



Kingdom of the Netherlands
Holland Innovation Network

Digital Port Innovations in Taiwan: Opportunities for knowledge intensive cooperation

*An overview of developments and challenges for
Taiwanese ports and possible digital solutions*





Abstract

Digital technologies have already shaped our lives and are only expected to transform our society and economy even further. The digital transformation of the logistic and transport industry is quickly picking up speed. Ports around the world have recognized the potential of these new digital innovations and are aiming to stay ahead.

Taiwan is the 22nd largest economy of the world and similar to the Netherlands in terms of land area and population. The biggest port of Taiwan, the port of Kaohsiung, was once one of the top five seaports in the world but gradually lost its top position due to intensive competition from ports in the region, currently the port of Kaohsiung occupies the 13th position.

Ports in Taiwan are still facing intensive competition from other ports in the region and have been developing and implementing digital solutions to enhance their operational efficiency and thereby raising the competitiveness of their ports. These digital projects are aimed to not only raise the competitiveness but also to improve the safety and sustainability of the port. Various projects such as monitoring and optimizing the vessel movement in the port, linking digital systems and sharing data and installing smart sensors are planned in order to address the aforementioned challenges.

This research will shed a light on the digital developments in the port sector in Taiwan. The report will first give a brief overview of the economy of Taiwan, general information on the port sector and the characteristics of the different ports in Taiwan. This will be followed by a chapter on the challenges ports in Taiwan are facing and the digital projects to come up with solutions for these challenges.



Index

Abstract.....	2
Chapter 1 – Introduction and Scope.....	4
1.1 <i>Introduction to digital Port Innovation</i>	4
1.2 <i>Scope of the research</i>	5
1.3 <i>Acknowledgements</i>	5
Chapter 2 – Port Sector in Taiwan.....	6
2.1 <i>Introduction to the economy of Taiwan</i>	6
2.2 <i>A glance at the port sector in Taiwan</i>	6
2.3 <i>Ports of Taiwan</i>	8
2.4 <i>Institutional context</i>	11
Chapter 3 – Challenges, developments and opportunities in the port sector in Taiwan and need for digital solutions	12
3.1 <i>Challenges and developments in Taiwanese port sector in recent years</i>	12
3.2 <i>Smartport plan</i>	13
3.3 <i>New projects as opportunities for mutual cooperation</i>	14
3.4 <i>Contact us</i>	15



Chapter 1 – Introduction and Scope

1.1 Introduction to digital Port Innovation

New digital technologies such as internet of things, artificial intelligence, virtual reality and blockchain are the talk of the town and are expected to shape our near future.

Digitization transforms the global economy and society as we know them in rapid fashion. According to the Organisation for Economic Co-operation and Development (OECD), this digital transformation is only expected to further expand and deepen¹. As this digital transformation disrupts society ever more profoundly, being well prepared is not a luxury but a necessity. Take for example the smartphone which was introduced just over a decade ago but is already playing an essential and indispensable role in our modern lives.

The Dutch government perceives the ongoing digital transformation not as a threat, but as an opportunity. In close cooperation with the Ministry of Justice and Security and the Ministry of Interior and Kingdom Relations, the Ministry of Economic Affairs and Climate Policy formulated the *Nederlandse Digitaliseringsstrategie*; a digital strategy aiming to make the Netherlands the digital leader in Europe². To achieve this ambitious goal, companies, consumers and government agencies need to accelerate their digitization process and embrace innovation.

The coalition agreement already formulated the ambition of the Dutch government to invest in research and innovation. Furthermore it underlined that the Netherlands has the capacity to find the best solutions for digitization and globalization. The Netherlands is indeed in a good position to reap the benefits of this digital transformation. The existing digital infrastructure is topnotch, the labor force is well educated and there is a tradition of strong cooperation between government, companies and knowledge institutions.

The Dutch government stresses the importance of dialogue and international cooperation in an increasingly fast changing environment³. As these digital developments are not bound by geographical boundaries, other countries are facing the same questions posed by these developments

The Innovatie Attache Netwerk (IA-Netwerk) puts this in practice as it aims to enhance the capacity of the Netherlands to innovate by facilitating international knowledge intensive cooperation. The IA-Netwerk in Taiwan facilitates knowledge intensive cooperation between the Netherlands and Taiwan. Moreover it provides information and assistance to the private sector, research institutions, universities and the Dutch government by closely monitoring developments in science, technology and innovation in Taiwan. Also it focuses on Taiwan's most promising and innovative sectors including photonics, internet of things, energy and cybersecurity. These sectors are linked to the topsector High Tech Systems and Materials (HTSM) and the topsector Energy.

Back to the potential disruptiveness of these new digital innovations: Booking.com has transformed the hotel industry, Uber is changing the taxi market. Another good example of the disruptive ambitions of

¹ Key Issues for digital transformation in the G20, OECD, 2017 see <https://www.oecd.org/g20/policy-recommendations-for-digital-transformation-in-the-G20.pdf>

² Kamerbrief Nederlandse digitaliseringsstrategie, 15 June 2018 see <https://www.rijksoverheid.nl/documenten/kamerstukken/2018/06/15/kamerbrief-over-nederlandse-digitaliseringsstrategie>

³ Nederlandse digitaliseringsstrategie, *Hier kan het. Hier gebeurt het.*, page 13, 2018, (in Dutch only) <https://www.rijksoverheid.nl/documenten/rapporten/2018/06/01/nederlandse-digitaliseringsstrategie>



these new tech giants is a service launched earlier this year by Amazon to disrupt the shipping industry⁴. This is a delivery service which puts the tech giant in direct competition with big shipping companies.

Port authorities around the world have recognized the potential disruptiveness of these new digital innovations and are aiming to stay ahead. Ports in the Netherlands have stated their ambition to become smart ports. The Port of Rotterdam is even aiming to become the smartest port in the world. The IA-Netwerk has recognized these developments and is eager to explore opportunities for the Taiwanese and Dutch ports to leverage each other's strengths.

This research will shed a light on the developments in the port sector in Taiwan. In addition this report will generate an overview of new digital projects in the ports of Taiwan which could be an opportunity for Dutch organizations to start cooperation.

1.2 Scope of the research

Ports around the globe are facing similar challenges such as increased competition between ports, safety demands and the need to meet the sustainability goals. They have turned to digital tools as a mean to provide solutions for the challenges they are facing and to improve their operations.

Disclaimer

Digitisation will shape the society of the future. For the logistic and transport industry it is seen as promising mean to work more effectively, efficiently and safely. In this research we have therefore limited the scope to digital port innovations. Other opportunities in the port sector such as the offshore windenergy opportunities in Taiwan are therefore outside the scope of this research.

In this research we will identify the challenges and latest developments for Taiwanese ports, the possible digital solution they are looking at to resolve these challenges and outline possibilities for the Dutch and Taiwanese to cooperate. In doing so we are focusing on the way Taiwanese ports are looking at digital innovations to improve the operations of their port in order to cope with the challenges they are facing.

1.3 Acknowledgements

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⁴ Amazon Launches Service to Disrupt Shipping Industry, 13 February 2018, see <https://www.porttechnology.org/news/amazon-launches-service-to-disrupt-shipping-industry>



Chapter 2 – Port Sector in Taiwan

2.1 Introduction to the economy of Taiwan

Ties between the Netherlands and Taiwan can be traced back to almost four centuries ago to the year 1624 when the Dutch constructed Fort Zeelandia in Anping (now part of Tainan city) and started trading with surrounding aboriginal tribes⁵. The period of Dutch rule was brief though as in 1662 the Chinese military leader Zheng Chenggon (Koxinga) sieged the fort and forced the Dutch to surrender and leave Taiwan. The first contact started with the incoming sailing ships and even to this day sea trade is still a vital part of the Taiwanese economy.

In more recent years Taiwan has undergone a successful and impressive transformation from a manufacturing driven economy to a developed ICT hub. In 2001 Taiwan became a member of the World Trade Organization and by now it is the world's leading supplier of computer chips, responsible for the production of about 73% of the world's computer chips⁶. Even size-wise Taiwan and the Netherlands are comparable; Taiwan has a slightly smaller land size than the Netherlands but has with 23.5 million inhabitants a larger population.

As an open economy, Taiwan lays great importance on its strong ties with the international business community and welcomes international trade. For example, around 40% of all consumer products are being imported. Moreover, Taiwan receives high rankings from the World Bank for its 'Ease of Doing Business' thanks to its strong legal environment with protection of intellectual property rights, high educated human capital and good business facilities⁷. Taiwan is ranked 13th in the global competitive index, with an average annual GDP growth of 2.6% in the last ten years⁸.

Taipei, Kaohsiung and Taichung are the three main cities of Taiwan. Taipei is the capital and main commercial, political and cultural centre, located in the north of Taiwan. Taichung is located in the middle of Taiwan and is mainly known as the bicycle capital. Kaohsiung, in the south of the country, has the biggest port with nearby heavy industry such as the steel, petrochemical and shipbuilding industry.

2.2 A glance at the port sector in Taiwan

As mentioned, Taiwan is out looking and export-oriented, import and export accounts for around 40% of the GDP of Taiwan⁹. Being an island, Taiwan relies on international transportation through its ports as 99% percent of the total trade volume is transported by sea, according to the Maritime and Port Bureau¹⁰. Others have stated slightly lower figures, nonetheless foreign trade is key for Taiwan's economic development and the majority of foreign trade is done via shipping¹¹. The ports in Taiwan profit from their favourable geographical location, as Taiwan is located between Hong Kong, China, Japan and Korea. Due

⁵ Taiwan Today, In the days of the Dutch, <https://taiwantoday.tw/news.php?unit=20,20,29,35,35,45&post=25894>

⁶ See <https://www.moeasmea.gov.tw/ct.asp?xItem=15551&ctNode=724&mp=1>

⁷ Global Competitiveness Index 4.0 2018 edition, Country Report Taiwan, http://reports.weforum.org/pdf/gci4-2018/WEF_GCI4_2018_Profile_TWN.pdf

⁸ The Global Competitiveness Index 4.0 see <http://reports.weforum.org/global-competitiveness-report-2018/competitiveness-rankings/>

⁹ Tseng, Po-Hsing, and Nick Pilcher. "Port governance in Taiwan: How hypocrisy helps meet aspirations of change." *Research in Transportation Business & Management* 22, 2017: 38-48

¹⁰ Maritime and Port Bureau, 2015, Annual Report 2015 MTB

¹¹ Tsai, Jiun-Yan, et al. "Use of a Hybrid MDCM method to evaluate key solutions influencing service quality at a port logistic center in Taiwan." *Brodogradnja: Teorija i praksa brodogradnje i pomorske tehnike* 69.1, 2018: 89-105



to its strategic location, Taiwan has become a transit center for distant and near-sea maritime transport in East Asia for the last decades. Taiwan sits at the hub of trade routes linking north east Asia, south east Asia, and China¹².

Taiwan is home to seven international ports with a total yearly container capacity of approximately 15 million TEU (twenty-foot equivalent units)¹³. See table 1 for an overview of the container throughput for ports in Taiwan in 2017. Kaohsiung, Keelung, Taichung, Taipei and Hualien are the main international ports of Taiwan. There are a number of smaller ports that also operate internationally such as the port of Anping (which serves as an auxiliary to the port of Kaohsiung) and Suao (which serves as an auxiliary to the port of Keelung). Next to these international ports there are various domestic ports such as the port of Penghu and the port of Xing-da.

TABLE 1 CONTAINER THROUGHPUT FOR TAIWAN IN 2017

PORT	CONTAINER THROUGHPUT
KAOHSIUNG	10.27 MILLION TEU
TAICHUNG	1.66 MILLION TEU
TAIPEI	1.56 MILLION TEU
KEELUNG	1.42 MILLION TEU
TOTAL	14.91MILLION TEU

The port of Kaohsiung is called the gateway of Taiwan and handles around two third of all container throughput for Taiwan¹⁴. Kaohsiung is playing an important role in Taiwan's economy as a supporting point of import and export of commodities and industrial production. The port of Kaohsiung is currently ranked as the world's 13th largest port in terms of the amount of container throughput¹⁵. Coal, oil, iron-ore, gravel, iron and crude oil account for the largest shares of general cargo for ports in Taiwan.

Since the beginning of the 2000's, and still, ports in Taiwan have faced severe competition from ports in China, (northeast Asia, and southeast Asia). Ports such as the port of Shanghai have shown remarkable growth figures which have led to a declined market share for the ports in Taiwan, see Table 2¹⁶. While still facing severe competition from ports within the region, Ports in Taiwan have slowly bounced back after the global crisis. The container volume at Kaohsiung Port has step by step increased from 8.58 million TEU in 2009 to 10.27 million TEU in 2017¹⁷. This relative moderate pace of growth is a result of the slowing domestic demand, intense competition from other ports in the region and lower operational efficiency and thus competitiveness of the ports in Taiwan¹⁸. In order to improve the operational efficiency and overall competitiveness of the ports in Taiwan a reorganization started in 2012 and led to the establishment of the Taiwanese International Ports Corporation (TIPC)¹⁹.

At present, ports in Taiwan are actively looking to optimize their operations and to improve their efficiency and safety. They are doing so by upgrading their physical infrastructure, which is being

¹² Taiwan's Ports Linking Asia to the World, TIPC 2018 see

<https://www.twport.com.tw/Upload/A/RelFile/CustomPage/1/b8181d54-8fbd-4197-ab6d-ae9402d80050.pdf>

¹³ ANNUAL STATISTICAL REPORT Taiwan International Ports Corporation Year 2017

¹⁴ Taiwan's Port Linking Asia to the World, TIPC 2018

¹⁵ TOP 50 WORLD CONTAINER PORTS, World Shipping Council, 2018 see <http://www.worldshipping.org/about-the-industry/global-trade/top-50-world-container-ports>

¹⁶ Tsai, Jiun-Yan et al, 2018

¹⁷ Su, Dong-Taur, Cheng-Hsien Hsieh, and Hui-Huang Tai. "Container hub-port vulnerability: Hong Kong, Kaohsiung and Xiamen." *Journal of Marine Engineering & Technology* 15.1 , 2016, 19-30

¹⁸ Idem

¹⁹ Idem



invested in. Furthermore, they are actively looking for ways to improve their operational efficiency by upgrading their digital infrastructure. As ports in the Netherlands are leading the way regarding the digital innovations there is potential for cooperation. The following paragraph will provide an overview of the different ports and their main characteristics.

2.3 Ports of Taiwan

See the figure below for an overview of the ports of Taiwan.



Figure 1 Ports of Taiwan (source: compiled from TIPC)²⁰

²⁰ Ports of Taiwan, Image owned by TIPC, see <https://www.twport.com.tw/en/cp.aspx?n=87000105717E0CCB>



Port of Kaohsiung

In the 1980's and the 1990's, the port of Kaohsiung was one of the five biggest seaports of the world²¹. Mainly due to the favorable geographical location and excellent container handling facilities the port of Kaohsiung positioned itself as a transshipment port between the west coast of north America and south east Asia. By the turn of the millennium the ranking of the port of Kaohsiung began to decline, leading to an exit from the top ten by 2008²². This relative decline is mainly caused by the tremendous growth of competing ports in the region such as Shanghai²³. Other factors have been the relocation of industries and a sharp decline in global demand after the financial crisis of 2007-2008.

Table 2: Market share of Kaohsiung, Singapore, Hong Kong and Shanghai, Containerized Traffic (1990-2010)

	1990	2000	2010
Singapore	21.9%	26.1%	14.9%
Hong Kong	21.3%	27.8%	12.4%
Kaohsiung	14.6%	11.4%	4.8%
Shanghai	1.9%	8.6%	15.2%

Source: Compiled from Madani 2018

Kaohsiung has been and still is playing an important role in Taiwan's economy as a supporting point of import and export of commodities and industrial production. The port of Kaohsiung is currently ranked as the world's 13th largest port in terms of the amount of container throughput and 15th for cargo handling capacity²⁴. Port of Kaohsiung is an import transit point for maritime transport between Asia, Europe and America and has more than three hundred routes spreading over five continents²⁵. Port of Kaohsiung has an annual volume of more than 10 million TEU. Bulk cargo handled is mainly iron ore, oil, pig iron, crude oil and coal-based materials. Kaohsiung is the industrial heart of Taiwan and the port is in close proximity to steel manufacturing, shipbuilding, petrochemical, and many other industries. China Steel Corporation and China Shipbuilding Corporation, CPC Corporation and CSBC Corporation are a few of the big companies located in Kaohsiung.

To accommodate the new generation of huge container vessels, and remain competitive, TIPC has been investing and developing a new terminal which is scheduled to be operational by 2022.

This new terminal (terminal 7) is 2415 meter in length with 18 m draught, can handle up to 4 million TEU per year and can accommodate five 22,000 TEU large container vessels simultaneously. It will be operated by Evergreen who recently signed the lease contract. The first phase of the project (two and a half berth) will be completed in 2022 and the second phase of the project in 2023²⁶. Evergreen is already the biggest container shipping client in Kaohsiung, accounting for more than 35% of the ports total handled container volume for 2017 (more than 3.6 million TEU)²⁷.

²¹ Yap, Wei Yim, Jasmine SL Lam, and Theo Notteboom. "Developments in container port competition in East Asia." *Transport Reviews* 26.2, 2006: 167-188

²² Madani, Shiva. "Global seaport competitiveness: a resource management perspective." 2018

²³ Idem

²⁴ TOP 50 WORLD CONTAINER PORTS, World Shipping Council, 2018 see <http://www.worldshipping.org/about-the-industry/global-trade/top-50-world-container-ports> & Interview with Port of Kaohsiung, Taiwan, about ECOPORTS Certification (Chinese) <https://www.ecoslc.eu/news/interview-with-port-of-kaohsiung-taiwan-about-ecoports-certification-1>

²⁵ Taiwan's Ports Linking Asia to the World, TIPC, 2018

²⁶ Evergreen leases 7th terminal in Kaohsiung to cater to ultra-large containerships see <http://www.seatrade-maritime.com/news/asia/evergreen-leases-7th-terminal-in-kaohsiung-to-cater-to-ultra-large-containerships.html>

²⁷ Evergreen Marine Expands Port of Kaohsiung Operations with New Lease Agreement at the Port's 7th Container Terminal, 2018 see: https://kh.twport.com.tw/en/News_Content.aspx?s=F918AE6AE34350A1&SMSU=7886AF6A805074BD



Port of Taichung

Port of Taichung is located on the west coast of central Taiwan, 110 nautical miles to port of Keelung in the North and 120 nautical miles to port of Kaohsiung in the south²⁸. Port of Taichung is the second biggest port of Taiwan, handling over 1.66 million TEUs in 2017 (11.13% of total for Taiwan)²⁹. Next to this, the port of Taichung handled 36.40% (70.23 million revenue tons) of general cargo for Taiwan. Port of Taichung is a port for international cruise ships and cross-strait ferries. Other services of the port of Taichung include large scale bulk cargo shipping and storage, near-sea container shipping port and serving as a cargo vessel berthing port. Main commodities in the port of Taichung are coal, oil, iron ore, natural gas and cement.

A fairly new function of the port of Taichung is the service to support offshore-wind farm construction work. As a large percentage of the designed areas for offshore wind farms are located nearby off the coast of Taichung. With its close proximity, deep water access, ability to accommodate large commercial vessels, the availability of adequate warehouse facilities, good hinterland connections, and the excellent handling and operation facilities, port of Taichung is the optimal port to support offshore windfarm construction work³⁰. In order to accommodate the needs for the construction of offshore wind infrastructure the port has constructed and modified different piers. Port of Taichung also reserved eighty hectares of land aiming to attract domestic and foreign offshore wind companies.

Port of Keelung

Port of Keelung is located in the north of Taiwan, and is an important hub for the tourist cruise ship industry. Easily reached by public transport from Taipei and located at the heart of the city of Keelung, the port is favored by international cruise ships. Next to the passenger services the port of Keelung is providing cargo services including international containers, cross-strait passengers and freight transport, intra-Asia container services and container storage. The port of Keelung accounted for 9.53% of the container throughput for Taiwan (1.42 million TEUs)³¹, products mainly include gravel, oil, cement, steel hardware and cars³². Port of Keelung handled 4.73% (9.14 million revenue tons) of general cargo for Taiwan.

Port of Taipei

Port of Taipei, while traditionally being an auxiliary port to port of Keelung, has been steadily growing in most recent years and now serves as a new base for container distribution in the northern part of Taiwan. The port of Taipei is an important hub for the automobile logistics centers and chemical oil products. Port of Taipei handled 10.46% (1.56 million TEUs) of all container throughput for Taiwan in 2017³³. Port of Taipei handled 8.46% (16.33 million revenue tons) of general cargo for Taiwan.

²⁸ Lu, Chin-Shan, Chi-Chang Lin, and Mei-Hui Lee. "An evaluation of container development strategies in the port of Taichung." *The Asian Journal of Shipping and Logistics* 26.1, 2010: 93-118

²⁹ Annual Statistical report Taiwan International Ports Corporation Year 2017

³⁰ Port of Taichung Set to Support Major Expansion of Offshore Wind Farms, TIPC, 2017 see https://www.twport.com.tw/en/News_Content.aspx?n=8D3BBBAE4914D793&cs=5B14BFD6FE401FEA&SMSU=E8F028695151BA82&ishistory=True

³¹ Annual Statistical report Taiwan International Ports Corporation Year 2017

³² Taiwan's Ports Linking Asia to the World, TIPC, 2018

³³ Annual Statistical report Taiwan International Ports Corporation Year 2017



Port of Suao

Port of Suao is situated in the Suao Bay in the northeast of Taiwan and, as the port of Taipei, serves as an auxiliary to port of Keelung. Coal, fuel, slag, steel billets cement and paraxylene acid are the main commodities being traded in the port of Suao³⁴. Plans are drawn to turn the Port of Suao into a new tourism attraction by further developing the waterfront.

Port of Anping

Port of Anping is located nearby the city of Tainan, serving as an auxiliary port to the port of Kaohsiung. Port of Anping was Taiwan's largest commercial port before the 20th century, but the port lost its market share due to limited vessel access³⁵. Plans and investments are made to revive the port of Anping in order to turn it into a multifunctional port including tourism and commercial services.

Port of Hualien

Port of Hualien is the only international commercial port in the east coast of Taiwan. The cargo of this port is mainly cement, gravel, wood panels, ore, and coal-based products. Port of Hualien handled 4.58% (8.83 million revenue tons) of general cargo for Taiwan³⁶. In most recent years the port authority has focused on the development of the tourism industry at this port. By investing in a passenger transport wharf and tourist service center, improving port waterfront facilities, and promoting to attract cruises and yachts, the port of Hualien plans to become a tourist attraction.

2.4 Institutional context

In 2012, the Ministry of Transportation and Communications reorganized the operations of the four harbor bureaus at Keelung, Taichung, Kaohsiung and Hualien with the aim to enhance the performance and competitiveness of ports in Taiwan³⁷. The reform was based on the need to create a separation between the role of public authority and the role of business management. It was also felt that, under the previous organizational structure, port development was restricted by the complexity of the regulatory environment³⁸.

As previously the ports have been managed by four units, this reorganization reduced the number to two: the Maritime and Port Bureau (MPB) and Taiwan International Ports Corporation (TIPC)³⁹. The MPB and TIPC are both reporting to the ministry of Transportation and Communication.

MPB is a governmental organization and is in charge of maritime and port-related public administration. Other functions of the MPB include drafting of legislation, administration policies and supervision of the shipping industry.

³⁴ TIPC, About Suao, see https://kl.twport.com.tw/su_en/cp.aspx?n=0FDD04E7796A440D

³⁵ TIPC, About Anping, see <https://www.twport.com.tw/Upload/A/RelFile/CustomPage/1/a87740c8-c670-4573-9a9d-c5f31c820d0b.pdf>

³⁶ Annual Statistical Report Taiwan International Ports Corporation Year 2017

³⁷ Brooks, Mary R., Kevin PB Cullinane, and Athanasios A. Pallis. "Revisiting port governance and port reform: A multi-country examination." *Research in Transportation Business & Management* 22 2017: 1-10

³⁸ Po-Hsing Tseng a, Nick Pilcher, 2016. Po-Hsing Tseng a,*, Nick Pilcher, Port governance in Taiwan: How hypocrisy helps meet aspirations of change, 2016

³⁹ Po-Hsing Tseng a, Nick Pilcher, 2016.



Taiwan International Ports Corporation (TIPC) is a state-owned enterprise and in charge of business management and development of the seven international (Kaohsiung, Keelung, Taichung, Hualien, Taipei, Suao, and Anping) and two domestic (Budai and Penghu) ports⁴⁰. Taiwanese port authorities have, in the last decades, operated terminals in their own ports⁴¹. Next to being a port authority, TIPC operates and manages some of the terminals in their ports. For example, TIPC manages and operates eight of a total of fifteen terminals in the port of Keelung⁴².

Chapter 3 – Challenges, developments and opportunities in the port sector in Taiwan and need for digital solutions

This chapter will briefly describe the recent developments and challenges for ports in Taiwan. Followed by a chapter on the aim of ports in Taiwan to become a smart port and to use digital innovations to solve the ongoing challenges they are facing.

3.1 Challenges and developments in Taiwanese port sector in recent years

Since the turn of the century ports in Taiwan have gradually lost a part of their market share due to increasing competition from ports in the region, diminishing cargo sources from Taiwan and inflexible responses from the port authority to market changes. For example, the port of Kaohsiung lost its position as one of the top ten container ports in the world in 2008.

The port reform in 2012 aimed to reverse this downwards trend, caused by the intensive competition with regional ports. The main goal of the strategy of TIPC has therefore been to enhance the competitiveness of its ports. Either by setting up free trade zones, the construction of new infrastructural projects, or by focusing on new markets such as the offshore wind industry or cruise ship tourism.

The strategy to set up free trade zones (at the port of Keelung, port of Taipei, port of Suao, port of Taichung, port of Kaohsiung and port of Anping) can be seen in this light as it aimed to increase the attractiveness and efficiency of its ports by eliminating various administrative barriers and offering tax concessions to port users⁴³. The same can be said for the various infrastructural projects such as the construction of new terminals such as terminal 6 and terminal 7 (to be operational in 2022) in the port of Kaohsiung. The construction of these new terminals enlarges the capacity of the port of Kaohsiung and makes it possible for the largest vessels in the world to enter the port. Another example is the construction and modifying of different piers in the port of Taichung to make them suitable for wind turbine assembly⁴⁴. A relatively new part of the strategy of TIPC is the focus on cruise ship tourism, with the ports of Keelung and Kaohsiung as the main ports for cruise ship tourism. In order to make the ports more attractive for tourism various waterfront development projects have been executed in ports such as Kaohsiung, Hualien, Taichung and Keelung.

In line with developments around the world sustainability has become a pressing issue for ports in Taiwan in recent years. Various greening measures have been introduced, as part of the green port action plan,

⁴⁰ Maritime and Port Bureau, see https://en.motcmpb.gov.tw/content_6.html

⁴¹ Su, Dong-Taur, Cheng-Hsien Hsieh, and Hui-Huang Tai, 2016

⁴² Taiwan International Ports Corporation, Port of Keelung see <https://kl.twport.com.tw/en/cp.aspx?n=BA76F0328531B369>

⁴³ Taiwan's Ports Linking Asia to the World, TIPC, 2018

⁴⁴ Idem



and by now all international commercial ports under TIPC have obtained the Ecoports certification (issued by the European Sea Ports Organization)⁴⁵. In 2014, the port of Kaohsiung was the first port in the Asia Pacific region to receive this eco-port certification.

3.2 *Smartport plan*

Ports around the world are facing similar challenges such as the sustainability challenges, the increasing competition and the need for operational excellence and efficiency. These challenges, and specifically the aspiration to stay competitive, are stressing the need for digital innovations and are fueling the ambition of ports to become a smart port⁴⁶.

In the fall of 2018, at the Global Harbor Cities Forum in Kaohsiung, TIPC launched the Trans- SMART plan to transform their ports into smart ports. In this plan TIPC stated that the future competitiveness of a port will depend on how well it will integrate and apply these new emerging technologies⁴⁷. It is therefore vital to stay ahead and follow these brand new digital developments.

The goal of the plan is to improve the overall environment, sustainability, safety and operational efficiency of the port and thus turn the ports into sustainable, innovative and advanced ports. In the plan they have outlined several projects to start this transformation. Although the plan was recently launched, ports in Taiwan have already digitized various parts of the port operations. Automatic Identification System (AIS), Vessel Traffic Services (VTS), Radio Frequency Identification (RFID), computerized berth deployment, CCTV (Closed-circuit television) and Ship Dynamics are all available and operational⁴⁸. The Ship Dynamics system is an electric board with information on the conditions of ships entering, berthing, and exiting the port.

Next to this TIPC created several platforms including Taiwan Port Net (Portnet) to improve the operational efficiency in the ports⁴⁹. Portnet is an electronic system and can be used by ship agents and other related operators to submit requests for port services, berthing permission, or harbor pilot assistance⁵⁰.

Automatic Identification System (AIS)

Ports around the world are exploring and experimenting with uses of the data obtained by AIS, for example, to make estimations of vessel arrival time or to improve berth widow productivity⁵¹. Vessels

⁴⁵ Interview with Port of Kaoshiung, Taiwan, about ECOPORTS Certification (Chinese)see: <https://www.ecoslc.eu/news/interview-with-port-of-kaoshiung-taiwan-about-ecoports-certification-1>

⁴⁶ Smart Ports Point of View, Deloitte, 2017

⁴⁷ Presentation by TIPC during Global Harbor Cities Forum in Kaohsiung 25-27 September 2018

⁴⁸ Taiwan's Ports Linking Asia to the World, TIPC

⁴⁹ Idem

⁵⁰ Overview of the Basic Differences between the TPNet and MTNet online service portals, see https://www.twport.com.tw/en/News_Content.aspx?n=4A8B52D4E410EBA5&s=C6345AAD86D5FE33&SMSU=8D3BBBAE4914D793&ishistory=True

⁵¹ Kenji Ono, Masayuki Tanemura, and Yasuhiro Akakura AI Port Initiatives -World Congress Panama City, Panama 2018 & Rajabi, Aboozar & Saryazdi, Ali & Belfkih, Abderrahmen & Duvallet, Claude. 2018. Towards Smart Port: An application of AIS Data

Remark: AIS is an automatic tracking system used on ships and might be the most significant technological innovation in maritime navigation, since the introduction of radar. AIS integrates a standardized VHF transceiver with a GPS positioning system and is used to track and monitor ship movements. All passenger ships, cargo ships that exceed three hundred gross tonnage and sail international sea routes are mandated to be equipped with AIS.



travelling within 20 miles of ports in Taiwan are required to reduce their speed to below twelve knots in order to reduce the emission, AIS data was used to make the vessel speed reduction calculations⁵². A mobile application (app) has been developed for the port of Kaohsiung which provides basic information on the profile of incoming ships, course, speed and expected time of arrival.

Ports are comprised of a cluster of competing companies, a lack of willingness to share data can therefore be a major issue for the successful implementation of digital solutions. As for other modern ports the challenge in Taiwan is linking the different systems and to overcome the reluctance of different parties to share data and collaborate⁵³.

3.3 New projects as opportunities for mutual cooperation

In this paragraph we will outline the upcoming projects in Taiwan. Most of these projects will first be implemented in the port of Kaohsiung, being the biggest port in Taiwan, but will be integrated by the other ports in Taiwan in the near future. Dutch organizations who have the required expertise, knowledge and services are more than welcoming to contact us.

Ship navigation optimization system

This project is scheduled to improve the safety of berthing and to reduce accidents in the ports. First step will be to set up a long term database of ship movement entering and exiting the port including the path, angle and average speed. By combining this with real time monitoring of incoming vessels, ships can be warned when the speed is above safety limits or when abnormal movements occur. It will be an upgrade of the current AIS system.

Weather and tide warning system

Installing smart sensors to monitor and measure wind, waves, currents and tide level in the port. By analyzing this data it will be possible to receive warnings in case of abnormal conditions. Weather prediction published by the government cover a wide area, this system will provide real time meteorological information in the port area. The goal is to strengthen the capability of the port authority to respond and act accordingly when severe weather conditions occur. Pilots of vessels will also be able to assess the system so that they can act accordingly.

Smart sensing

As mentioned in the above paragraph sensors (or receivers) can be installed to measure weather and tide conditions, but sensors can also be used to measure air pollution levels. The data provided by these sensor can be analyzed to determine optimal times for ships to dock, load and unload and thereby improving the efficiency as more ships will be able to use the facilities. This is already being operational in ports such as the port of Rotterdam⁵⁴. Ports in Taiwan want to install sensor (or receivers) to collect environmental data and meteorological data.

⁵² TIPC Vessel speed reduction, see <https://www.twport.com.tw/en/cp.aspx?n=73EA6EF0477205D4>

⁵³ Kenji Ono, Masayuki Tanemura, and Yasuhiro Akakura AI Port Initiatives -World Congress Panama City, Panama 2018 & Rajabi, Aboozar & Saryazdi, Ali & Belfkih, Abderrahmen & Duvallet, Claude. 2018. Towards Smart Port: An application of AIS Data.

⁵⁴ Rotterdam IOT tech to boost efficiency, see <https://www.portstrategy.com/news101/world/europe/rotterdam-iot-partnership-to-boost-efficiency>



Intelligent berthing system

The objective of this project is to integrate all operations of ships entering, and berthing to improve the efficiency of terminal and port operations. The current information systems such as Portnet and Ship Dynamics will need to be upgraded and integrated with other relevant operations. As for every port call many different operations must be performed in a limited amount of time. The exchange of data between shipping companies, terminals and agents is key in order to improve the operational efficiency.

Inspection, maintenance and construction of underwater port facilities

In the ports of Taiwan, underwater operations have traditionally been manual labor undertaken by divers to monitor, maintain and construct underwater port facilities. To improve the safety and efficiency TIPC is looking for maritime robots or drones for the inspection, maintenance and construction of underwater port facilities.

Port security system

TIPC plans to enhance the security system in the port by optimizing the CCTV system. Intelligent analysis will be applied through sensing and image recognition to automatically monitor and track real-time situations and provide warning in case of abnormal movements.

Smart transportation system in port area

TIPC is starting a project to set up a smart transportation system in the port to optimize the traffic flow and reduce emissions from trucks. The transport efficiency in the port can be raised by sharing real time traffic information. Take for example the GPS of trucks and the loading/unloading time of containers between relevant parties.

Automated container terminal

This project is part of the second phase of the 'Intercontinental Container Center Project' in response to the increasing size of large container ships. The new terminal will be able to accommodate 22,000 TEU container vessels, and raising the capacity of the port of Kaohsiung with 4 million TEU. Port of Kaohsiung is mainly a landlord port. Evergreen will operate the new terminal and they can decide if they will invest in automated equipment.

3.4 Contact us

As mentioned the digital transformation of a port is an ongoing process, more projects will be added and or updated in the near future. For more information, you can contact the IA department of the Netherlands Trade & Investment Office in Taipei via HollandInnovation@ntio.org.tw

You can find general information about doing business in Taiwan, available subsidies and financing for entrepreneurs on the website of Netherlands Trade and Investment Office (<http://www.ntio.org.tw/>) and on the website of the Netherlands Enterprise Agency (www.rvo.nl).