is required (not only the adjustments, but wagon investments too), but even then, these wagons could serve many alternative cargo flows in Ethiopia and generate a return.

The amount of adjusted wagons required is directly derived from the number of wagons per train and the time a roundtrip takes from Modjo to Djibouti container terminal. As stated before we have assumed the full reefer train setup to be 40 containers, power generation is supplied by 2 generators, both generators also occupying a wagon place.

SCENARIO 1: CURRENT PERFORMANCE						
General						
Days a week	7	days				
Hours a day	24	hours				
Turnaround time						
	km	hour	km/ hour	moves	moves/ hour	in/ out in hour
Mojo - Djibouti	800	16	50			
Handlings Djibouti		6		80	20	1
Djibouti - Mojo	800	16	50			
Handlings Mojo		6		80	20	1
Two way trip in hours		44	hours			
Roundtrip per week		3,82	times per week per wagon set			

SCENARIO 1: COOL RAIL SPAIN TURN AROUND						
General						
Days a week	7	days				
Hours a day	24	hours				
Turnaround time						
	km	hour	km/ hour	moves	moves/ hour	in/ out in hour
Mojo - Djibouti	800	10,7	75			
Handlings Djibouti		6,0		80	20	1
Djibouti - Mojo	800	10,7	75			
Handlings Mojo		6,0		80	20	1
Two way trip in hours		33,3	hours			
Roundtrip per week		5,04	times per week per wagon set			

FIGURE 19: COOL RAIL ETHIOPIA TURNAROUND TIME SCENARIOS

SCENARIO 1: CURRENT PERFORMANCE

ASSUMPTIONS

Wagon set		
Wagons	40	train
Round trips	3,8	days
Assumed operational availability	80%	
Required spare capacity	10%	
Prices		
Generator	75.000	USD
Wagons adapted	19.000	USD

WAGON SETS REQUIRED + INVESTMENT INVOLVED

Departures	# wagon sets	Wagons	Generators	USD adapt	USD generators	Total
0,5	0,13	5	1	99.524	75.000	**174.524**
1	0,26	10	1	199.048	75.000	**274.048**
2	0,52	21	2	398.095	150.000	**548.095**
3	0,79	31	2	597.143	150.000	**747.143**
4	1,05	42	3	796.190	225.000	**1.021.190**
5	1,31	52	3	995.238	225.000	**1.220.238**

SCENARIO 1: COOL RAIL SPAIN PERFORMANCE

ASSUMPTIONS

Wagon set		
Wagons	40	train
Round trips	5,0	days
Assumed operational availability	80%	
Required spare capacity	10%	
Prices		
Generator	75.000	USD
Wagons adapted	19.000	USD

WAGON SETS REQUIRED + INVESTMENT INVOLVED

Departures	# wagon sets	Wagons	Generators	USD adapt	USD generators	Total
0,5	0,10	4	1	75.397	75.000	**150.397**
1	0,20	8	1	150.794	75.000	**225.794**
2	0,40	16	1	301.587	75.000	**376.587**
3	0,60	24	2	452.381	150.000	**602.381**
4	0,79	32	2	603.175	150.000	**753.175**
5	0,99	40	2	753.968	150.000	**903.968**

FIGURE 20: COOL RAIL ETHIOPIA: INVESTMENTS REQUIRED IN SPECIFIC RAIL EQUIPMENT

Regarding turnaround times we have assumed two scenarios: The first scenario uses current times in rail transport and terminal handling times. A more ambitious scenario uses turnaround times realised in Cool Rail Spain as a benchmark. Ethiopia's train performance could surpass that benchmark, as the train from Spain to the Netherlands goes through four different countries which negatively impacts transit times.

Currently, the total turnaround time is around 44 hours, of which 32 hours are actual train transport (73%), and the rest is the time for loading and unloading at the origin or destination terminals. The average speed is around 50 km/h, far below the maximum operational speed of 120 km/h. This allows room for fine-tuning and optimising the system. To get a robust view on wagon sets required in an optimised system we have constructed a second scenario. In this scenario, the speed is assumed to be 75 km/h, reducing transit time to around 33 hours. In figure 19 turnaround time calculations are depicted with all relevant assumptions.

In line with our assumptions wagon sets investments are calculated for both scenarios. Extra assumptions made were made on operational availability (80%), required spare capacity (10%), USD investment for adjustment (19,000 USD) and USD investment for generator (75,000 USD). In figure 20 these wagon-set investment calculations are depicted, assumptions left, investments required right. For both scenarios the amount of investment needed per development phase is made explicit (required investment for 0.5 train departure per week, for 1 train departure per week, and so on). Results for scenario 1 is listed first, followed by scenario 2 with its better rail performances.

In scenario 1 in total around 52 wagons need to be adjusted (1.31 wagon set) to transport 208,000 ton of perishable cargo (10,400 containers). From the perspective of just the Addis-Djibouti connection one could state that here the saw tooth principle applies as well. This means 2 wagon sets are needed, for now we assumed that 1.31 wagon set is realistic, as wagon sets synergies can be realised across the various fresh produce connections around the country. A total investment of 1.2 million USD is required, consisting of wagon adjustment (80%, around 1 million USD) and two generators (20%, 225,000 USD).

In scenario 2 less investments are required because of the swifter turnaround times. In total 903,968 USD of investments are required as the amount required for wagon adjustments have decreased to 753,968 USD. With a rail performance like this, one wagon set can accommodate a daily connection. Which is preferable, as dependence on other connections to avoid a saw tooth effects disappears.

Although some investments are required, it is fair to say that these are very modest compared to the cool logistics supra structure around the railway line (Cool Port Addis, chapter 5; Cross-dock Djibouti, chapter 6) or the multibillion investments in basic railway infrastructure.

ASSUMPTIONS

Generator investment	75.000
Revenue lost generator wagon	1.655
Adapt wagons	18.750

ANNUAL CONTRIBUTION REQUIRED PER CONTAINER TRANSPORTED

Average # containers		Equipment		Investment				Annual contribution required		
Per week	Per year	Wagon	Generator	Wagon	Generator	Total	Per annum	Per container	Revenue lost	Total
1	52	1	2	18.750	150.000	168.750	42.188	811	3.309	4.120
2	104	2	2	37.500	150.000	187.500	46.875	451	1.655	2.105
3	156	3	2	56.250	150.000	206.250	51.563	331	1.103	1.434
4	208	4	2	75.000	150.000	225.000	56.250	270	827	1.098
5	260	5	2	93.750	150.000	243.750	60.938	234	662	896
6	312	6	2	112.500	150.000	262.500	65.625	210	552	762
7	364	7	2	131.250	150.000	281.250	70.313	193	473	666
8	416	8	2	150.000	150.000	300.000	75.000	180	414	594
9	468	9	2	168.750	150.000	318.750	79.688	170	368	538
10	520	10	2	187.500	150.000	337.500	84.375	162	331	493
11	572	11	2	206.250	150.000	356.250	89.063	156	301	457
12	624	12	2	225.000	150.000	375.000	93.750	150	276	426
13	676	13	2	243.750	150.000	393.750	98.438	146	255	400
14	728	14	2	262.500	150.000	412.500	103.125	142	236	378
15	780	15	2	281.250	150.000	431.250	107.813	138	221	359
16	832	16	2	300.000	150.000	450.000	112.500	135	207	342
17	884	17	2	318.750	150.000	468.750	117.188	133	195	327
18	936	18	2	337.500	150.000	487.500	121.875	130	184	314
19	988	19	2	356.250	150.000	506.250	126.563	128	174	302
20	1040	20	2	375.000	150.000	525.000	131.250	126	165	292

FIGURE 21: COOL RAIL ETHIOPIA: REQUIRED CONTRIBUTION PER CONTAINER FOR 1 GENERATOR SETUP

FIRST STEP: 20 CONTAINER TRAIN ONCE A WEEK

A full reefer train setup requires a certain minimum volume. Primarily because reefer trains require generators. These occupy a wagon place leading to a loss of revenue for this particular wagon place. With the current railway pricing this would be 1,655 USD per wagon place used. This cannot be borne by only a few containers if these fresh produce containers are to meet CIF market thresholds.

Preliminary calculations were made to assess what number of containers would be needed to cover the loss of revenue of 2 wagon places, investment in generators and wagon set adjustments, without leading to prices which make it impossible to meet market thresholds. These calculations are only indicative, as other value chain components should also be part of this equation (farm gate prices, etc.)

In figure 21 an overview is depicted of the required contribution given a certain average number of containers on adjusted wagons behind a power generator. Investments are assumed to generate a return in line with a pay-back period of 4 years. Wagons and generators should have a much longer economic life expectancy, but a 4-year period is assumed because of the duration of the proof of concept phase for Cool Rail Ethiopia.

Figure 21 shows that having too few containers behind 2 generators require a too high contribution per container trip, at 10 containers the contribution decreases to 500 USD, at 20 containers it is 300 USD. The medium and higher value crops (avocados, mangoes, etc.) will probably be able to bear such an annual contribution right from the start.
This annual contribution in the proof of concept phase can be significantly brought down in a scenario with only one generator, which is also capable of keeping 20 containers at the right temperatures. Security of cold chain in such a scenario should then be guaranteed with contingency plans in case the generator breaks down.

PILOTS TO FACILITATE MENTAL SHIFT

Change is not only about the investment in physical infrastructures triggering these transformations, but perhaps even more about getting people ready to adapt and manage the social part of the shift towards rail transport. This mental shift is often an important part of the modal shift.

Ultimately, competitive perishable trains in Ethiopia require full reefer trains. It may take some time to have enough volume to run full reefer trains, even a 20-container setup cannot be achieved overnight.

Moving actual perishable cargo via rail will help build momentum which is important in transition processes. In the immediate future, pilots of one container using clip-on units could be very helpful to facilitate this mental shift. These pilots help railway parties learn about the specifics of the different types of perishable cargo, while perishable shippers (fruit, meat, etc.) can experience how the railways can best be used in their total logistics operation.

CHAPTER 5

INVESTMENT COMPONENT 2: 'COOL PORT ADDIS'

5.1 RATIONALE

Long-distance rail solutions deliver world-wide (far) lower USD/km prices than trucking alternatives ever could. Setting up these Cool Rail Ethiopia trains will make many horticulture growth regions meet thresholds for export markets. Efficiencies of around 20%-50% are entirely possible, depending on volumes and occupancy rates of the many fixed assets (locomotives, wagons, etc.) used in rail transport.

In terms of operations implementing train solutions can be quite difficult. Trucks can travel directly from their origin to their destination, while train concepts need pre- and onward trucking to and from intermodal nodes, and all kind of handlings involved that must be performed efficiently.
Cargo volumes trains are much higher (40 containers vs 1 container), therefore storage capacity is needed as a buffer between train schedules and farm or factory output. This is particularly true for horticulture for which the moment of production can be more difficult to plan compared to factory production.

Horticulture producers could themselves invest in dedicated cold store facilities at or near their packing station, from which containers are filled, and afterwards brought directly to the hinterland railway terminal. This could work in many situations; the cold chain can be kept closed from beginning to end, only one stuffing handling is made, etc. We expect to see this type of direct flow in Ethiopia too, once high-performance perishable rail solutions are offered by the Ethiopian Railway Corporation. In particular, larger producers with stable year-round output may consider this option.

However, many drivers point to significant market potential for third-party cold storage at Modjo:

- Seasonality of fresh produce makes decent occupancy rates of producer-owned storage challenging
- Producers do not consider cold storage core business
- Cold store operations by cold store specialist are more efficient
- Lack of investment resources for relatively expensive smaller-scale cold storage
- Pre-/ onward trucking disadvantages of container transport compared to regular trucks

- Option to consolidate produce of different kind of producers to same destination to increase logistics performance (price, frequency, etc.)
- Limited availability of reefer containers with required demurrage and detention conditions that allow transport to farms

All of the above are relevant for Ethiopia. Despite the widely acknowledged potential of rail transport for perishable goods, it is still an unproved concept and it is unlikely that producers will invest in multi-million cold storage facilities in the immediate future. Third-party storage is virtually non-existent in Ethiopia. Current and future investments in infrastructure (railway and road network, dry ports, etc.) will most likely improve the logistical performance in Ethiopia significantly and unlock all kind of cargo flows that require third-party storage. Cool Port Addis will specifically be developed to unlock and serve cargo flows that need temperature-controlled services.

5.2 LOCATION

Modjo Dry port was the first dry port setup in Ethiopia in 2009, and has growing into an important hinterland hub. Volume growth rates were around 30% per year. It is centrally located in the country, approximately 70 km from Addis at the junction of many transport corridors: the express highway Addis-Adama, the new road to Djibouti via Galafi, the express highway Nodjo-Hawassa, etc.

Modjo currently consists of a 61 ha area of which around 30 ha is operational. 27 ha are used for container stack operations, the remaining area is used for warehousing (10,800 m2 in total) and office buildings. The warehouses are predominantly used for storage of high risk consignments and are still underutilised. The layout and positioning of the Modjo's current functionalities can be seen at figure 23. The incoming and outgoing truck gate at the bottom of the facilities, right fof it offices and customs, the container stack in the middle, and the warehouses to the left.

Dry port Modjo offers truck to truck operations. Under the multimodal arrangement of the government, trucks bring containers from Djibouti port to Modjo. At Modjo the containers are picked up to get unloaded at facilities around Addis. Operationally Modjo is run through a reach stacker operation, trucks enter the premises via the gate, and containers are moved from truck to stack via reach stackers, of which there are 10-15. Operations are managed by Ethiopian Shipping Lines.

Due to the multi-modal directive, almost all imports will go through Modjo Dry port (79%), see figure 22. Its volume has increased to 125,000 TEU in 2015/2016, and is expected to continue to grow at an annual growth rate of above 30%.

Dry Port Modjo is currently expanded to accommodate future growth. Current capacity is insufficient to cater to much higher container volumes. Its 14,000 TEU stack capacity is becoming a bottleneck, party because of high dwell times.

An expansion plan is being implemented to turn Modjo into a world-class hinterland hub that can process 2 million TEU per year. This development is backed by a World Bank funding of 150 million USD. This investment program is directed at infrastructure investments (120 million USD), IT systems and logistics coordination (15 million USD) and regulatory and institutional support (15 million USD).

The majority of funding is invested in infrastructure. The following facilities are part of the upgrading project: intermodal facilities (27 million USD), bulk storage and bagging facilities (25 million USD), container yard and equipment (32 million USD), bonded and general warehousing (20 million USD) and a (de)consolidation centre (16 million USD).

The current reach stacker operation will be transformed into a rubber tired gantry operation, which provides more stack capacity per square meter. Investments in IT are for a terminal operating system and electronic gate pass systems to improve stack productivity and management and reduce unnecessary handling.

Volume of containerized Import Cargo 2011/12 — 2016/17

No.	Destination	Meast.	2011/12	%	2012/13	%	2013/14	%	2014/15	%	2015/16	%
1	Total import	TEU	16,387	100	60,800	100	84,869	100	114,120	100	159,051	100
2	Modjo	TEU	13,386	82	42,560	70	59,128	70	86,120	75	124,944	79
3	others	TEU	3,001	18	18,240	30	25,741	30	28,000	25	34,107	21

FIGURE 22: MODJO DRY PORT SHARE OF CONTAINER IMPORT TRAFFIC

Dry port Modjo is owned and managed by Ethiopian Shipping Lines. Part of the funding is allocated to develop Modjo into a multi-user facility and let other parties operate Value Added Service activities (like cool logistics services) in the new setup. At the moment, a consultancy project is in progress to work out future scenarios on how to implement the transition into such a multi-user facility.

Recently Modjo already realised a connection with the main railway line. An on-dock rail terminal with 4 cargo (un)loading lines, a length of 700 meters and a gantry crane operation is planned.

All trains to and from Djibouti are handled at Modjo Dry port. The dry port has two 210 meter tracks, which can be seen in figure 23 right above the container stack. The area between container stack and rail terminal has already been paved, but has not been processed yet by Google maps. Preparations have been made for 2 additional tracks. Room has been reserved to extend the rail terminal tracks to a length of 700 meter (extension direction to the right).

The extension of the dry port will be in the right-hand direction, as at the left the Dry port is bordered by the main railway line. In the future Dry Port Modjo is foreseen to comprise at least approximately 160 ha (currently: 61 ha) with a total stack area of 70 ha (currently: 27 ha). Stack productivity is assumed to go up significantly through decreasing dwell times and unproductive moves (terminal operation system.) In this new setup Modjo can handle 2 million TEU in 2030. In figure 24 the annual volume growth forecast are depicted, which shows a continuation of the average annual growth of recent years as well as a dominant import volume market share.

FIGURE 23: DRY PORT MODJO AERIAL VIEW

Import Containerized Cargo Forecasting 2017/18 — 2026/27

No.	Destination	Meast.	2017 /18	2018 /19	2019 /20	2020 /21	2021 /22	2022 /23	2023 /24	2024 /25	2025 /26	2026 /27
1	Total import	TEU	228,605	299,068	391,249	511,844	669,609	876,002	1,146,011	1,499,244	1,961,355	2,565,901
2	Modjo	TEU	171,454	224,301	293,437	383,883	502,207	657,001	859,508	1,124,433	1,471,016	1,924,426
3	others	TEU	57,151	74,767	97,812	127,961	167,402	219,000	286,503	374,811	490,339	641,475

FIGURE 24: MODJO CONTAINER GROWTH FORECAST

Modjo has a strong import cargo base on which train frequency can be built. Its central location along many highways to and from production centres makes it a logical place to start with the National Cool Logistics Network. The Modjo-Hawassa highway passes Ziway and many other (possible) fruit & vegetable production areas and the evolving garment cluster in Hawassa, while the nearby meat cluster could also provide baseload volume.

The large ongoing expansion also offers the opportunity to use the Cool Port Addis for optimal (internal) logistical operations. This would minimise costs for transporting full and empty containers from Cool Port Addis to the several general Modjo dry port areas (container stack, empty depot, rail terminal, etc.).

In principle, the best location therefore would be close to all three areas. Locating Cool Port Addis on Modjo in synergy with these general functionalities will be worked out during the upcoming feasibility phase. In this pre-feasibility the footprint of Cool Port Addis will first be determined based on its envisioned business concept and linked cool logistics volume forecast.

5.3 BUSINESS CONCEPT AND POSSIBLE MARKETS

In most mature markets the current market context (volumes, clients, etc.) is one of the main design variables when developing new business concepts for cold storage. The case in Ethiopia is slightly different: current logistics performance makes that current volumes are low and far from close to its potential. This applies to all relevant possible value chains and markets.

This implies that designing in this case is less about predicting but more about building in flexibility in technical design and business model so that Cool Port Addis can adapt to many different kinds of market opportunities and serve whatever value chain picks up significantly first. The setup will be kept as general and versatile as possible for the facility to act as a kind of incubator that provides services to all five identified value chains. The services which are in higher demand during the first years of operation will probably form a bigger part of Cool Port's capacity in the end, and vice versa. This kind of flexibility increases chances of large development impact on Ethiopia and Djibouti, and reduces risks of not reaching Cool Port's full operational capacity.

We have designed a business concept capable of serving various market segments with three types of functionalities:

1. **Fresh capacity** to accommodate different kinds of fresh produce, predominantly export of horticulture products like fruit & vegetables, flowers, etc. to different kinds of markets
2. **Frozen capacity** to accommodate different kinds of frozen produce, predominantly import of meat, fish, etc. intended for the Greater Addis regions, and to a lesser extent frozen export by producers around Modjo to export markets
3. **CFS capacity** to accommodate the reefer containers filled with dry goods that are cross-docked in Djibouti to eliminate empty legs

FRESH CAPACITY

The horticulture exports (fruit, cut flowers) will most likely be one of the main value chains to which Cool Port Addis provides its services. As stated, all these flows have a certain maximum door-to-door transit time, given the importance of shelf life (or vase life) for these value chains.

Ultimately a daily train from Modjo connected to the various ship departures in Djibouti is a pre-requisite to have sustainable market access to export markets in Europe, on the Arabian Peninsula, etc. Being able to fuel a daily train of perishable export produce is the main design criterion for the Fresh Capacity of Cool Port Modjo. This means approximately 200,000 ton of fresh produce will have to go through this part of the facility.

Most likely the fruit & vegetable flows will make up the bulk of products handled, because of its voluminous character. The flows to the various Gulf countries will probably play an important role in Cool Port Addis operations, as the relative proximity give Ethiopia a competitive edge to rivals such as South Africa and South American producers. The size of both the seaborne fruit import market of Europe and fruit & vegetable import of the Gulf Countries make it very likely that Cool Port Addis will have sufficient volume to run feasible operations with robust occupancy rates. For this flow the majority of these flows are palletised. The seasonal character of fruit with different seasons for different products will probably make producers less inclined to invest in their own dedicated cold store facilities unless a portfolio of products give them a balanced year-round occupancy rate.

The current cut flower flows could serve as an interesting launching customer of Cool Port Addis. Third-party cold storage could give them the opportunity to do a multi-annual real-life try out of rail container logistics without requiring many upfront investments. When perishable train solutions have

Fresh Capacity assessment

Volume				
Train	40	wagons/ 40ft containers		
Container	20	pallets		
Throughput				
Trains per week				
0,5	20.800			
1	41.600			
2	83.200			
3	124.800			
4	166.400			
5	208.000			
Nr. of pallet places				
	Dwelltime in days			
Throughput	3,5	7	14	21
20.800	199	399	798	1.197
41.600	399	798	1.596	2.393
83.200	798	1.596	3.191	4.787
124.800	1.197	2.393	4.787	7.180
166.400	1.596	3.191	6.382	9.574
208.000	1.995	3.989	7.978	11.967
Capacity	2.304	pallet places		

FIGURE 25: FRESH CAPACITY CALCULATIONS

grown into daily reliable services, the largest producers with sufficient financial resources might consider setting up their own bigger dedicated cold storage facilities to stuff containers directly at the farm. Even then their flows will still have to go via Cool Port Addis as described in paragraph 'rationale'.

Another interesting launching customer flow is the current fruit & vegetable export from Ethiopia to Djibouti. At the moment, already 70,000-80,000[1] ton is trucked to Djibouti per year. This cargo flow has a today-for-tomorrow character and is not palletised. Cool Port Modjo could serve as the interface to put the 10 reefer wagons bought by the Ethiopian Railway Corporation to work. Room will be reserved in Cool Port Modjo to receive trucks bringing in regional flows (docks being able to receive Isuzu's) and store non-palletised fruit & vegetable products. At later stages of Cool Port Addis' life cycle this flow will probably be moved to a dedicated facility, once the fruit & vegetable flow to Djibouti and the global markets has reached more mature volume levels.

Calculations in the figure below show that Cool Port Addis needs a fresh capacity of around 2,300 pallets if it wants to support a daily train connection. A train setup is 40 wagons with 40 containers each containing 20 pallets. In our calculations, a dwell time of approximately 3.5 days is assumed for cargo flows to Europe and the Arabian Peninsula, and 1 day for cargo flow to Djibouti. For global market producers will deliver their products a few days before train departure, to make sure the specific ship departure to a specific market will not be missed as in such a case revenues are jeopardised. Cargo for the Djibouti market is assumed to have a today-for-tomorrow character as competition comes from trucking as a fast transport alternative.

FROZEN CAPACITY

Frozen capacity has a different kind of rationale than fresh capacity. Fresh capacity is about unlocking Ethiopia's horticultural production and export potential knowing that volumes are most likely relatively limited during the early stages. This is probably different for frozen cold store capacity as market demand for third party cold store capacity is already there for products which need to be stored at temperatures below zero.

All frozen products (meat, fish, etc.) imported for the Greater Addis region offer an interesting base load volume for Cool Port Addis to build on. Market participants estimate there is already a monthly

[1] Part of this flows originates from Dire Dawa. It speaks for itself that the flow from this production region will not go via Cool Port Addis given its relative proximity to Djibouti.

Frozen Capacity assessment					
Volume					
Market	15	containers per month			
Container	20	pallets			

Throughput	Years ahead			
CAGR	3	6	9	12
4%	4.050	4.555	5.124	5.764
8%	4.535	5.713	7.196	9.065
12%	5.058	7.106	9.983	14.026
16%	5.619	8.771	13.691	21.370
20%	6.221	10.750	18.575	32.098
24%	6.864	13.087	24.952	47.573

Nr of pallet places	Dwelltime in days			
Throughput	14	28	42	60
5.000	192	384	575	822
10.000	384	767	1.151	1.644
15.000	575	1.151	1.726	2.466
20.000	767	1.534	2.301	3.288
25.000	959	1.918	2.877	4.110
30.000	1.151	2.301	3.452	4.932

Capacity	2.304	pallet places

FIGURE 26: FROZEN CAPACITY CALCULATIONS

import volume of around 10-20 containers for just the out-of-home segment. The inefficient and high-maintenance conditions under which these goods are stored make these interesting launching customers for Cool Port Addis.

Current volumes are estimated at between 3,000-5,000 ton per year. Double digit growth rates for this flow are not unlikely, if Addis' economic potential is taken into account, especially when more efficient (cool) logistics systems are in place. Should investments in highways, railways, etc. bring logistic costs down, huge leaps in volume are entirely possible.
In the figure below market sizing is done by using different kinds of compound average growth rates (CAGR) for the first decade of Cool Port Addis's operations. The first year of its operation will be no sooner than three years from now, given the time needed for project development, building, etc.
The rhythm of frozen import flows is different from fresh flows described. Freshness (shelf life) is a lesser concern but securing supply is important. Dwell time of these products is far higher: weeks or even months, instead of days.

Although we expect import flows to be the main client for Cool Port Addis's frozen capacity, the facility can also add value to various export value chains. The meat cluster around Modjo has several large slaughterhouses producing meat mostly destined for the Arabian Peninsula. These are significant flows that will grow further in the upcoming years. The size of these flows and their year-round character make dedicated storage capacity a viable option for these producers, but Cool Port Addis could be of value to them during peak periods and for overflow volumes.

Taking these frozen flows into account a demand calculation was made based on several forecasted CAGR based annual throughput levels and average dwell time levels between 14-60 days. An annual throughput level of around 10,000-20,000 ton would in this scenario lead to a demand of between 1,151 pallet places (15,000 pallets, dwell time 28 days) and 3,288 pallet places (20,000 pallets, dwell time 60 days). These kind of demand volumes could potentially be realised within 3-9 years from the start of Cool Port operations.

The frozen capacity of Cool Port Addis is therefore designed for around 2,300 pallet places. This is large enough to accommodate significant flows and have an impact on cool logistics for frozen products, yet small enough to ensure decent occupancy rates in the foreseeable future. Cargo flows are assumed to be palletised, based on the value chains they are part of. Alternatively, they will be palletised at entrance for efficient storage and handling in the facility.

CFS CAPACITY

The third flow accommodated by Cool Port Addis is a totally different kind of flow which most likely does not need any temperature-controlled services. This flow is still incorporated into Cool Port Addis' business concept and provides important input for the technical design and operational processes. This functionality is aimed to cater the dry goods coming in from Djibouti in reefer containers as they are cross-docked here to eliminate empty legs. Given the importance of avoiding these expensive empty legs for unlocking Ethiopia's horticultural export potential, the CFS capacity is fully integrated into Cool Port Addis's operations, at least for the first years of operations.

Required capacity calculations therefore are directly derived from the horticulture export train volume the Cross-dock Djibouti and this mirrored Container Freight Station are facilitating. The same train used to calculate fresh capacity requirements is used to estimate Cool Port Addis' CFS capacity (40 wagons with 40 containers containing 20 pallets) with annual throughput volumes of around 40,000 pallets per weekly departure: one train a week equals 41,600 pallets, two trains a week 83,200 pallets, and so on.

Cold store capacity and CFS capacity is best run through one integrated facility resulting in synchronised operations at least until proof of concept. Proof of concept in this case is not being able to do just run one train, but prove to be able to fuel multiple trains a week over a significant period of time (for now 3-5 trains a week are assumed). After this period one can imagine the CFS activities being outsourced to a CFS party doing other CFS activities which potentially could lead to further synergies and efficiencies. The CFS capacity freed could probably be made productive by converting the area into Fresh capacity, Value Added Services, etc. at that moment in time.

Dry import cargo currently shows (very) long dwell times, one of the reasons is a lack of foreign currency to pay for the cargo by informal traders. Preferably Cross-dock Djibouti is made so dry cargo will not have these kind of issues. The large surplus of dry import containers above reefer export containers make that the most suitable containers can be chosen to make matches with. Several criteria will probably be used in practice to optimise the dry import container – reefer export container matches, but the dwell time of the dry container will be one of them, to make the most of the CFS capacity. In the capacity calculations dwell times are assumed to range between 5 days in which scenario a 4,000 pallet place CFS is able to support 5 trains a week. Some of the dry cargo will be palletised already when moved from a dry to a reefer container in Djibouti, others will be stuffed in bulk. These non-palletised containers will be palletised at Cool Port Addis' entrance for efficient storage and handling.

5.4 TECHNICAL DESIGN

The functional design for these three functionalities (fresh, frozen and CFS capacity) based on the business concepts (and markets to be served) was translated into a technical design of Cool Port Addis in various talks with specialist cold store contractors with concrete experience in Africa and Ethiopia in particular. Before we go to the actual design we address some points in the design process. We close this paragraph with a high-level estimate of the investment involved.

STARTING POINTS AND DESIGN PHILOSOPHY

Each design process starts with having the starting point right. The two main design variables in this phase are having enough capacity to accommodate a daily train together with having maximum flexibility to adapt to different market dynamics within the same building:

1. **Capacity** is (in line with the previous paragraph) derived from the ability to support a daily train connection both with a fresh and CFS capacity, while the frozen capacity should be substantial enough to have a positive impact on frozen (import) flows:
    - 8 freezer cells with racks for 288 pallets each (2,304 pallets in total)
    - 8 refrigeration cells with racks for 288 pallets each (2,304 pallets in total)
    - 2 air-conditioned cold cells for 16 pallets each (32 pallets in total)
    - 1 Dry storage with racks for 864 pallets

2. **Flexibility** to react to market dynamics as future growth directions are relatively difficult to forecast with all current flows still in their infancies:
    - Relatively many different cells (8 fresh, 8 frozen) to be able to differentiate temperatures in case many different products need to be accommodated
    - Ability to adjust the ratio of fresh and frozen capacity (with using the flexible CFS capacity for fresh in the future)
    - Option to reduce part the CFS capacity (outsourcing to external CFS at Modjo) for the growth of the conditioned cargo (fresh and frozen) without having to put a new building in the same place.
    - Ability to handle different type of incoming trucks with both dock and overhead doors (cool trucks, Isuzu's, etc.)

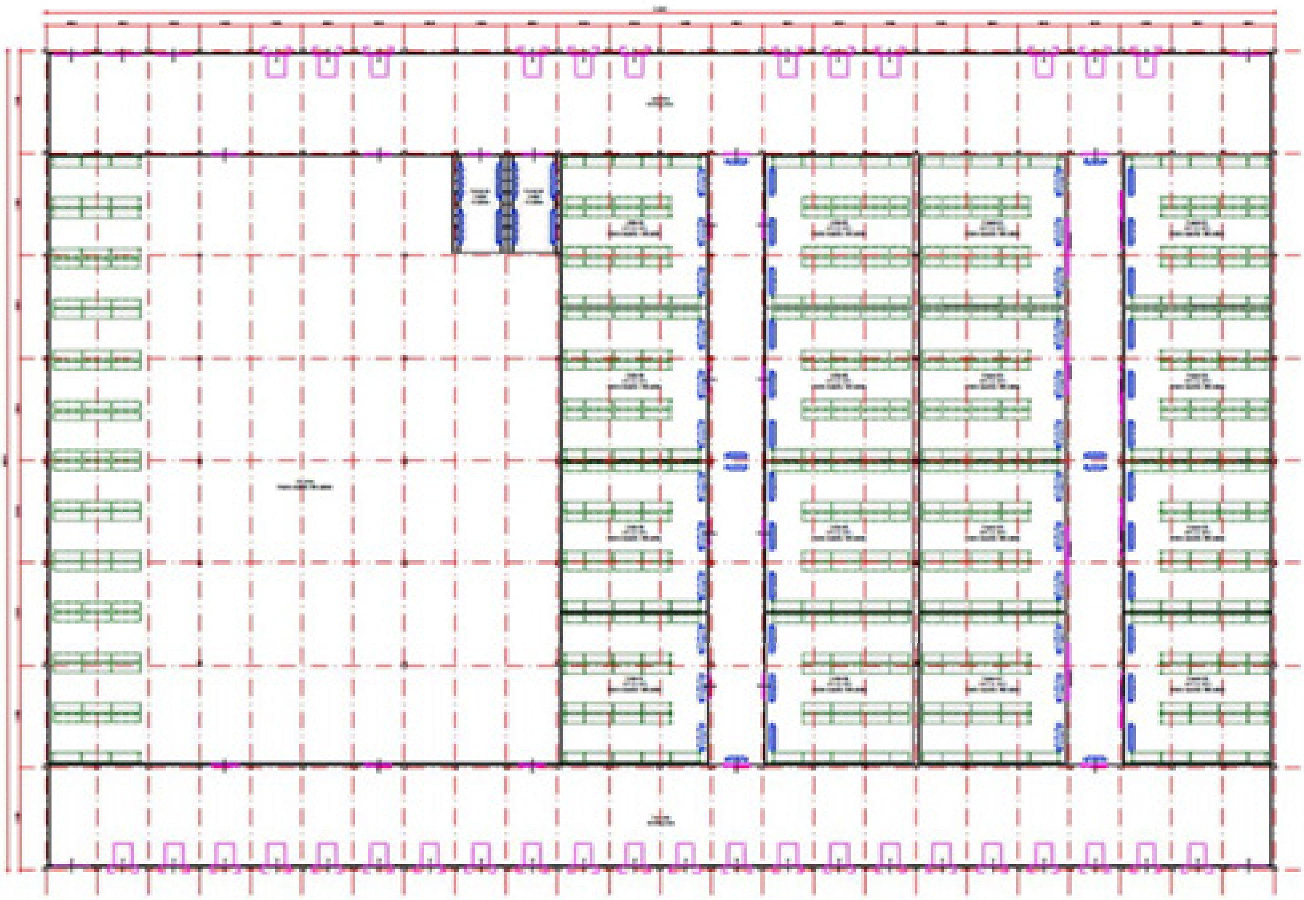


FIGURE 27: TECHNICAL DESIGN COOL PORT ADDIS

TECHNICAL DESIGN

The technical design of Cool Port Addis following from these two main starting points is shown in figure 27. The frozen capacity is located at the right side of the building, the fresh capacity in the middle, and the CFS capacity at the left. This setup allows extension of the fresh capacity in the future at the expense of the CFS capacity (outsourcing CFS activities to a specialist operator) while keeping maximum synergies with the current fresh capacity operations.

Export flows are coming in via dock doors and over-head doors (depending on type of truck) at the top of the building, while leaving the building at the bottom towards the Modjo train terminal where trains to Djibouti are departing.

To shed more light on the type of operation we envision and how the building will accommodate these flows while complying with cold chain standards and be able to play into market dynamics and different product portfolios, we have listed remarks showing main building characteristics:

- Frozen capacity cannot easily be transformed into fresh capacity. The part of the building focusing on frozen products works with thicker panels, floor insulation and heating. Furthermore, the cooling unit is not efficient in the fresh product temperature range.
- Inside the building the design is based on multiples of 6 meters given the size of a standard deep-sea container (12 meters), as all materials must be imported: steel construction profiles between columns is 6 meters. (For larger spans, e.g. 12 meters thicker columns or firmer panels would have been required.)
- The columns are located outside the fresh and frozen compartments to maximise cold store compartment space and minimise the need for column insulation against condensation.
- The building has 8 compartments for fresh produce, and 8 compartments for frozen produce with a size of 18m by 18m to optimise the number of pallet places within one compartment; 2 extra racks are foreseen along the walls of each compartment as forklifts are not supposed to drive around these racks.
- The square type of compartments chosen limits the driving distances for forklifts as each compartment has a length of only 14 ground pallet places.
- The number of ground pallet places is 72. Pallets can be stored 4 high, meaning each compartment has 288 pallet places in total.
- Each rack has a depth of 1.3 meter. Pallets are stored in such a way that the forklift lifts the pallets at the shortest side (1.0 meter) meaning pallet depth inside the rack is 1.2 meter.

- Each rack has a width of 3 pallet places (and a depth of 1 pallet place) which is optimal in terms of minimizing the usage of steel while keeping required racking strength/ robustness.
- The space between two rows of racking is 3.5 meter which allows the deployment of normal forklifts in the compartments, the same type used in expedition areas, which decreases the number of forklifts in total through synergies between expedition area and compartment work, but has a slight negative effect on the number of square meters required for the building.
- Two cells for forced cooling with 16 units each are placed within the CFS area. Depending on the type of unit used this would mean cargo can be brought to the right temperature within three hours.
- The CFS area has two doors to the expedition area at the land side of the building (top of the building) and three doors to the expedition area at the train side of the building (bottom of the building), as the deliveries to trains are expected to have a higher peak demand.
- The land side of the building has 12 dock doors (standard trucks) and 4 overhead doors (isuzu), dock doors are clustered around the central gangway, while the overhead doors are located at each side of the building near de walls. The recharging area for forklifts is located in a corner of the expedition area, the nearby overhead door could also serve for evacuation purposes (e.g. repair), most likely a ramp needs to be built at this side of the building.
- The building is elevated (height to be determined with civil contractor) to prevent possible hindrance of heavy rainfall.
- The land side of the building has three dock doors for the frozen compartments and six dock doors for the fresh compartment, directly in front of the main gangway. Frozen has less dock doors than fresh as this is slower moving cargo. All dock doors can be used for either frozen or fresh goods to have maximum flexibility.
- The expedition area at the land side has a depth of 24 m and is temperature controlled to keep the cold chain closed within the building (minimum temperature is minus 8 degrees Celsius for employee productivity purposes).
- This expedition area depth leaves ample space for inspection and scanning and staging of pallets behind the dock doors to protect high dock door productivity
- The expedition area of the frozen and fresh part of the building and CFS part is separated by a wall for energy saving purposes, a door will be placed to allows forklifts to go from CFS to the cold store, and vice versa. The CFS area accommodates dry goods for which temperature control is not required.
- The CFS area has relatively many overhead doors which gives flexibility in the type of vehicles which can be handled (trucks, isuzu, etc.)
- Offices, changing rooms, etc. are planned on top of the expedition area at the land side of the building.
- The expedition area at the rail terminal side of the building has a depth of 12 meter as less scanning, inspection and staging work is foreseen, this part of the building has 22 dock doors and 2 overhead doors given expected peak demand before train arrival and departure. Assumption here is that containers are loaded directly from the fresh and cool compartment and enough empty (reefer) containers are available to do so.
- At the rail side of the building specific reefer dock doors (more expensive than regular ones) are included to avoid opening container doors outside before the containers are docked, for both efficiency as well as cold chain purposes.
- Each dock door has its own power plug to be able to keep the container at the right temperature, also pre-tripping services can be done with this setup at the door dock. This makes it possible to unload containers, make the container ready for a new trip via pre-tripping and load new cargo in the container, all while the container stands at the dock door. This saves many unnecessary handlings and maximises turnaround times of containers (important with probably no surplus of containers at the start,)
- The possibility to go directly from dock door could relieve pressure on Modjo's container stack and reefer plugs during peak periods, and reduces Cool Port Addis' dependency on regular stack operations.
- The expedition area is also temperature controlled. Separate areas with different temperature (fresh, frozen, dry) can be created using temporary screens to minimise energy waste.
- In its early stages the CFS area will provide enough room to work without racking. In time, storage capacity can be increased by adding racks. This will provide enough storage capacity to handle a daily train of cross-docked containers. The capacity can be increased even more by using smaller gangways and specialised reach trucks.

The modular setup of the building with a frozen, fresh and CFS area gives much flexibility to adapt to different future market contexts. This is important with current volumes being limited. The timing of fruit & vegetable growth is difficult to predict, the same is true for cold storage investments at farms. Fresh capacity can be swiftly expanded at the expense of the CFS area by adding extra fresh cold store compartments in this area, and vice versa. When extra fresh cold store capacity is required the CFS cargo (e.g. cross-docked cargo in Djibouti) should move to another CFS facility at Modjo, which will be easy to setup and find investors for, as the market has proved itself.


Vorster
LETABA

ESTIMATED INVESTMENT

It all ends with an estimate of the investment involved. The costs related to the building (depreciation, interest and maintenance) is a significant part of the breakdown of total costs, especially because cold stores are more expensive than general warehouses given the cool technology included. Besides this, the investment involved is the main risk element the investors absorb, as other costs can be more easily cut down in case of lesser volume than expected.

The investment estimate of the building described was made in consultation with cold store contractors who participated in the designing of the building. The investment involved is around 23-24 million USD including project development, engineering and other costs.

For a complete overview of all costs involved see the breakdown of investment components below. During the feasibility study these numbers needs to be substantiated further in more specific talks with possible contractors during a period closer to actual construction, as construction prices tend to fluctuate during different periods of the economic cycle.

Phasing of the building is perhaps a topic relevant to elaborate on during the feasibility phase. Investments will be of course lower when the building is phased, with a self-evident positive impact on risk profile, etc. However, breaking the chicken-and-egg problem is far more important than this and phasing should not harm it. Fruit & vegetable investors must be able to count on cold store capacity capable to facilitate daily perishable trains to export markets, otherwise they will probably not come.

1. Groundwork	**$9.720.000**
m2	$38.880
USD/ m2	$250
2. Building construction	**$2.721.600**
m2	$15.552
USD/ m2	$175
3. Office + canteen	**$400.000**
m2	$800
USD/ m2	$500
4. Cool technique, panels& doors	**$6.520.400**
5. Racking	**$1.200.000**
pallet places	$16.000
USD/ pallet place	$75
6. Miscellaneous	**$1.300.000**
Engineering& permits	$800.000
Project development	$500.000
7. Contigency	**$2.000.000**
% of total investment	8%
Total investment	**$23.862.000**

FIGURE 28: HIGH-LEVEL INVESTMENT ESTIMATE

5.5 BUSINESS MODEL & BUSINESS CASE

The best business model depends on the context in which Cool Port Addis will function. In a context of being part of an efficient hinterland terminal (which is likely, given the current upgrade with World bank funds) and pre- and onward trucking done by shippers themselves ,the Cool Port can concentrate on its core competence: store produce and execute the handlings to get the cargo into and out of the storage facilities.

In certain scenarios one can imagine the Cool Port also providing pre-/ onward trucking services as this sometimes is done by hinterland terminals around the world for different reasons (synergy between truck-terminal-store, etc.). For now this is not included in business case calculations to not blur the view of conditions under which Cool Port Addis' operation is feasible. Therefore, Cool Port Addis is assumed to provide two kinds of (related) products to all identified market segments:

1. **Handlings:** provide services to get cargo out of truck into expedition area, to bring cargo from expedition area to storage places, and to store cargo in racking (same handlings, but in reverse order, when cargo leaves facility)
2. **Storage:** provide storage services for a certain period of time

Both type of services and products are different. Cold store operates towards clients as a different value chain and requires a different amount of storage days to functional well, for example assumed in our calculations: fresh cargo (3.5 days), frozen cargo (30-60 days), etc. Both types of cargo pay more or less the same for handlings, but self-evidently totally different prices for storage.

A business case is setup for Cool Port Addis with the above described business model as market positioning. The various business case components and its assumptions are described more in detail below: revenues, operational costs, depreciation, interest, etc.

REVENUES

Cool Port Addis markets its three functionalities to various market segments via the two above mentioned products: fresh capacity (predominantly to horticulture export parties), frozen capacity (predominantly to frozen import parties) and CFS parties (to cross-docked containers in Djibouti).

Annual throughput volumes are assumed for a period in which Cool Port Addis is operating near full capacity to get a feeling for the volumes the designed facility is capable of processing. For all different functionalities a client profile is assumed in terms of dwell time and degree of palletization, the two main factors influencing Cool Port Addis' production capacity:

1. **Fresh Capacity:** 90% of its product portfolio is fast-moving produce (dwell time: 3.5 days) for global markets which is mainly palletised, the remaining 10% intended for Djibouti is even faster (dwell time: 1 day) but not-palletised
2. **Frozen capacity:** slow-moving (import) products with a significant amount of storage days (dwell time: 45 days), (almost) all cargo is palletised
3. **CFS capacity:** selection out of total import dry container flow with limited storage footprint (dwell time: 5 days), if goods are not yet palletised, they will be at entrance.

Throughput& storage volumes

Throughput in pallets& boxes

	Per year	Per day			
Fresh capacity	208.000	570	in tonnes	90%	Palletized
				10%	Non-palletized
Frozen capacity	15.000	41	in tonnes	100%	Palletized
				0%	Non-palletized
CFS capacity	208.000	570	in tonnes	80%	Palletized
				20%	Non-palletized*

Number of pallets per container	20	pallets
Number of boxes per container	1500	boxes
Pallet	1	tonnes
Pallet	75	boxes

	Per year		Per day	
	Pallets	**Boxes**	**Pallets**	**Boxes**
Fresh produce	187.200	1.560.000	513	4.274
Frozen produce	15.000	0	41	0
CFS dry goods	166.400	3.120.000	456	8.548
Total	**368.600**	**4.680.000**	**1.010**	**12.822**

Storage day pallets& boxes

	Palletized	Non-palletized	
Fresh capacity	3,5	0,75	in days
Frozen capacity	45	45	in days
CFS capacity	5		in days
		10	

Volume	**Pallet days**	**Box days**
Fresh produce	655.200	1.170.000
Frozen produce	675.000	0
CFS	1.040.000	0
Remark: CFS boxes palletized for efficient storage		

Capacity	**Pallet days**	**Box days**
Fresh produce	756.864	1.576.800
Frozen produce	840.960	0
CFS	1.168.000	5.475.000

Occupany rates	**Pallet places**	**Box places**
Fresh produce	86,6%	74%
Frozen produce	80,3%	0%
CFS	89,0%	0%

FIGURE 29: VOLUME FORECAST: THROUGHPUT AND STORAGE

The volume forecasts are assumed in such a way that occupancy rates of the various functionalities will be approximately around 80%-90% for conservative financial modelling purposes. In principle the facility is able to reach higher occupancy rates as all pallet places can be approached individually.

In terms of pricing of the two products (handling & storage) we have chosen to benchmark with global best practices:

1. For fresh/ frozen cargo: 12.5 USD per pallet in & out, 1.5 USD per pallet per day for storage
2. For CFS cargo: 10 USD per pallet in & out, 1.25 USD per pallet per day for storage

Remark: Prices for handling of palletised vs non-palletised cargo are equal in terms of handlings per kilogram. Storage of non-palletised cargo is 4 times more expensive than palletised cargo given the difficulties to use the height of the building optimally

The current prices earned by cold store operators in the region seems to be higher, in particular for storage. Cool Port Addis will perhaps also have the option to work with higher prices because Ethiopia does not yet have a mature third-party cold store operator market leading to compete with. However, we have chosen not to include premiums, the main goal with this facility is to catalyse the development of new value chains and industries, therefore price setting has to be aligned with this.

PERSONNEL

In principle cold store operations aim to have their personnel setup as "flat" as possible, few people in charge of management, sales, etc., and the majority of people employed are active in actual storage operations.

The "white collar" setup in this business case follows this strategy containing of:
1 general manager
1 operational manager
2 sales employees
1 reception/ drivers desk employee

One of the key components of each cold store operation: motivated people performing all the relevant handling activities efficiently and with care. It is often one of the main cost components, together with the investment in the building (depreciation/ interest).

To get an overview of the amount of personnel needed to perform the handlings of the throughput volumes just described all relevant activities are identified, all handlings together forming a full cycle: facility in (unstuff trucks and containers in expedition area), identification (inspect cargo), palletization (palletise cargo if not-palletised), storage in (bring cargo from expedition area to racking area), storage out (bring cargo from racking to expedition area) and facility out (stuff truck/ container from expedition area).

For all activities an average production per hour is assumed. These assumptions are based on global best practices. Handlings of palletised cargo is usually more efficient than handle each container separately. The degree of not-palletised cargo of the total volume handled thus has a significant impact on the personnel required.

Eight hour working days are assumed. Of these eight hours people are expected to work seven hours effectively, the other hour is assumed to be non-productive because of meetings, breaks and other interruptions. During the day workload will most likely vary. Despite the fact that store management will try to balance this as much as possible, 20% idle time is assumed due to workload volatility. On a yearly basis people are assumed to work 210 days, with a total of 40 days off for vacation, public holidays, etc.

Following the assumptions in the figure on the next page Cool Port Addis will have 123 people employed in actual warehouse operations. Together with the few people involved in Cool Port management the total setup will be around 130 persons.

General assumptions		
Netto hours per working day	7	hours
Netto working days per year	84%	210 working days of 250 days
Correction for workload volatility	80%	20% idle time

At full capacity

Average working day	Number of pallets	Number of boxes	Productivity (number/ man hour)		Man hours needed	Headcount per day
FACILITY IN						
1. Palletized, fresh	513	na	50	palllets	13	2
2. Non-palletized, fresh	na	4.274	90	boxes	59	8
3. Palletized, frozen	41	na	50	pallets	1	0
4. Non-palletized, frozen	na	0	90	boxes	0	0
5. Palletized CFS	456	na	50	pallets	11	2
6. Non-palletized CFS	na	8.548	90	boxes	119	17
IDENTIFICATION						
1. Palletized, fresh	513	na	120	palllets	5	1
2. Non-palletized, fresh	na	4.274	216	boxes	25	4
3. Palletized, frozen	41	na	120	pallets	0	0
4. Non-palletized, frozen	na	0	216	boxes	0	0
5. Palletized CFS	456	na	120	pallets	5	1
6. Non-palletized CFS	na	8.548	216	boxes	49	7
PALLETIZATION						
1. Palletized, fresh	na	na	25	palllets	na	na
2. Non-palletized, fresh	na		45	boxes	0	0
3. Palletized, frozen	na	na	25	pallets	na	na
4. Non-palletized, frozen	na		45	boxes	0	0
5. Palletized CFS	na	na	25	pallets	na	na
6. Non-palletized CFS	na	8.548	45	boxes	237	34
STORAGE IN						
1. Palletized, fresh	513	na	25	palllets	26	4
2. Non-palletized, fresh	na	4.274	45	boxes	119	17
3. Palletized, frozen	41	na	25	pallets	2	0
4. Non-palletized, frozen	na	0	45	boxes	0	0
5. Palletized CFS	570	na	25	pallets	28	4
6. Non-palletized CFS	na	0	45	boxes	0	0
STORAGE OUT						
1. Palletized, fresh	513	na	25	palllets	26	4
2. Non-palletized, fresh	na	4.274	45	boxes	119	17
3. Palletized, frozen	41	na	25	pallets	2	0
4. Non-palletized, frozen	na	0	45	boxes	0	0
5. Palletized CFS	570	na	25	pallets	28	4
6. Non-palletized CFS	na	0	45	boxes	0	0
FACILITY OUT						
1. Palletized, fresh	513	na	50	palllets	13	2
2. Non-palletized, fresh	na	4.274	90	boxes	59	8
3. Palletized, frozen	41	na	50	pallets	1	0
4. Non-palletized, frozen	na	0	90	boxes	0	0
5. Palletized CFS	570	na	50	pallets	14	2
6. Non-palletized CFS	na	0	90	boxes	0	0

Average head count for palletized cargo	25
Average head count for non-palletized cargo	78
Total average head count	104
Average number of fte	123

FIGURE 30: PERSONNEL SETUP

DEPRECIATION & INTEREST

As described earlier total investment assumed to setup Cool Port Addis is close to 24 million USD. Phasing could be an option, as long as the proposition to potential agro investors still holds the guarantee that the facility is able to accommodate the volumes of a daily train. For now, the total investment number is included in all calculations
The depreciation table of the various investment components follows the periods of depreciation used in general with global best practices: groundwork (25 years), cross-dock building + office (20 years) and other components (7 years). This leads to an annual deprecation amount of around 1,519,865 million USD.

Interest rates are assumed to be in line with levels generally used in Africa. An interest rate of around 9% corresponds with an amount to be paid to the financier of 1,114,575 USD per year. In total the annual costs in relation to the investment in the facility will therefore be 2,634,440 USD.

OTHER OPERATIONAL COSTS

The costs with regard to the building and pool of personnel together form the majority of the total breakdown of costs. Other costs involved are land, equipment, electricity & water usage, maintenance, etc.

In the current version of the business case the cost of land is “to be determined”. The footprint of the building is approximately 4 ha, conditions under which land can be leased/ acquired at Modjo is still to be decided upon by the Ethiopian government.

With regard to equipment the facility has to buy and lease forklifts to (un)stuff containers at the dock doors, and bring the pallets to the storage areas.

Compared to other African countries Ethiopia has a well-performing electricity supply in terms of uninterrupted availability and prices per Kwh. An average usage per pallet place is used based on global best practices, prices paid per Kwh are derived from current tariffs in Ethiopia.

The annual maintenance which has to be done in order to keep the building and its cooling facilities functioning in such a way that reliable cold storage services can be provided has been assumed based on input from cold store contractors.

BUSINESS CASE AND FINANCEABILITY

In the figure below the business case of Cool Port Addis is depicted in line with the various profit loss items lines described previously. On the left all relevant assumptions and input variables are listed leading to the Profit Loss Statement of Cool Port Addis at full capacity. Full capacity in this scenario is defined as having an average occupancy rate of 80%-85%. Some upside potential could be reaped with high-performance operations and higher occupancy rates are possible because all pallet places are accessible individually as stated before.

With the described volume forecast to be handled by Cool Port Addis set against global best practices, the annual turnover will be around 8.2 million USD. Cost of goods sold in these kinds of operations are of course limited to zero. Operational costs in total add up to around 1.5 million USD, leaving an EBITDA of approximately 6.7 million USD on.

The total investment involved for constructing Cool Port Addis is 24-25 million USD. This is self-evidently also the main asset component of its Balance Sheet, besides some smaller investments which must be done in trade working capital to run the operations. In figure 32 the Balance Sheet statement of an average year at full capacity is depicted, at the left the main assumptions with regard to trade working capital, at the right the asset & liability setup.

ASSUMPTIONS				
Revenues				
Throughput fresh palletized	187.200	pallets	12,50	USD per pallet
Throughput frozen palletized	15.000	pallets	12,50	USD per pallet
Throughput fresh non-palletized	1.560.000	boxes	0,17	USD per box
Throughput frozen non-palletized	na	boxes	na	USD per box
Throughput CFS palletized	166.400	pallets	10,00	USD per pallet
Throughput CFS non-palletized	3.120.000	boxes	0,13	USD per box
Storage fresh palletized	655.200	pallet days	1,50	USD per pallet day
Storage frozen palletized	675.000	pallet days	1,50	USD per pallet day
Storage fresh non-palletized	1.170.000	box days	0,08	USD per box day
Storage frozen non-palletized	0	box days	0,08	USD per box day
Storage CFS palletized	1.040.000	pallet days	1,25	USD per pallet day
Storage CFS non-palletized	0	box days	0,07	USD per box day
Personnel (operational)				
Blue collar	123	fte	€ 3.500	USD per year
General manager	1	fte	€ 40.000	USD per year
Operational manager	1	fte	€ 30.000	USD per year
Sales employee	2	fte	€ 25.000	USD per year
Drivers desk/ reception	1	fte	€ 20.000	USD per year
Equipment				
Forklift& reach trucks	24	obv 7 uur openingstijden, als 14 uur de helft		
Back-up capacity	20%			
Average lease price	€ 9.500			
Electricity& maintenance				
Electricity	1.600.000	kwh		
Price	0,08	USD per kwh		
Maintenance	3%	of investment		
Interest				
Interest on debt	9%			
Tax				
Corporate tax	30%			
Other				
contingency	20%			

	PROFIT& LOSS STATEMENT	
1.	**REVENUES**	
1.1	Handlings fresh palletized	$2.340.000
1.2	Handlings frozen palletized	$187.500
1.3	Handlings fresh non-palletized	$260.000
1.4	Handlings frozen non-palletized	na
1.5	Handlings CFS palletized	$1.664.000
1.6	Handlings CFS non-palletized	$456.000
1.7	Storage fresh palletized	$982.800
1.8	Storage frozen palletized	$1.012.500
1.9	Storage fresh non-palletized	$93.600
1.10	Storage frozen non-palletized	$0
1.11	Storage CFS palletized	$1.300.000
1.12	Storage CFS non-palletized	$0
	Subtotal	**$8.256.400**
2.	**COST OF GOODS SOLD**	na
3.	**GROSS MARGIN**	**$8.256.400**
4.	**COSTS**	
4.1	Land	tbd
4.2	Blue collar personnel	$431.745
4.3	White collar personnel	$140.000
4.4	Equipment	$269.897
4.5	Electricity	$128.000
4.6	Maintenance	$125.260
4.7	Other/ contingency	$258.980
	Subtotal	**$1.553.882**
5.	**EBITDA**	**$6.702.518**
5.1	Depreciation	$1.519.865
6	**EBIT**	**$5.182.652**
6.2	Interest	$1.114.575
7	**EBT**	**$4.068.078**
7.1	Tax	$1.220.423
7.	**PAT**	**$2.847.654**

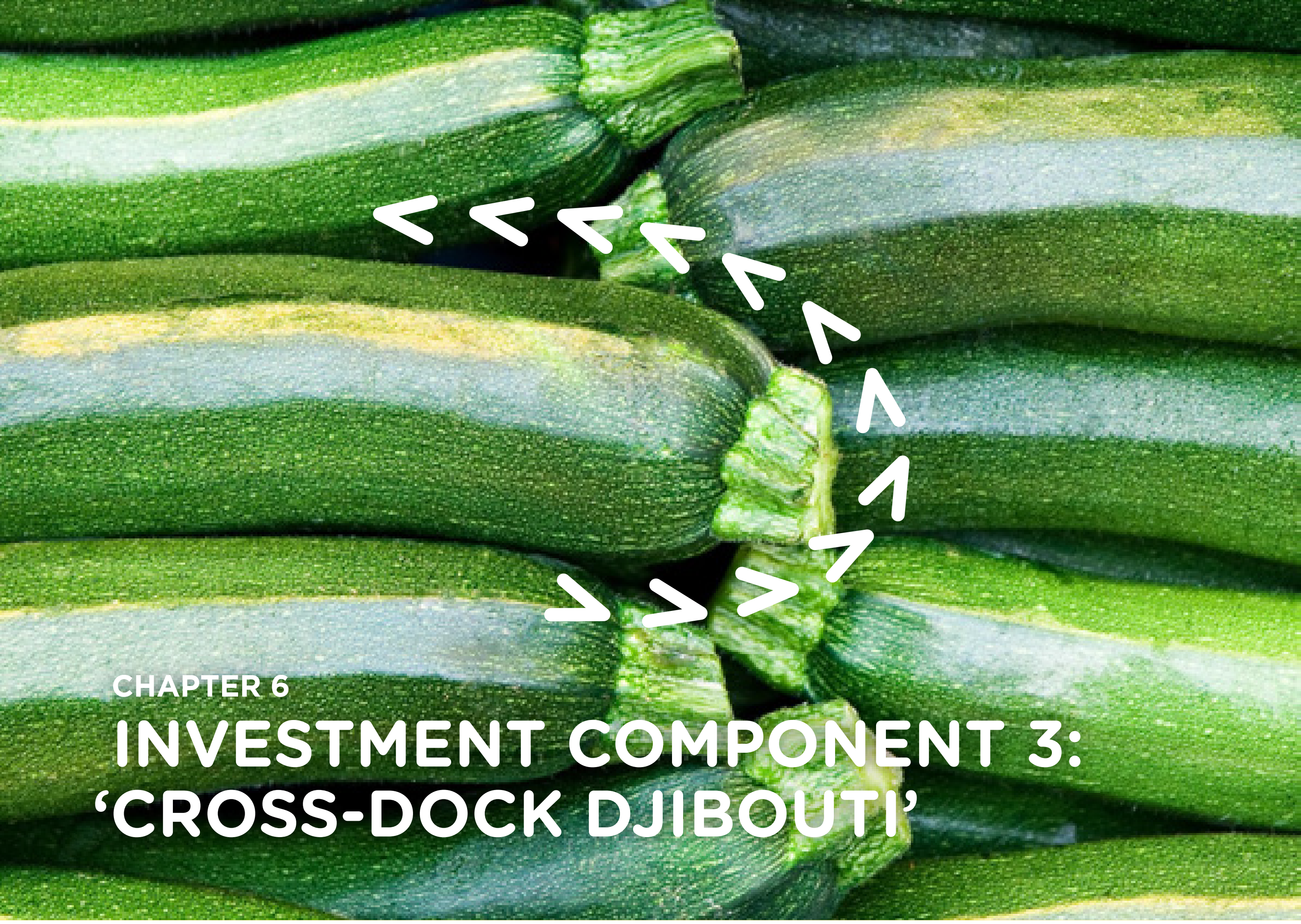
FIGURE 31: PROFIT & LOSS STATEMENT COOL PORT ADDIS

The gearing assumed is 50%, 50% of equity is needed to get 50% of debt. In terms of volume the equity investor has to put in around 12.5 million USD and attract 12.5 million USD from banks providing various debt facilities (long-term, working capital, etc.) With a profit after tax of around 2.8 million USD a return on equity of approximately 20%-25% is within the realm of possibility.

ASSUMPTIONS		
Trade working capital		
Debtor days	8,2%	to sales
Inventory	100.000	Fixed level
Cash	8,2%	to operational costs
Creditor days	8,2%	to operational costs
Gearing		
Debt	50,0%	
Equity	50,0%	

BALANCE SHEET	
1. ASSETS	
1.1 Fixed assets	
1.1.1 Building	$23.862.000
1.1.2 Pre-operative expenses	na
Total fixed assets	**$23.862.000**
1.2 Current assets	
1.2.1 Debtors	$678.608
1.2.2 Inventory	$100.000
1.2.3 Cash	$127.716
1.2.4 Creditors	na
Total current assets	**$906.325**
Total assets	**$24.768.325**
2. LIABILITIES	
2.1 Equity	$12.384.162
2.2 Debt	$12.384.162
Total liabilities	**$24.768.325**

FIGURE 32: BALANCE SHEET STATEMENT



CHAPTER 6

INVESTMENT COMPONENT 3: 'CROSS-DOCK DJIBOUTI'

6.1 RATIONALE

When Ethiopia realises its horticulture ambitions, a significant amount of reefer containers will be exported each year. The 10-year goal of 1 million ton of fruit & vegetable exports corresponds with 50,000 containers each year, while within in decades once really living up to its potential, it would increase the volume two- or threefold.

Availability of reefers at hinterland locations is limited at the moment. Therefore, exporters pay two-way prices to get their produce to Djibouti for exports, as they also have to pay to bring back their empty reefer containers from container depots in Djibouti. One could say that half the amount paid to get a reefer full of fresh produce to Djibouti port is to cover the empty transport from Djibouti to the exporter's premises (Addis area: 50% of 5,000 USD = 2,500 USD). This situation probably will not change unless imports and exports using reefer containers are balanced out, which is unlikely: in particular in a scenario in which Ethiopia increases its reefer exports in the upcoming decade, reefer imports will probably not grow at the same pace.

FIGURE 33: IMPORT-EXPORT IMBALANCE FOR REEFER IN ETHIOPIA

Also Ethiopia's dry container logistics system faces the same import-export imbalance challenges, however the imbalance is exactly the other way around: more dry containers are imported than exported. Here again it is fair to say that this imbalance is here to stay for the upcoming years. Dry container exports will definitely pick up with the current investments in the garment industry, etc., but with the growing average income per capita dry container imports pick up too, perhaps even more rapidly. In this case financial consequences are significant: half the price of a dry container import for empty repositioning (50% of 3,000 USD = 1,500 USD)

The difference in directions of dry and reefer container flows provides the opportunity to explore logistics concepts unlocking synergies between both flows. In this case we see opportunities to cross-dock cargo from a 40ft dry container to a 40ft reefer container in order to eliminate the empty legs of both the dry and reefer container value chain. A potential maximum saving of 50% on logistics costs for both chains could be unlocked with such a concept. Set against the current trucking prices a value creation of 4,000 USD per match made is possible (2,500 USD for reefers; 1,500 USD for dry containers). In a scenario in which containers are transported to hinterland locations by rail the saving in terms of percentages stays the same, the saving in USD is less (as costs per km are lower for rail as stated before), but still a huge amount of money is at stake.

6.2 LOCATION

Matching dry and reefer container chains to eliminate empty legs implies many different kinds of container moves to the cross-dock facility where the actual match is made. Understanding this dynamic is key in order to get things right in terms of location of the facility, technical design, business model, etc. Therefore, a description of the different container flows to the facility is given below.

In order to be able to make the empty leg match, the following containers moves have to be made:

1. Bring the empty reefer container from the empty depot/ deep-sea terminal stack to the facility
2. Bring the full reefer container from the deep-sea terminal stack to the facility
3. Transfer cargo from dry container to reefer container at the facility
4. Bring the reefer container full of dry goods to the rail terminal for transport to Ethiopia
5. Bring the empty dry container to empty depot/ deep-sea terminal stack for evacuation overseas

Apart from move number 3 all other moves happen outside the facility. In principle, all these transport moves cost money, therefore keeping these transport moves described to and from the facility at the right performance levels (on time) and cost-efficient is key. Locating the cross-dock facility on the Djibouti deep-sea container terminal is highly preferable as this allows these transport moves to be done at short distances with terminal equipment without gate in & out procedures.

Currently all (most) container imports and exports are handled at Doraleh Container Terminal (DCT). The capacity of this terminal is assumed to be 1.6 million TEU. The terminal has a quay length of 1.050 meters (water depth 18.0 meters), is equipped with eight Super Post Panamax gantry cranes, and thus can handle ships up to 20,000 TEU.

Annual volumes handled are around 900,000 TEU. Current dwell times (around 10 days) make that maximum quay capacity cannot be reached as container stack capacity (static capacity: 36,000 TEU) is the bottleneck at the moment. An additional storage area has been opened recently (6,000 TEU), but really significant stack expansion directly behind the ship-to-shore crane requires relatively expansive dredging work.

The same is true for adding on-dock rail terminal operations, therefore an off-dock rail terminal is setup on land, right next to the truck gate, at the start of the cause way, meaning relatively long transport distances for rail containers between container stack and rail terminal, but possible train efficiencies (stop & add containers & go) with trains of the multi-purpose terminal (DMP).

This terminal had been operated by DP World since 2006, up until the beginning of 2018, when the Djibouti government cancelled the concession agreement, as a (intermediate) result of a long lasting conflict between Djibouti and DP World, from that moment on DCT is under the control of Doraleh Container Terminal Management Company (SGTD). Talks and legal procedures are ongoing, and both timing and outcome are uncertain at the moment of writing.

However with area capacity too limited to put a Cross-dock Djibouti and on-dock rail terminal on DCT this is not insurmountable, and this conflict will most likely be solved when operations at Cross-dock Djibouti is to start after the coming project development and construction period. Moreover, a new deep-sea container terminal is being developed: Djibouti International Container Terminal (DICT). The location of Djibouti port along major East-West shipping routes (feeder volumes) and Ethiopia's growing economy in its hinterland (gateway volume) are back up these plans. The planned capacity of DICT is 2.5-4.0 million TEU. In consultation with Djibouti Ports & Free Zones Authority it was decided to integrate the cross-dock facility within the new DICT container plans. In figure 34 a picture is depicted of DICT (left) right next to the current DCT terminal (right).

Initial capacity of DICT in phase 1 (green part of impression in figure 34) is 2.5 million TEU with a quay length of 1.250 meter at a natural water depth of 18.5 meter through which 20,000 TEU ships can be received. With a terminal depth of around 690 meter the total terminal area is around 780,000 m2.

The total investment involved is 654 million USD assuming a caisson construction approach. Phase 2 would increase terminal capacity to 4.0 million TEU with among others adding another 550 meter of length (white part of impression in figure 34)

The investing parties and operating model are not yet finalised. Parties which expressed interests in being involved in DICT are China Merchants Group Holding (through their equity participation in PDSA), CMA CGM (through their terminal company Terminal Link) and State General Reserve Fund (Oman). Final feasibility studies for DICT have not been started yet, but are scheduled to commence soon by Djibouti Ports & Free Zones Authority and the other interested parties. Right afterwards construction would start, and 2 years after terminal operations are planned to start.

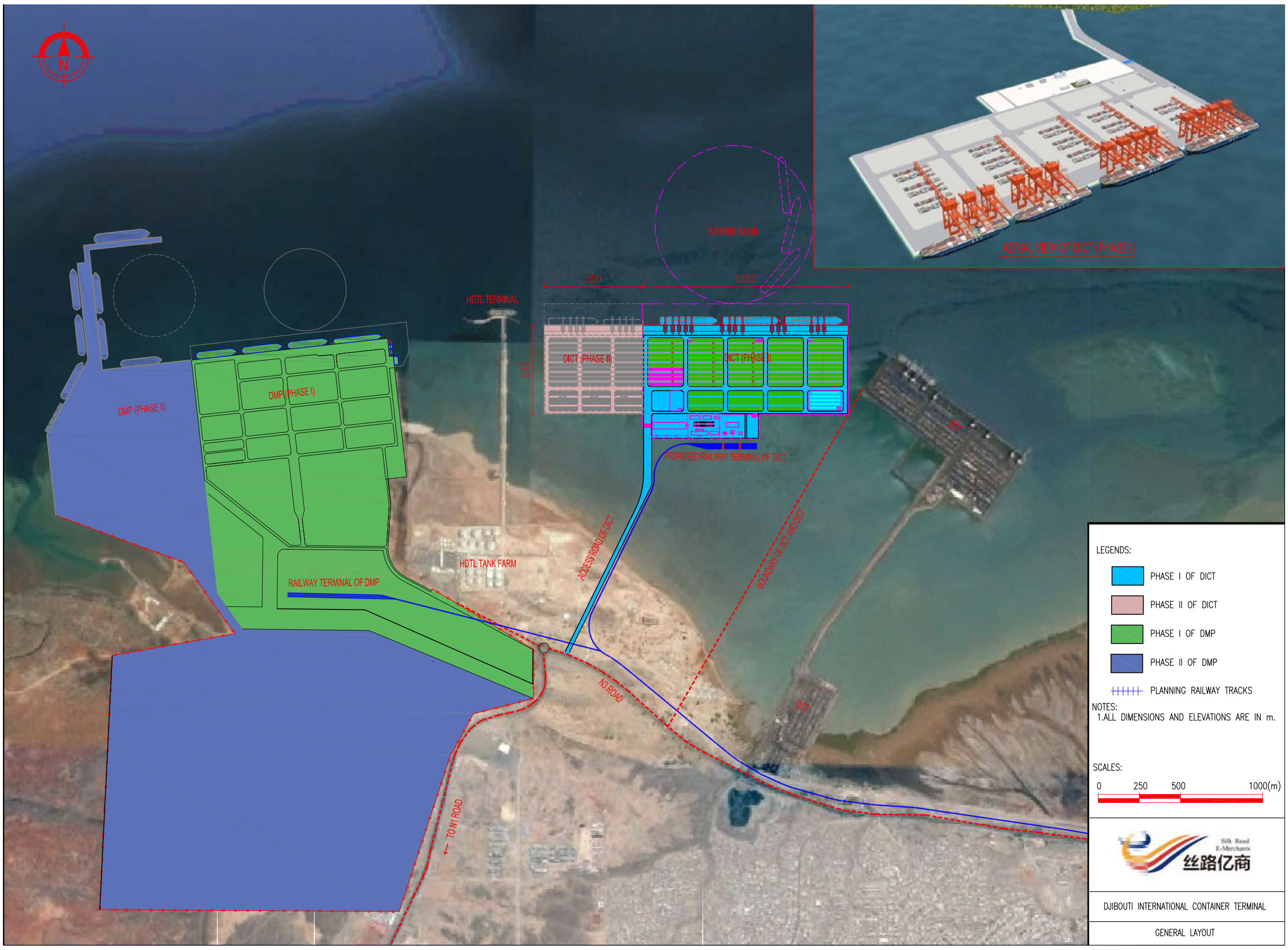


FIGURE 34: DICT TERMINAL LOCATION RIGHT NEXT TO CURRENT DCT TERMINAL

The (pre)feasibility study of the DICT, where for example the first technical designs originated from, has been done by Silk-route E-merchants. Various design sessions were organised with participation from Djibouti Ports & Free Zones Authority, Flying Swans and Silk-route E-merchants. General container terminal topics were part of these discussions. Zooming in on the cool logistics point of view it is preferable to:

- Have an on-dock rail terminal close to container stack and empty depot; to minimise transport distances and risks of breaking the cold chain.
- Have a connection with the current DCT terminal; to be able to work with containers from carriers from both terminals.
- Etc.

These discussions are ongoing and can be rounded up only when the group of parties involved in DICT is finalised. Moreover, this joint design process resulted in a technical design in which Cross-dock Djibouti is fully integrated into DICT container terminal operations. In figure 35 a more detailed depiction is shown of DICT's technical design, including the location of Cross-dock Djibouti, where interests of both the deep-sea terminal and the cross-dock facility are balanced.

Several matters were considered in the joint design process. Deep-sea terminal operations are about processing high volumes efficiently at the lowest cost possible. The cross-docking facility should not hamper this, the facility is located in such a way that the cross-docking facility will not interfere with key process flows in the deep-sea terminal operations (stack to-/ from rail, etc.).

Another important criterion on positioning is keeping the dry and reefer container flows between the cross-dock facility and the stack & empty depot of the deep sea terminal cost effective and responsive. The shorter the driving distance, the better: a compact design where container stack, empty depot, rail terminal and cross-dock facility are located as close together as possible.

This setup will be the starting point during the upcoming feasibility studies. Several matters will need to be worked out in detail then: location of on-dock rail terminal, possible connection between both terminals, the exact number of reefer plugs in what phase, etc. Start of the feasibility study will depend on when the group of companies involved is finalised, which is expected to be soon.

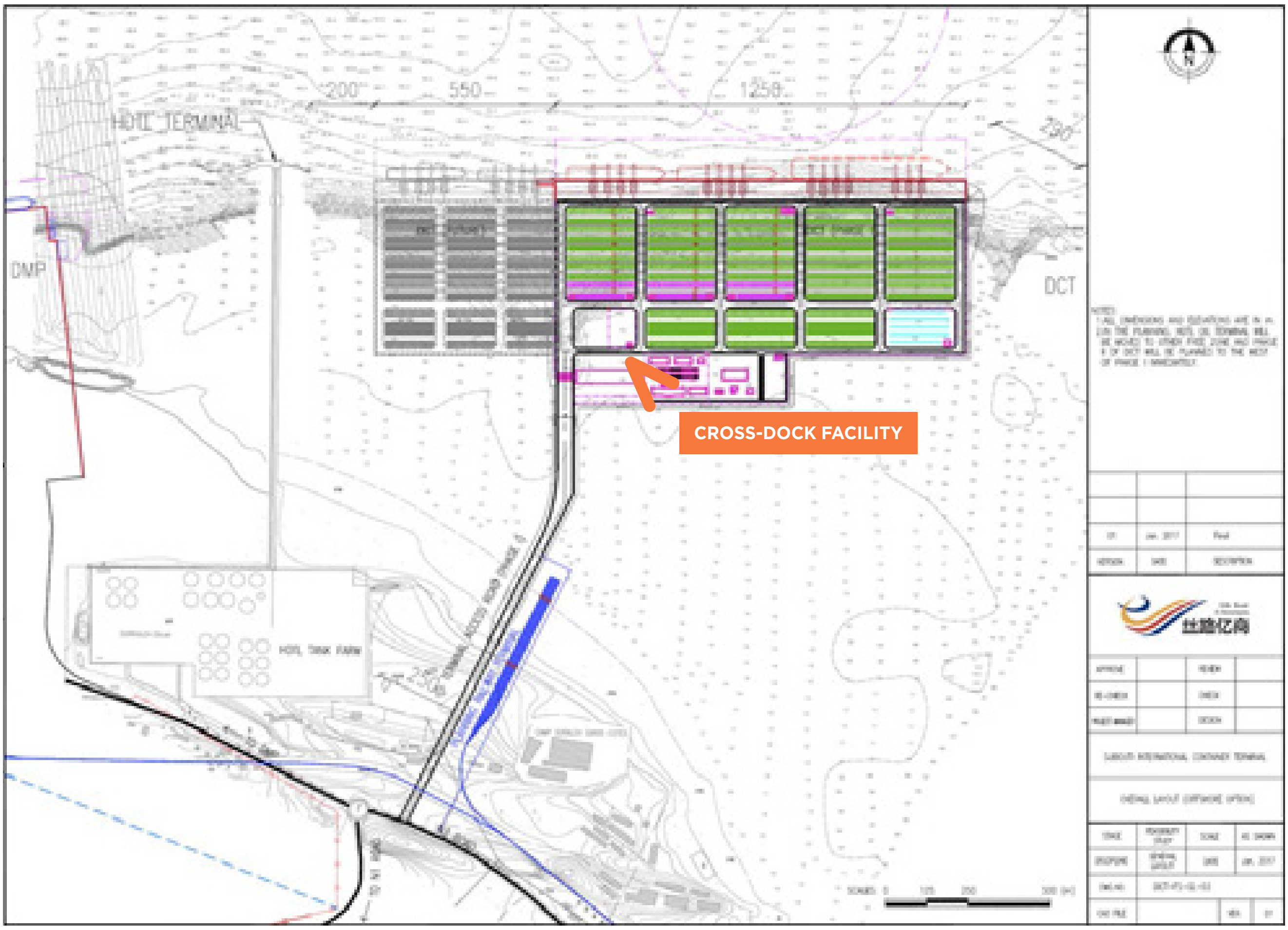


FIGURE 35: POSITIONING ON DICT

6.3 BUSINESS CONCEPT AND POSSIBLE MARKETS

The rationale of the Cross-dock Djibouti development is the need to eliminate the empty leg for reefer flows in order to unlock Ethiopia's horticulture potential. Such a facility could also add value to other flows and value chains. In our analysis we have not taken into account other business opportunities given the strategic rationale, although in practice these could help reach decent occupancy rates during the first years when fruit & vegetable volumes will probably be limited. In the end the facility must give priority to matches with export reefers in order to reach the goals the facility is developed for.

Therefore, market analysis for the cross-docking facility is predominantly focused on the various reefer flows passing Djibouti port and its container terminal(s). Contrary to Cool Port Addis (which delivers services to shippers of fruit, vegetables, flowers, etc.) the actual goods inside the reefer container are not important: after all the facility only sees the empty reefer container which will be filled with dry goods from dry containers within her walls. On the other hand the contents of the dry container do matter as these products will be cross-docked, 40ft dry container import volumes are expected to be much higher than 40ft reefer export volumes, providing the opportunity to 'select the least laborious' ones to make matches with.

Several types of reefer flows pass the Djibouti terminal. In order to design an optimal business concept, technical design, etc. for the cross-dock facility, it is important to figure out which flows would be served by the facility, and which will not. In total six different types of reefer flows were identified in interaction with market parties during interviews.

Only one of the six identified reefer flows through Djibouti will go via the cross-docking facility, the other flows will pass the facility without using it: the empty reefer flow transported to hinterland locations by rail. The interesting fact however is that this one flow will also positively influence the others, as these flows can profit from the same "fly-wheel of volume-logistics performance" catalysed by the cross-docking facility. The total number of reefer flows identified are depicted in figure 37.

With the market (types of flows passing the facility) identified the next step is sizing in terms of volume. This has been done for two particular moments in the future. The first one is the amount of volumes after a standard explicit forecast period of around 10-12 years similar to what has been used for Cool Port Addis. For this facility we added another time window, a volume forecast after 30 years. With the facility being fully integrated in DICT deep-sea operations with a similar long-term perspective this is necessary for spatial planning reasons.

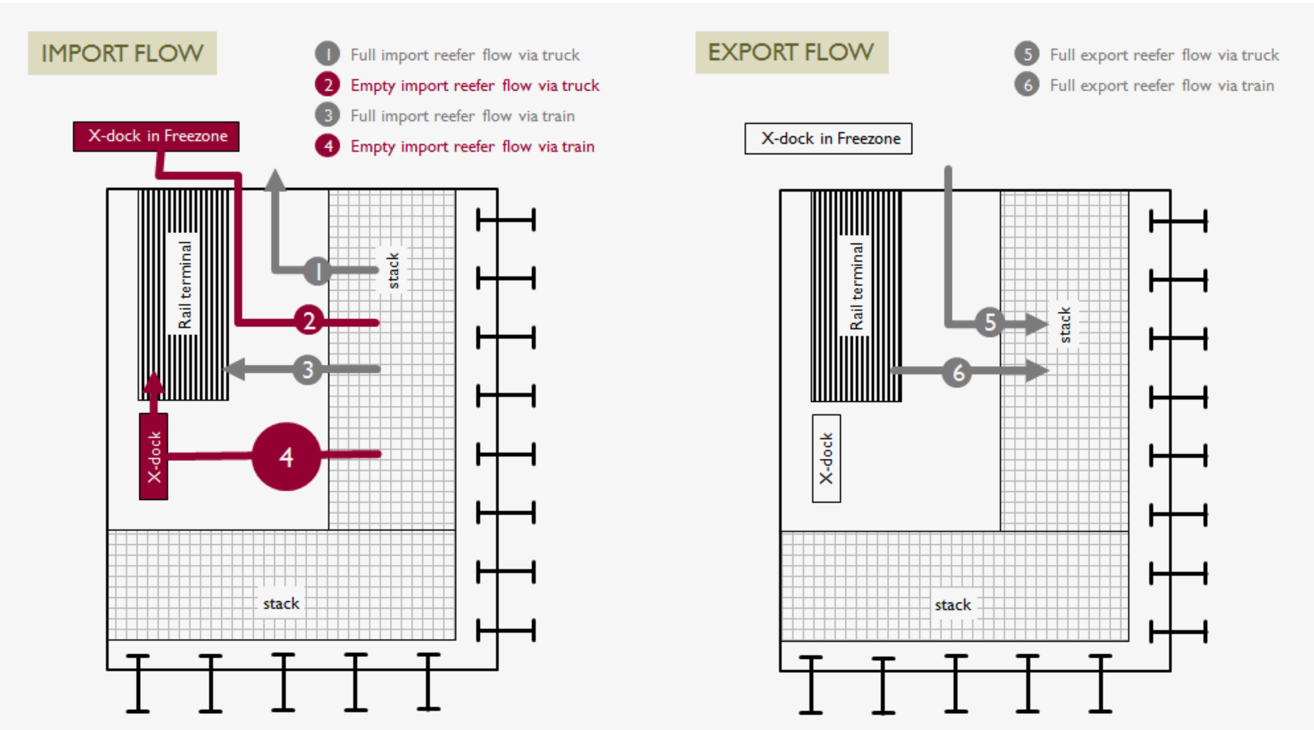


FIGURE 36: TYPE OF REEFER FLOWS GOING THROUGH CROSS-DOCKING FACILITY

Type of flows identified	Truck	Train
Import		
Full	1. Directly from stack to truck	3. Directly from stack to train terminal
Empty	2. Via x-dock in freezone	**4. via x-dock on deep-sea terminal**
Export		
Full	5. Directly from truck to stack	6. Directly from train to stack
Empty*	Not applicable	Not applicable

Scenario assumptions	After 10 years	After 30 years
Export reefer volume in ctrs	62.500	190.000
Import reefer volume in ctrs	62.500	190.000
Modal split rail	80%	90%
Reefer import full	5%	20%

After 10 years	Truck	Train
Import		
Full	1%	4%
Empty	19%	76%
Export		
Full	20%	80%
Empty*	0%	0%

After 30 years	Truck	Train
Import		
Full	2%	18%
Empty	8%	72%
Export		
Full	10%	90%
Empty*	0%	0%

After 10 years	Truck	Train
Import		
Full	625	2.500
Empty	11.875	**47.500**
Export		
Full	12.500	50.000
Empty*	0	0

After 30 years	Truck	Train
Import		
Full	3.800	34.200
Empty	15.200	**136.800**
Export		
Full	19.000	171.000
Empty*	0	0

FIGURE 37: SCENARIO ANALYSIS FOR CROSS-DOCK DJIBOUTI VOLUMES

A number of variables are important in estimating the amount of containers going through the cross-docking facility:

1. Ethiopia's Fruit & vegetable (and other perishables) overseas export
2. Ethiopia reefer overseas imports
3. Rail modal split of (empty) reefer container going to Ethiopia

For both moments in time (10 years and 30 years from now) the estimates are made for all three variables mentioned above based on desk research of railway & horticulture industry studies and interviews with market participants. Leading to the following expected volumes for the cross-docking facilities for future operations, see figure 37.

Thirty years from now ,Ethiopia is assumed to be a horticulture powerhouse similar to South Africa. Fruit & vegetable volumes would in this scenario be around 3,000,000 ton, in combination with other perishable exports flows like flowers, meat, etc. the total reefer export is assumed to be around 4,000,000 ton or approximately 190,000 containers (21 ton per container). With this amount of exports realistically reefer imports will not be able to match more than 20%, because the most voluminous reefer like products (fruit, vegetable, meat, etc.) will be produced in the country itself. A rail modal split of around 90% should be in the realm of possibilities, as many production locations are far away from Djibouti port (>600 km) and at such distances rail is more competitive than trucks. Particularly so many years ahead when trucking will most likely be far more expensive than nowadays. As stated before only one type of flow uses the cross-docking facility (flow nr. 4), in a scenario based on the above mentioned assumptions this would be 136,800 containers or 2,872,800 pallets.

The export volumes after ten years are assumed to be around 60,000 containers, 50,000 containers for fruit & vegetables, the remaining filled with other perishable exports. Assumptions for the other two variables are: rail modal split (80%) and reefer imports (5%). The same math as in the previous scenario leads to a volume of 47,500 containers or 997.500 pallets.

6.4 TECHNICAL DESIGN

Self-evidently the business concept and the subsequent volume scenarios are one of the most important input variables for the technical design of the building. For this the figures described in the previous paragraph will be used. However, other factors play a role in designing the cross-docking building, for example: the terminal design of DICT, the type of operations within the building and the demand profile of the volume to be handled (% palletised, % of cargo needing storage, expected storage time, volatility of volume, etc.). The specifics of DICT taken into account were already touched upon in previous paragraphs, in this paragraph the facility's operations will be described.

FACILITY'S OPERATIONS AND DEMAND PROFILE

With the cross-docking facility being located on the premises of the DICT (which is on expensive reclaimed land) a high volume per m2 is a pre-requisite to justify its on-dock location. Moving as many goods as possible is also preferable to keep USD price per move as low as possible. With the cross-docking facility designed for moving pallets instead of storing them, the design of the building and its operational setup are aimed at keeping driving distance of moving goods from one container to another to a minimum.

The design of the facility is derived from the standard dimensions of dock doors (2.4m) and the space between two dock doors (3m) to keep operations compatible with international practices. The short-term storage area is dimensioned on one block-stowed 40ft container load (12m-2.4m) and enough room around these areas to manoeuvre pallet handling equipment (3m).

Two dock doors and two short term storage areas are a minimal crossdocking 'production unit'. Moving goods from the dry container (position 1 at figure 38) to a reefer container (position 2 at figure 38) takes place via adjacent doors to minimise driving distances. Goods are transferred directly to avoid extra handling, short-term storage in the designated areas will only be done in case of unexpected issues (damage to goods and pallets), requests for controlling agencies (customs), etc.

Both longitudinal sides of the building have as many dock doors as possible as the number of doors is the most likely bottleneck of the building. In case of issues resulting in extra storage place requirements the bottleneck self-evidently shifts to the amount of storage places.When this takes place, one should act on resolving these issues as on-dock locations preferably are not used for storage, although the larger need for storage can be served by introducing racking in the short term to prevent operations coming to halt.

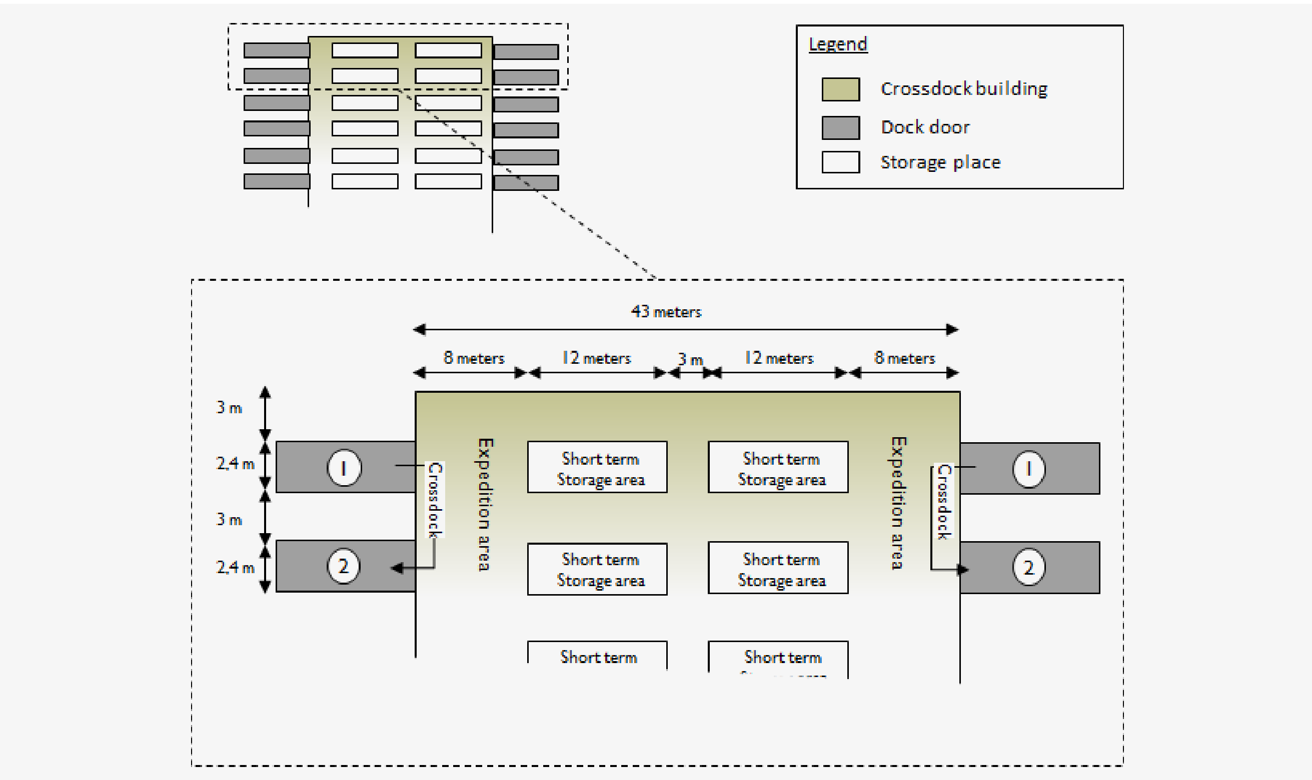


FIGURE 38: CROSS-DOCK DJIBOUTI OPERATIONS

The amount of volume handled ten and thirty years in the future was already determined in the previous paragraph. However, the (type of) workload the facility needs to cope with will be defined by several other demand profile variables:

- **Ratio palletised vs non-palletised goods in dry container:** non-palletised goods take more time to be cross-docked at the facility than goods on pallets (eight vs one hours). At the moment, most import containers are loaded with bulk products, e.g. informal trade containers. In the future, the degree of containers filled with pallets will probably go up when rising labour, costs will increase the need for efficiency.
- **Direct cross-dock vs short term storage:** estimate of number of containers of which cargo needs to be stored in one of the short-term storage areas before getting cross-docked because of customs, damage, etc. The percentage of containers requiring storage will be lower thirty years than ten years from now.
- **Average storage time in short-term storage area:** three different types of problems are assumed that cause storage demand: small size problem (50% of total, 0.5 day), medium size problem (35% of total, 1 day) and large size problem (15% of total, 5 days) resulting in an average storage time of 1.35 days at both time windows.
- **Peak factor:** the amount of volume fluctuations the facility must cope with for various regions, for fruit & vegetable seasonality is always very relevant. In principle Ethiopia has (with its many different climatic zones) the potential to become a year-round producer, but this depends on the product portfolio choices made across the country. Peak factor for now is assumed to be 20%.
- **Other relevant input variables:** time to (un) dock container at facility (15 minutes), number of pallets in container (21 pallets), number of boxes in container (1,500 boxes), number of days/ hours of operations (365 days, 16 hours a day),

One final remark with regards to the variables assumed: Only a relatively small percentage of all Ethiopia dry gateway import containers will be cross-docked in this cross-docking facility in Djibouti. This opens the opportunity for its operator (self-evidently in consultation with its logistics chain partners) for careful "selection of the most suitable flows" in order to increases efficiency of operations. Most likely, this means selecting the containers which the least issues and subsequent storage days as this is often the bottleneck in these kinds of operations. In our scenarios the operator is capable of selecting the most suitable containers, probably through sharing a percentage of the value created with its logistics chain partners whose cooperation is required.

FUNCTIONAL DESIGN AND PHASING

For both moments in time assumptions are made for these relevant variables in order to sketch the functional design of the facility. Designing this building is less complex as for example Cool Port Addis, as the goods handled are relatively homogeneous in terms of care required when handled with no need for different climatic zoned and compartments.

FIGURE 39: SCENARIO 30 YEARS AHEAD: ASSUMPTIONS AND CALCULATIONS

The two main design building blocks in this case are the required amount of dock doors and storage places given the demand profile the facility is assumed to handle. The same calculation model is used for both the 10 year and 30 year scenario, of course with different input variables reflecting the different assumed context at both moments.

At first the calculation model is depicted for the 30 year scenario, see figure 39. On the left the relevant variables of the demand profile are listed, while in the middle and on the right the output variables and its occupancy rates are calculated (middle: dock doors; right: storage places).

A reasonable maximum occupancy rate is assumed to be around 80%. In theory, higher percentages are also possible, but in practice these kinds of operations tend to run the risk of coming to occasional standstills with higher utilization rates. Therefore, we have chosen to design the building with a capacity that can handle the 30 years ahead volume at an occupancy rate of around 80%.

Thirty years ahead the facility should be able handle the goods of around 130,000-140,000 containers. Most containers contain palletised goods (almost 90%), and only a small portion of the goods will have issues resulting in the need for storage (10%, 1.35 days of average storage time).

The combination of these two variables 'palletised versus non-palletised' and 'cross-dock direct from dry to reefer container versus via intermediate storage' result in four types of flows being handled in the facility: 1. Palletised goods cross-docked directly, 2. Non-palletised goods cross-docked directly, 3. Palletised goods cross-docked via intermediate storage and 4. Non-palletised goods cross-dock via intermediate storage. All flows together represent 450 containers a day with a dock door production of 1,079 dock door hours, while at an average moment in time the facility must be capable of storing the contents of 61 containers.

Above-described functional requirements result in a building with a length of 200 meters and a width of 40 meters. Both longitudinal sides of the building offer 43 dock doors, given the building a total of 86 dock doors. This is where the dry and reefer containers are brought to get cargo cross-docked from one container to another. The calculated occupancy rate of these dock doors is 78% during peak period days.

The occupancy rate of the storage places is 70%, also during peak volume periods. In total the building has 86 storage places at ground level which should be able to accommodate the peak storage demand of 61 days. In case more storage capacity is need, the height of the building allows racking to create extra capacity as stated before.

At both sides of the building around 36 meters is reserved (including staging areas of containers) to create manoeuvring space for transport vehicles of the deep-sea terminal delivering and picking up containers. The total footprint of the building including this manoeuvring space is roughly 2 ha (112 meters by 200 meters), which is equal to 1-1.5% of the total terminal surface.

Figure 40 depicts a two-dimensional top view of the Cross-dock Djibouti facility. The assumed production levels at this 2 ha facility will be the most productive part of the DICT terminal in terms of containers handled per m2. Self-evidently this is possible because the deep sea container terminal has full control on the flow of both the dry and the reefer containers, making it relatively easy to provide the cross-dock with the container input for continuous production. In practice this means sometimes bringing container to the facility in advance during DICT's off-peak hours in order to decrease the number of containers to be brought in when much of the terminal's capacity is needed at the sea-side. For the cross-dock this means some extra dock door capacity is a pre-requisite, which is thus included with the maximum 80% occupancy assumption.

The 10 year scenario volume does not need a facility of this size. With the assumed volumes of 47,500 containers the occupancy rates of the dock doors (34%) and storage places (37%) allow phasing of the facility. We can imagine starting operations with 50% of the capacity could be a realistic option, but of course the remaining area should be reserved to grow to the full capacity during phase 2.

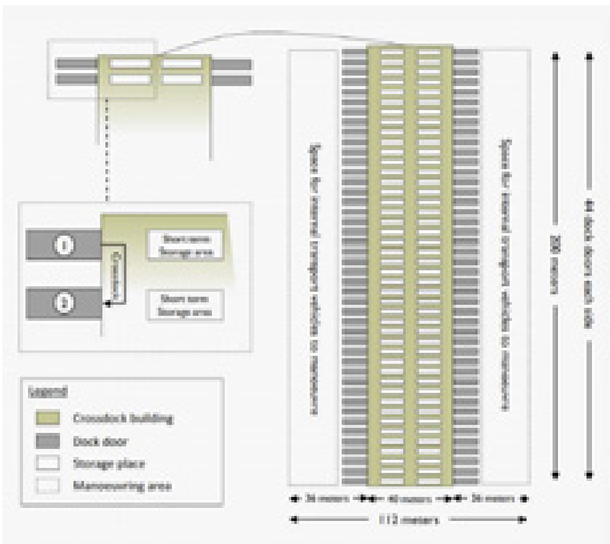


FIGURE 40: FUNCTIONAL DESIGN 30 YEARS AHEAD

Volumes					
Opening hours					
Days per year	365	days			
Hours per day	16	hours			
Throughput					
Annual throughput	47.500	containers	997.500	pallets	
Peak factor	20%				
Maximum daily throughput	156	containers pd			
Maximum hourly throughput	10	containers ph			
Dwelltime per flow type					
		Time (un)load		Storage	
1. Palletized, direct	70%	1,5	hours	0	days
2. Non palletized, direct	15%	9	hours	0	days
3. Palletized, short stay	10%	1,5	hours	1,35	days
4. Non palletized, short stay	5%	9	hours	1,35	days
	100%				
Flows to be handled on a average day					
Maximum daily throughput	156	containers pd			
Summary, type of flows	in %	in containers per day	Dock door in hours	Storage in days	
1. Palletized, direct	70%	109	164	0	
2. Non palletized, direct	15%	23	211	0	
3. Palletized, short stay	10%	16	23	21	
4. Non palletized, short stay	5%	8	70	11	
		156	468	32	

Dock door occupancy rate		
Docks door required		
Daily dock door production hours	468	working hours
Working hours per day	16	hours
Dock doors required	29	
Lenght of building		
Dock door	2,5	meters
Space between dock doors	2	meters
Meters needed per dock door one side	4,5	meters
Dock doors at both sides	2	dock doors
Space between wall and dock door	3	meters
Lenght needed	72	meters
Crossdock capacity		
Lenght	200	meters
Meters needed per dock door one side	4,5	meters
Space between wall and dock door	3,0	meters
Dock doors at both sides	2,0	dock doors
Nr of dock doors	86,2	
Occupancy rate	34%	
Occupancy rate phase 1	68%	

Storage places occupancy rate		
Storage places required		
Daily storage days production	32	
Width of building		
Space expedition area	8	meters
Storage area	12	meters
Nr of storage areas widthwise direction	2	pieces
Space between storage areas	3	meters
Width needed	43	meters
Nr of storage areas		
Lenght of building	200	meters
Storage area	2,5	meters
Space between storage areas	2	meters
Meters needed per storage area	5	meters
Space between storage area and wall	3	meters
Max. nr of storage areas longitudinal dir.	43	spaces
Maximum nr of storage areas	86	spaces
Occupancy rate	37%	
Occupancy rate phase 1	73%	

FIGURE 41: SCENARIO 10 YEARS AHEAD: ASSUMPTIONS AND CALCULATIONS

The number of containers requiring intermediate storage due to the reasons mentioned before is difficult to predict in phase 1. At the moment, the concept is new to Ethiopia and Djibouti. In case the storage percentages are higher than assumed now in the model, racking will give the flexibility to store much more cargo within Cross-dock Djibouti.

ESTIMATED INVESTMENT

An estimate of the investment involved is important. The costs related to the building (depreciation, interest and maintenance) is a significant part of the breakdown of total costs, although normally personnel are the main cost component in these kinds of operations. Besides this, the investment involved is the main risk element the investors absorb, as personnel costs can be more easily brought down in case of setbacks, especially in countries like Djibouti where unemployment rates are high.

An investment estimate of the building described in the previous paragraph was made using benchmarks of many similar buildings in global markets, and checked with local parties to make sure it is fitting within the Djibouti context.

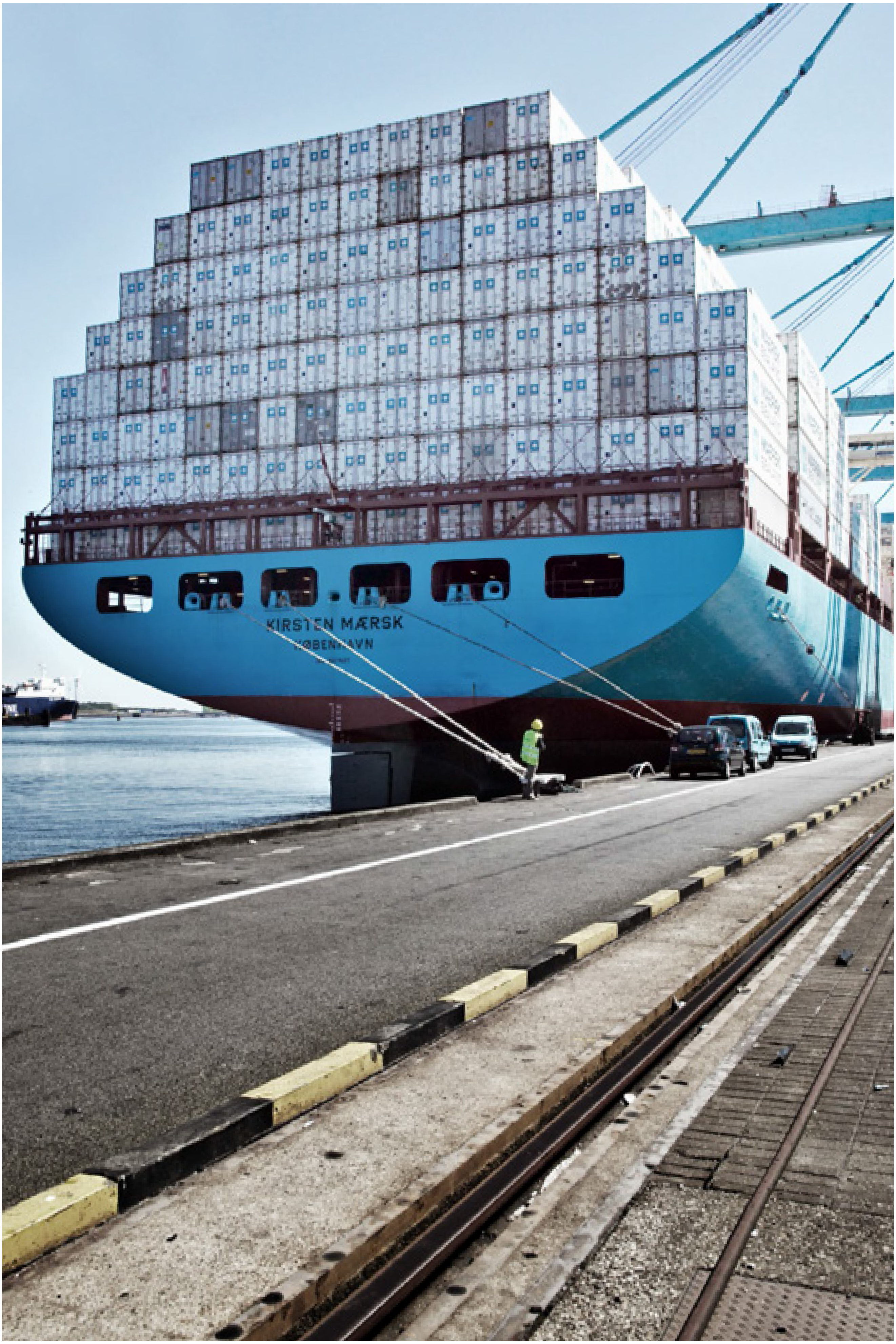
This estimate is based on a 10.5 meters high building, although for a highly efficient operation this is not necessary. It gives the opportunity to introduce racking if market demand requires it. A limited extra investment achieves a lot of flexibility which allows for different types of business.

The investment is estimated at 8-10 million USD including project development, engineering, etc. Compared to regular warehouses a cross-docking building is slightly more expensive because of the many dock doors per m^2.

For a complete overview of all costs involved see below for a breakdown of investment components. Both for the building at full capacity, as well as phase 1. Inefficiency of phasing construction is assumed to be around 10%. During the feasibility study these numbers needs to be substantiated further in more specific talks with possible contractors at a time closer to the actual construction, for construction prices tend to fluctuate during different periods of the economic cycle.

INVESTMENT		Phase 1
		50%
		10%
1. Groundwork	**$2.240.000**	**$1.232.000**
m2	$22.400	
USD/ m2	$100	
2. Crossdock building	**$2.798.333**	**$1.539.083**
Building		
m2	$8.600	
USD/ m2	$175	
Elevated building, height 10.5 m	$1.505.000	
Dock doors		
Extra number of docks vs 1 per 1,000 m2	$86	
Extra investment per dock	$15.000	
	$1.293.333	
3. Office + canteen	**$400.000**	**$220.000**
m2	$800	
USD/ m2	$500	
4. Miscellaneous	**$1.300.000**	**$715.000**
Engineering& permits	$800.000	
Project development	$500.000	
5. Other/ contingency	**$1.000.000**	**$550.000**
% of total investment	$0	$0
Total investment	**$7.738.333**	**$4.256.083**

FIGURE 42: HIGH-LEVEL INVESTMENT ESTIMATE


KIRSTEN MÆRSK
KØBENHAVN

6.5 BUSINESS MODEL & BUSINESS CASE

Cross-dock Djibouti's business is derived from its spot in the logistics chain, directly after deep-sea terminal operations, and before train operations from Djibouti to hinterland terminals like Modjo (seen from an import perspective). This makes it logical to focus on performing the cross-docking core activities efficiently. Operators probably will not consider becoming involved in many ancillary services.

The DICT container terminal will most likely be responsible for the transport of container to and from the cross-dock facility to the container stack, empty depot and rail terminal. Although this could be done by the cross-dock operator it is unlikely for different reasons: the deep-sea terminal will not allow it to minimise interference, the deep-sea terminal should be able to do it more efficiently through synergies with all these other internal transport moves, etc.

Therefore Cross-dock Djibouti is assumed to provide two kinds of (related) products:

1. **Handlings:** provide services to get cargo out of dry 40ft container into the reefer 40ft container, directly or via intermediate storage
2. **Storage:** provide storage services for a period of time

A business case is set up for Cross-dock Djibouti with the business model described above as market positioning. The various business case components and its assumptions are described in more detail below: revenues, operational costs, depreciation, interest, etc.

Similar to Cool Port Addis' business case the time window chosen is ten to twelve years ahead in line with the explicit forecast periods of financiers. The thirty years ahead time frame presented before was very relevant for functional design purposes in order to provide input to DICT's spatial planning process, but is less relevant for financial planning. Self-evidently if Cross-dock Djibouti is assessed feasible ten years from now, it is assumed to be even more so with the higher thirty years ahead volumes.

REVENUES

In line with the business model chosen in the previous paragraph, Cross-dock Djibouti has two main product categories from which it generates revenues: handling inbound and outbound flow and short-term storage.

As already stated previously, Cross-dock Djibouti probably has to cope with four different kinds of flows from the foreseen demand profile (forecasted volumes between brackets):

1. Palletised cargo to be cross-docked directly from dry to reefer containers (698.250 pallets)
2. Palletised cargo to be cross-docked with intermediate storage (99.750 pallets)
3. Non-palletised cargo to be cross-docked directly from dry to reefer containers (10.687.500 boxes)
4. Palletised cargo to be cross-docked with intermediate storage (3.562.500 boxes)

The expected work load per type of flow also varies significantly. Being forced to go through an intermediate storage place because of damage, customs, etc. self-evidently means extra handlings, while goods cross-docked directly need only one handling. In the revenue model this is translated into double the prices of such a handling compared to a direct cross-dock (5.5 USD per pallet vs 2.75 USD per pallet).

Handling pallets versus boxes is also different in terms of work which needs to be done, with moving boxes being approximately 8 times less efficient. On the other hand, pallets require relatively expensive fork lift equipment while labour in Djibouti is still cost-effective. For modelling purposes labour is assumed to compensate handling inefficiencies, meaning prices of handling pallets versus boxes is equal per ton handled.

Prices incorporated in the business case are lower than current handling prices in Djibouti. At the moment, market parties can make use of open-air cross-docking at around 6-7 USD per pallet (175 USD per container), however current cross-docking is still small-scale and ad-hoc without the economies of scale advantages of Cross-dock Djibouti. This explains the price differences.

PERSONNEL

The same personnel setup principle used in Cool Port Addis is applied in Cross-dock Djibouti. There will be a limited number of white collar workers for cost-efficient operations. Most workers will be required for cross-docking handling operations, especially in this highly adaptable business concept.

The assumed white collar setup is:
1 general manager
1 operational manager
1 sales employee
1 reception/ drivers desk employee

The same kind of methodology was used to get an overview of the amount of personnel needed to perform the handlings of the throughput volumes just described. All relevant activities are identified

10 years ahead

Average working day	Volume in %	Number of containers	Number of pallets	Number of boxes	Productivity (number/ man hour)		Man hours needed	Headcount per day
IN/ OUT								
1. Palletized, direct	70%	109	2.296		50	palllets	57	8
2. Non-palletized, direct	15%	23		35.137	90	boxes	488	70
3. Palletized, short stay	10%	16	328		50	pallets	8	1
4. Non-palletized, short stay	5%	8		11.712	90	boxes	163	23
EXTRA STORAGE HANDLING								
3. Palletized, short stay	10%	16	328		50	palllets	8	1
4. Non-palletized, short stay	5%	8		11.712	90	boxes	163	23
Average head count								127
Average number of fte								151

FIGURE 43: PERSONNEL SETUP

and for each handling a production per persons per hour is assumed. All these handling operations together form a full cycle: a cross-dock handling from dry to reefer container (facility in and out) and extra handling for some containers because of intermediate storage.

Sixteen hour working days are assumed with this facility being incorporated into the port context with its 24-hour operations. We have chosen not to go for a 24-hour working day for this facility as we assume each day will have a period of less (to no) container input from the deep-sea terminal when the terminal has rush hour receiving both ships and trucks.

Other relevant variables are: 20% idle time is assumed due to workload volatility. On a yearly basis people are assumed work 210 days, with 40 days off for vacation, public holidays, etc..

Following the assumptions in the figure above Cross-dock Djibouti will have 151 people employed in actual warehouse operations. Together with the few people involved in management to total setup will be around 155-160 people.

Salaries in Djibouti are said to be 40%-50% higher than in an average African country. This has its implication for Cross-dock Djibouti with its labour-intensive business model. Blue collar workers are assumed to earn 7,500 USD per year, while management roles are paid between 20,000-40,000 USD depending on their rank.

DEPRECIATION & INTEREST

The investment involved for the total building capable of accommodating all reefer matches thirty years from now (3,000,000 ton) is around 8-10 million USD. Provisionally construction was assumed to be executed in two phases, each covering half the total work. Phase 1 is assumed to cost around 5 million USD. Building in two phases adds an extra 10%-20% of required investment. Still this is prudent, as phasing decreases the risks associated with the most difficult period of Cross-dock Djibouti's life cycle. The first years when fruit & vegetable volumes still have to pick up.

The depreciation table of the various investment components follows the periods of depreciation used in general with global best practices: groundwork (25 years), cross-dock building and office (20 years) and other components (7 years). This leads to an annual deprecation of around 274,902 USD.

Interest rates are assumed to be in line with levels generally used in Africa. An interest rate of around 9% corresponds with an amount to be paid to the financier of 223,103 USD per year. In total the annual costs in relation to the investment in the facility will therefore be 500,000 USD.

OTHER OPERATIONAL COSTS

The costs with regard to the investment in the building and the salaries of personnel are the two main cost components of the business. Other costs involved are land, equipment, electricity & water usage, maintenance, etc.

In the current version of the business case the cost of land is "to be determined". The footprint of the building is approximately 2 ha, conditions under which land can be leased/ acquired are DICT is still to be decided upon.

Regarding equipment the facility has to buy and lease forklifts to (un)stuff containers at the dock doors, and bring the pallets to the storage areas.

Compared to other African countries electricity in Djibouti is more expensive per Kwh. The advantage, compared to Cool Port Addis, is that this facility does not need to be cooled down to temperatures suitable for perishables. Djibouti's summers are relatively hot, talks with contractors during feasibility should make it clear whether insulation and other measures could guarantee an indoor climate that would allow efficient operations, or if some kind of temperature controlled system needs to be installed to ensure workable conditions.

The annual maintenance that has to be done in order to keep the building functioning in such a way that reliable cross-dock services can be provided has been assumed based on input from similar projects and tested with local parties.

BUSINESS CASE AND FINANCEABILITY

In figure 44 the business case of Cross-dock Djibouti is depicted in line with the various profit loss items described previously. On the left all relevant assumptions and input variables are listed leading to the Profit Loss Statement of Cross-dock Djibouti phase 1 at full capacity. Full capacity in this scenario is defined as having an average occupancy rate of 80%-85%.

With the described volume forecast handled by Cross-dock Djibouti against global best practices prices the annual turnover will be around 3.4 million USD. Cost of goods sold in these kinds of operations are of course limited to zero.

If need be, revenues could be increased by offering higher handling prices, the premium location between rail terminal and deep-sea stack would probably allow this. On the other hand, this is in contradiction with the strategic rationale: the cool logistics overlay (which Cross-dock Djibouti is part of) is to unlock massive fruit & vegetable flows which in the end all stakeholders profit most from.

Operational costs in total add up to around 2 million USD with self-evidently, given the labour-intensive process, personnel being the largest cost component (>50%), but this could be managed in accordance with volume fluctuations: when volumes grow, the personnel setup can probably follow soon in the current Djibouti labour market, and vice versa.

After operational costs an EBITDA of approximately 1.4 million USD is left. As stated before, depreciation and interest together add up to 0.5 million USD, the second biggest cost component of the business. Contrary to personnel this is a fixed cost that cannot be managed in line with volume growth or fluctuations.

The total investment involved for constructing Cross-dock Djibouti is 4-5 million USD in phase 1. This is self-evidently also the main asset component

ASSUMPTIONS				
Revenues				
Throughput in pallets direct	698.250	pallets	€ 2,75	USD per pallet
Throughput in pallets with storage	99.750	pallets	€ 5,50	USD per pallet
Throughput in boxes direct	10.687.500	boxes	€ 0,04	USD per box
Throughput in boxes with storage	3.562.500	boxes	€ 0,08	USD per box
Storage in pallets	134.663	pallet days	€ 1,00	USD per pallet day
Storage in boxes	4.809.375	box days	€ 0,01	USD per box day
Personnel				
Blue collar	151	fte	€ 7.500	USD per year
General manager	1	fte	€ 40.000	USD per year
Operational manager	1	fte	€ 25.000	USD per year
Sales employee	1	fte	€ 20.000	USD per year
Drivers desk/ reception	1	fte	€ 12.500	USD per year
Equipment				
Forklift trucks	11			
Back-up capacity	20%			
Lease price	€ 9.500			
Building				
Electricity& water	600.000	KwH	€ 0,15	USD per KwH
Maintenance (% of investment)	5%	of investment		
Interest				
Interest on debt	9%			
Other				
contingency	20%			
Tax				
Corporate tax rate	25%			

PROFIT& LOSS STATEMENT		
1	**REVENUES**	
1.1	Crossdock handlings pallets direct	$1.920.188
	Crossdock handlings pallets with storage	$548.625
1.2	Crossdock handlings boxes direct	$411.469
	Crossdock handlings boxes with storage	$274.313
1.3	Crossdock storage pallets	$134.663
1.4	Crossdock storage boxes	$67.331
	Subtotal	**$3.356.588**
2	**COST OF GOODS SOLD**	
		na
3	**GROSS MARGIN**	**$3.356.588**
4	**COSTS**	
4.1	Land	
4.2	Blue collar personnel	$1.131.561
4.3	White collar personnel	$97.501
4.4	Equipment	$120.168
4.5	Electricity& water	$90.000
4.6	Maintenaince	$212.804
4.7	Other/ contingency	$330.407
	Subtotal	**$1.982.442**
5	**EBITDA**	**$1.374.146**
5.1	Depreciation	$274.902
6	**EBIT**	**$1.099.244**
6.1	Interest	$223.103
6	**EBT**	**$876.141**
	Tax	$219.035
7	**PAT**	**$657.106**

FIGURE 44: PROFIT & LOSS STATEMENT CROSS-DOCK DJIBOUTI

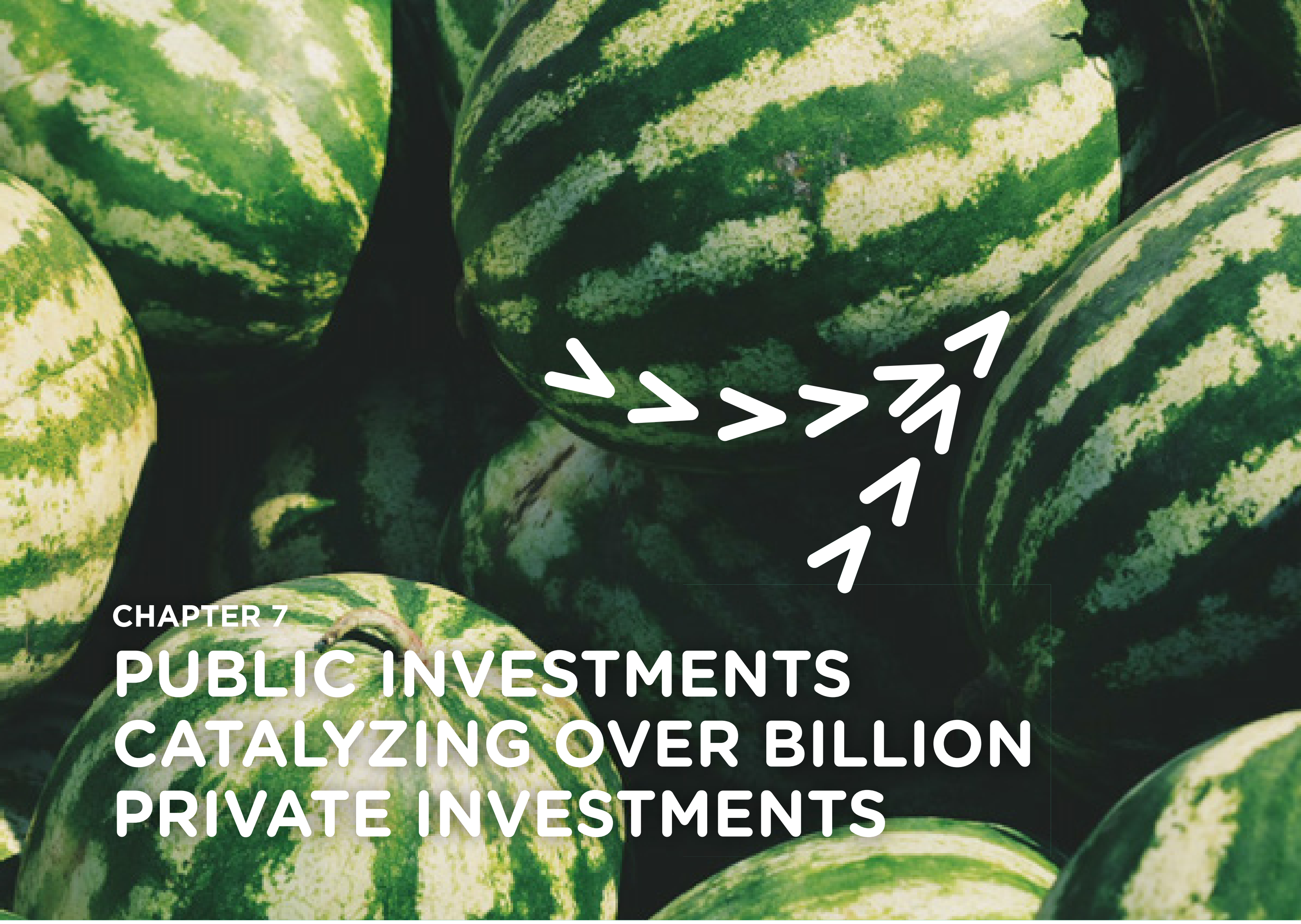
on its Balance Sheet. Additionally, some smaller investments are required to provide trade working capital to run the operations. Below the Balance Sheet statement of an average year at full capacity is depicted, on the left the main assumptions with regard to trade working capital, on the right the asset & liability setup.

The gearing assumed is 50%, 50% of equity is needed to get 50% of debt. In terms of volume the equity investor has to put in around 2.5 million USD and attract 2.5 million USD from banks providing various debt facilities (long-term, working capital, etc.). With a profit after tax of around 0.7 million USD, a return on equity of approximately 25% is possible.

ASSUMPTIONS		
Trade working capital		
Debtor days	8,2%	to sales
Inventory	100.000	Fixed level
Cash	8,2%	to operational costs
Creditor days	8,2%	to operational costs
Gearing		
Debt	50,0%	
Equity	50,0%	

BALANCE SHEET		
1.	**ASSETS**	
1.1	**Fixed assets**	
1.1.1	Building	$4.256.083
1.1.2	Pre-operative expenses	na
Total fixed assets		**$4.256.083**
1.2	**Current assets**	
1.2.1	Debtors	$275.884
1.2.2	Inventory	$100.000
1.2.3	Cash	$162.940
1.2.4	Creditors	$162.940
		$701.765
Total assets		**$4.957.848**
2.	**LIABILITIES**	
2.1	Equity	$2.478.924
2.2	Debt	$2.478.924
Total liabilities		**$4.957.848**

FIGURE 45: BALANCE SHEET STATEMENT CROSS-DOCK DJIBOUTI



CHAPTER 7

PUBLIC INVESTMENTS CATALYZING OVER BILLION PRIVATE INVESTMENTS

7.1 CHICKEN-AND-EGG CONTEXT IN EXPLICIT FORECAST PERIOD

In this pre-feasibility study a total of around 25-40 million investments are identified to make the Addis-Djibouti corridor suitable for transport of perishables. Both for export of fruit & vegetable, meat, flowers, etc. and all kinds of import goods like fish, medicine, etc. In sum, this total investment is spread over three investment components[2]:

1. Cool Rail Ethiopia: 1.0-1.2 million USD
2. Cool Port Addis: 15-25 million USD
3. Cross-dock Djibouti: 7.5-15 million USD

The previous chapters which elaborated on the cool logistics overlay investments along the Addis-Djibouti corridor – Cool Rail Ethiopia, Cool Port Addis and Cross-dock Djibouti – showed that these investments can deliver robust financial ratios. This is in line with examples of similar logistics facilities around the world.

However, the context in Ethiopia is specific in the sense that current seaborne fruit & vegetable volumes, the main product flows the business cases of these cool facilities are built on, are still limited. This has significant implications for the volumes the three cool logistics facilities can count on, in particular the certainty of volumes in the early years of their life cycle, and thus on the risk-return profile for investors.

Ethiopia faces a classic chicken-and-egg challenge in its aim to develop a fruit & vegetable industry with a portfolio of low, medium and high volume products: without these cool facilities, no export parties

[2] Definitive investment amounts depend on the final scope of the investment. Among others groundwork expenditures can vary depending on what work has already been taken care of in earlier stages of the construction process (as being part of the general Modjo and DICT construction process for Cool Port Addis and Cross-dock Djibouti respectively). Normally in a deep-sea port context much of the groundwork has been done by the landlord port already, which is often not the case at hinterland terminals This situation is assumed in the Cool Port Addis and Cross-dock Djibouti investment estimates too.

are probably interested to start production, as logistics will not allow products to reach export markets, while setting up these cool facilities requires base load volume to be profitable from the start.

This is particularly true for Cool Port Addis, as this requiers not only the largest investments, but also the first of investments in the total National Cool Logistics Network development. An investment 'catalysing' other investments along the corridor: without this Cool Port it is unlikely fruit & vegetable cargo flows will be able to make use of the Addis-Djibouti railway line which is required to become competitive at world markets, for the reasons mentioned in paragraph 5.1.

Therefore, we zoom in on the Cool Port Addis facility in this final chapter of the pre-feasibility study, to assess the implications of this chicken-and-egg situation in terms of impact on operational/ financial ratios in the explicit forecast period (10 years) and gain insight on possible (financing) solutions despite the uncertainty of launching customer volume.

The same type of challenges we describe in this chapter with regard to Cool Port Addis will of course be found when elaborating on the explicit forecast periods of Cool Rail Ethiopia and Cross-dock Djibouti too. These investments will also face significant uncertainties about what volumes can be expected in what phase of their life cycles as these cool logistics components also depend on fruit & vegetable volume growth with current volumes still limited.

7.2 VOLUME GROWTH SCENARIOS AND IMPACT ON COOL PORT ADDIS

In this chapter scenario methodology is used to assess the possible outlooks in terms of operational and financial performance of Cool Port Addis in the first ten years of its operation. Compared to normal pre-feasibility practice this is a slightly different approach, normally in 'standard' assessments of new cold stores in mature markets an analysis is made using current volumes (often using database data of current operations), which serves as a firm fundament to forecast future volumes, from which the optimal business model and technical design options are derived.

In the case of Ethiopia this is unfortunately not possible, as current volumes are too low to serve as a reliable indicator for future volume portfolios, because the cool logistics facilities developed will have such an impact on logistics (price, frequency, transit time) that it opens windows of opportunity for several new products to be produced/ exported, which is a necessity for Ethiopia to grow its fruit & vegetable industry.

We have taken great care to make realistic scenarios based on different future Ethiopian contexts Cool Port Addis might have to function in, using all the experience we have with similar types of cool logistics development processes around the world. However, introducing a cool logistics infrastructure will have a major impact on the fruit & vegetable value chain. With such a game changing investment, even scenarios must be interpreted with some caution. Our scenarios primarily help us understand the possible impact on operational and financial ratios based on foreseen fruit & vegetable volumes and likely perishable train developments. The numbers should not be taken too literally.

The following three scenarios are used to gain insight in Cool Port Addis' possible future outlook:

Base case scenario assumes a fresh volume handled by Cool Port Addis within year ten of its being operational of around 187,200 ton equalling around 5 full reefer trains a week to Djibouti, and a volume of around 62,400 ton after five years (1.5 a train). In this scenario agro-logistic developments will follow the time lines of similar global cool logistics practices, but slightly slower given the green-field context in Ethiopia.

The green-field character and current logistics challenges can cause developments to go much slower. This is modelled in the **downside case**. Building up agro production might show to be more difficult (land issues?). Turning Modjo into an efficient rail hinterland hub will take more time and DICT with its on-dock rail terminal will go live much later than expected. In this scenario two full reefer trains per week is the best to be expected within ten years, with a half a train setup no earlier than after five years.

Ethiopia and Djibouti are both investing heavily in infrastructures and removing logistics bottlenecks and have expressed intentions to really prioritize improving logistics chains. This entrepreneurial spirit could mean agro-logistic developments go (much) faster. Such a scenario is modelled in scenario 3: the **development case**. A full reefer train of around 40 containers would be running once a week within three years already, and after realizing this milestone, train frequency will swiftly grow to more trains a week.

DOWNSIDE CASE

	Year											
Volumes& ratios	0	1	2	3	4	5	6	7	8	9	10	Full capacity
Fresh volumes		2.080	4.160	8.320	14.560	20.800	29.120	39.520	52.000	66.560	83.200	187.200
Frozen volumes		150	300	600	1.050	1.500	2.100	2.850	3.750	4.800	6.000	15.000
CFS volumes		2.080	4.160	8.320	14.560	20.800	29.120	39.520	52.000	66.560	83.200	208.000
Av occupancy rate Cool Port		0,9%	1,7%	3,4%	6,0%	8,5%	11,9%	16,2%	21,3%	27,3%	34,1%	85,3%
Cash flow	-23.862.000	-637.768	-563.623	-415.335	-192.902	29.531	326.108	696.830	1.141.695	1.660.705	2.253.860	6.702.518
Cumulative cashflow	-23.862.000	-24.499.768	-25.063.391	-25.478.726	-25.671.628	-25.642.097	-25.315.989	-24.619.159	-23.477.464	-21.816.758	-19.562.898	na

BASE CASE

	Year											
Volumes& ratios	0	1	2	3	4	5	6	7	8	9	10	Full capacity
Fresh volumes		6.240	12.480	20.800	41.600	62.400	83.200	104.000	124.800	166.400	187.200	187.200
Frozen volumes		450	900	1.500	3.000	4.500	6.000	7.500	9.000	12.000	15.000	15.000
CFS volumes		6.240	12.480	20.800	41.600	62.400	83.200	104.000	124.800	166.400	208.000	208.000
Av occupancy rate Cool Port		2,6%	5,1%	8,5%	17,1%	25,6%	34,1%	42,6%	51,2%	68,2%	85,3%	85,3%
Cash flow	-23.862.000	-489.479	-267.046	29.531	770.974	1.512.417	2.253.860	2.995.303	2.995.303	5.219.632	6.702.518	6.702.518
Cumulative cashflow	-23.862.000	-24.351.479	-24.618.525	-24.588.994	-23.818.020	-22.305.604	-20.051.744	-17.056.441	-14.061.138	-8.841.507	-2.138.989	na

DEVELOPMENT CASE

	Year											
Volumes& ratios		1	2	3	4	5	6	7	8	9	10	Full capacity
Fresh volumes		6.240	20.800	41.600	83.200	104.000	124.800	145.600	166.400	187.200	187.200	187.200
Frozen volumes		450	1.500	3.000	6.000	7.500	9.000	10.500	12.000	15.000	15.000	15.000
CFS volumes		6.240	20.800	41.600	83.200	104.000	124.800	145.600	166.400	208.000	208.000	208.000
Av occupancy rate Cool Port		2,6%	8,5%	17,1%	34,1%	42,6%	51,2%	59,7%	68,2%	85,3%	85,3%	85,3%
Cash flow	-23.862.000	-489.479	29.531	770.974	2.253.860	2.995.303	3.736.746	4.478.189	5.219.632	6.702.518	6.702.518	6.702.518
Cumulative cashflow	-23.862.000	-24.351.479	-24.321.948	-23.550.974	-21.297.114	-18.301.812	-14.565.066	-10.086.877	-4.867.246	1.835.272	8.537.790	na

FIGURE 46: COOL PORT ADDIS SCENARIOS DURING ITS FIRST 10 YEARS OF OPERATION

In figure 46 the above-mentioned scenarios are translated into throughput volumes for the fresh, frozen and CFS capacity of Cool Port Addis given an assumed train frequency as indicated before. On the right, the full capacity scenario as described in chapter 5 is depicted for easy comparing purposes. At full capacity means an average occupancy rate of around 80-90%, as 100% is not possible in practice as operations need some slack to function well. In this full capacity scenario, Cool Port Addis delivers a return on equity of above 20% and a debt service coverage ratio of above 4 which make it likely to qualify for all kinds of commercial funding, both equity and debt.

The first three lines show the assumed fresh, frozen and CFS volumes. Fresh and CFS volumes are closely connected. When no fruit & vegetable volume is exported via Djibouti no containers need cross-docking in Djibouti or unpacking in the CFS part of the facility. The last item line shows the average occupancy rate at a certain moment during the specific period which is an average of the occupancy rates of the fresh, frozen and CFS capacity.

For all three scenarios, we have calculated EBITDAs in each year to gain insight in cash generation which could be used to service finance, either equity or debt. Other cash generation elements (e.g. working capital) are relatively limited, making EBITDA the most reliable indicator.

In figure 47 a summary is depicted of cash generation in all three scenarios: downside, base and development case. Each depiction contains two elements: the cash flow in a year and the cumulative cash flow at a certain moment within the explicit

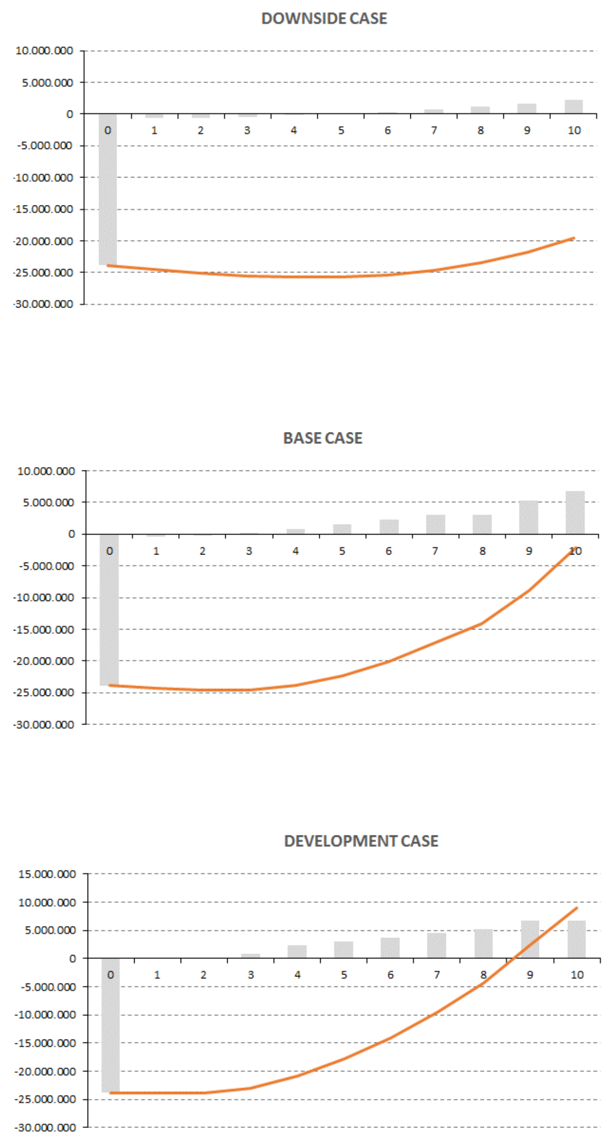


FIGURE 47: SCENARIOS: IMPACT COOL PORT ADDIS ON CUMULATIVE EBITDA

forecast period. All three scenarios have a significant cash out at the start because of the investment in the building (USD 24 million) which in principle must be earned back in the years afterwards.
In the base case scenario, the first positive EBITDA is expected in year three, after two years of limited volumes causing negative EBITDAs. EBITDA in year ten will be above 6 million USD per year, but cumulative cash flow will still be negative as EBITDA in the first ten years is not enough to earn back the investment.

Self-evidently the situation in the downside case is worse. The first positive EBITDA is expected no earlier than year five, in year ten EBITDA has grown to more than 2 million USD. The cumulative cash flow after the explicit forecast period shows that only a small part of the investment will have been earned back by then. In the years after this a positive cash flows will lead to further recovering of course.

The development case has positive EBITDAs already, almost right from the start. Only year one leads to a negative operational cash flow. In year five EBITDA would be 3 million USD already, while year ten shows an operational cash flow of almost 7 million USD. The cumulative cash flow should turn positive in year nine.

7.3 PUBLIC INVESTMENT TO UNLOCK FRUIT & VEGETABLE INDUSTRY

Chapter five showed that Cool Port Addis functioning at full capacity (85% occupancy rate) delivers decent return on equity (>20%) and debt service coverage ratios (>4) to qualify for commercial funding. However, the scenarios run in this chapter for the ten-year explicit forecast period showed that uncertainty of volumes in this period will make it impossible to do so right from the start. Despite the inevitable underutilization in the first years of its operation Cool Port Addis is still an investment worth making.

First and foremost, without these types of cool facilities it will be far more difficult or even impossible for Ethiopia to become a significant fruit & vegetable producer and exporter. This is particularly true for the production regions far away from export ports, of which Ethiopia has many. A fruit & vegetable industry, when managed to be setup in the years to come, would have a large impact on Ethiopia in many ways (for details see chapter two):

- Low-carbon logistical network for perishables saving between 70-80% on CO_2 emissions
- Create between two and four million jobs in the fruit & vegetable industry
- Generate a forex income of up to 3 billion USD per year
- Drastically improve availability of fruits & vegetables to vulnerable populations
- Etc.

Considering the multi-billion investments already made in basic infrastructure such as rail, road, and energy, Cool Port Addis requires a relatively modest one-off nvestment of 20 to 25 million USD while generating the impact in terms of jobs, forex, etc. for which these far bigger investments have been done in the first place. The small cool logistic investment stands on the shoulders of these basic infrastructure investments and realises part of the potential created by the National Railway Network, the Renaissance Dam and the many new high-ways.

The Cool Port Modjo case is very similar to Bahir Dar airport which served as catalyst for the development of the production region surrounding it. This facility did not process much volume in its first years, but was the only reason horticultural investors considered investing in this part of the country after all (despite its favourable climatic conditions, without logistics it is impossible to reach markets). With Cool Port at a central location like Modjo it is very likely volumes here will pick-up earlier than at a more remote location like Bahir Dar, while the portfolio of functionalities (frozen imports and container freight station as well) will help with getting volume sooner.

Nevertheless, the investment in Cool Port Addis must be backed by concessional finance. From a certain perspective, this does not come as a surprise, the same is true for the 150 million USD of investment in basic infrastructure at Modjo. The refurbishment is financed by the World Bank (instead of IFC) with far softer conditions in terms of grace period and interest rates than conditions offered by normal commercial banks. This can be considered a grant like financier when inflation is considered.

The developmental impact in the form of job creation, forex generation and security of nutritious food qualifies Cool Port Addis for concessional finance instruments. Many donor countries already active in Ethiopia are aiming for developmental impact. They will most likely be interested in getting involved in the implementation of a National Cool Logistics Network of which Cool Port Addis would be the first stepping stone. Additionally, The Netherlands offers grant like financial instruments that can be used when certain conditions are met.

Concessional finance constructions will often require co-finance from the Ethiopian side. The

Ethiopian government has demonstrated its entrepreneurial mentality at many occasions in the past, e.g. Ethiopian Airlines, National Railway Network, Hydropower generation, Flower Industry. Ethiopia has delivered impressive results with many of these developments. Unlocking the Ethiopian fruit & vegetable industry's full potential requires a similar spirit. In this cased investment needs are relatively modest, as has been shown in this feasibility study.

The first investment of a series is usually the most difficult one. The case in the built up of the National Cool Logistics Network in Ethiopia is no exception. Cool Port Addis investments are to be done in a context in which Cool Rail Ethiopia is in the process of becoming an efficient train connection for perishable goods between Addis and Djibouti, and most likely Cross-dock Djibouti is not yet there. For many reasons the following investments in setting up a Cool Logistics Network have a bigger chance to qualify for private investments:

- Fruit & vegetable production will already have picked up within the Great Lake Corridor
- Trains from other production regions will be able to tap into Addis-Djibouti trains via double hub systems
- Cross-dock Djibouti will be operationally integrated into the new deep-sea/ rail terminal
- Proof of concept will have been provided along the Addis-Djibouti corridor
- Etc.

These changes of context and investment climate all more or less depend on Addis-Djibouti cool logistics solutions, which is up for decision-making now in order to unleash Ethiopian fruit & vegetable industry. Making the upcoming investments in Cool Port Addis public would open up a window of opportunity for all kinds of other (private) investments all along the fruit & vegetable value chain in the years to come: in agro-production, in (cool) logistics, in value addition industries, and so on. First high-level estimates would at least result in:

- 1.5-3 billion USD of investments in agro-production[3]
- 300-400 million USD of investments in cold storage and consolidation centres[4]
- 50-100 million USD of investments in trucks, containers, reefer plugs[5]

The Netherlands is, as stated already in our earlier Proposal to Co-operate, happy to partner with Ethiopia and Djibouti on the development of the fruit & vegetable industry and the National Cool Logistics Network as supporting infrastructure. In our partnership we will bring part of the required project development funding in order to get relevant projects started. We are willing to push for concessional finance instruments to do the actual investments.

But above all, as the number one fruit & vegetable trader around the world with a state-of-the-art cool logistic network ourselves, we bring our knowledge, experience and our network to help bring about the huge potential success for the Ethiopian fruit & vegetable industry.

The Flying Swans Consortium, representing the Dutch horticulture and logistics industry and supported by the Dutch government, is committed to the implementation of projects along the entire value chain to get the Ethiopian fruit & vegetable export industry to the next level. The consortium, through its parties, has access to a wide range of Dutch producers, traders, engineers and contractors. The Netherlands is committed to unlock Ethiopia's horticultural potential and is ready to do business.

[3] Assumption: 3,000,000 ton, average production per ha (10 ton), average investment per ha (5-10k)

[4] Assumption: 3,000,000 ton, average Cool Port volume (200,000 ton) and average investment (20-25 million) and one Cross-dock in Djibouti (10 million)

[5] Assumption: 3,000,000 ton, average ton per container (20), average number of truck trips per day (2), average investment (100k)

The Flying Swans Consortium consists of the following partners:

The Netherlands has an export value of 9.6 billion EUR to 152 countries and an import value of 6.0 billion EUR from 120 different countries. **Fresh Produce Centre**, the branch organization of Fresh Produce in the Netherlands, represents 80% of this value. By joining the Flying Swans Consortium Fresh Produce Centre stimulates the opening of new markets.

Port of Rotterdam is the largest port in Europe with almost 470 million ton of total throughput and 13.7 million TEU containers. It is the world's leading port for perishables. Its objective is to continuously enhance its competitive position. The port is leading transitions to make supply chains more efficient and sustainable and is actively sharing its expertise and network with other ports across the globe and in emerging economies in particular.

Boskalis is a leading global contractor and service provider operating in the dredging, infrastructure, maritime and offshore sectors. With a versatile fleet of more than 900 vessels and 10,700 employees, Boskalis operates in 90 countries across six continents.

Mercator Novus is a project development advisory firm specialised in cool logistics facilities active around the world. They have a track record of projects in ports, hinterland terminals and intermodal connections.

The Flying Swans consortium is supported by the **Dutch government** with 8.5 million EUR for the development of fruit & vegetable supply chains strategic corridors. The Ethiopia-Djibouti corridor is designated a top priority for the Flying Swans strategic agenda.