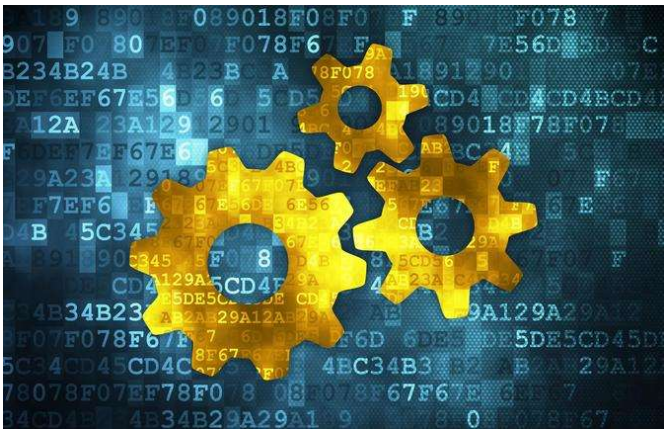
Chief Digital Officer

in small and medium sized ports

- investigation of function and profile



Conducted by Port of Helsingør as a part of the Interreg Northsea Program project NON-STOP

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Content

Preamble:

This investigation and analyses are developed as a part of the Interreg North Sea project NON-STOP co-funded by the Interreg North Sea Region Programme under priority 4: Promoting green transport and mobility.

This investigation and analysis should be seen in connection with the results from WP 4 in NON-STOP made as a part of the North Sea Connect project. The work is done in cooperation between Port of Elsinore and GEMBA Seafood Consulting A/S in the period June 2022 to May 2023.

1 Executive summary

The investigation of the digitalization in small and medium sized ports show a diversified implementation of the digitalization process and great variations in how digital they have become.

Table below some of the main take out from the investigation:

Main findings on Chief Digital Officer function in small and medium sized ports:

- Small and medium sized ports are facing increasing challenges due to digitalization and changing customer expectations.
- A Chief Digital Officer (CDO) can help small and medium sized ports to navigate the complex digital landscape and stay competitive as logistic providers.
- The CDO in small and medium sized should have a strong technical background and understand the unique needs of the port industry.
- The CDO should focus on improving digital infrastructure, implementing data-driven decision-making processes, and developing a culture of innovation and experimentation.
- Small and medium sized ports should prioritize investing in digital technologies and partnering with technology companies to stay competitive in the rapidly changing industry.
- To succeed in the digital era, small and medium sized ports must embrace change and be willing to adapt their operations to meet the evolving needs of their customers and stakeholders.

Based on the above findings the CDO-function is a very important component in the developing plans for small and medium sized ports and a way to keep the ports relevance as logistic hubs in the future.

The investigation also shows big and global port are working with well-developed and consolidated strategies that may be copied and used in moderated ways by small and medium sized ports.

In this way an awareness if the CDO-function in small and medium sized ports is important and essential. A strong both local and international cooperation between small and medium sized ports seems to be an important stepstone in port strategies to keep the port on track of the commercial development. The investigation also shows the importance of the port management in small and medium sized ports to take decision on and outline the role for a CDO-function.

The need for cooperation at both local and international level seems high and new projects should be started to upscale the standards and roadmaps for small and medium sized ports in the digitalization process.

2 Objectives

In the NON-STOP project the port of Elsinore will investigate the function of and need for a Chief Digital Officer (CDO) in small and medium sized ports. The investigation will discuss the digitalization process in various ports around the world and provide an insight into the challenges that ports from the NON-Stop project have faced in their digitalization process.

In many industries a CDO has been employed to professionalize and integrate the digitalization in many companies. Digital innovations have an impact on every industry, and as a response, many organizations have introduced this new leadership role in their C-suites. However, since the CDO role is still in its nascent stages and not well defined, the role means different things to different organizations.

The CDO function is also a new function in ports and for the main part of ports this function has not been seen as specific role due to size of staff and level of digitalization. The digitalization efforts that are needed in both small and larger ports require an upgrade of the current competencies in most ports. While larger ports may be able to employ a full-time digital officer, smaller ports will need to train existing employees to master these competencies. Most small and medium sized ports have not defined a role for a Chief Digital Officer (CDO) and the function is not existing.

Digitalization is still in a starting point in many small and medium sized ports and the relevance to outline how this new CDO role and function can be addressed in the future - helping both a smart digitalization process and reducing time and energy consumption.

With this analysis, the NON-Stop project wishes to initiate a discussion and provide perspectives on how digitalization is implemented in small and medium sized ports and provide perspectives on how each port may learn from each other to support the goal of getting more digital in their daily operations. This task is managed through a depiction of different approaches to digitalization with examples of how this has been achieved.

With this understanding of digitalization approached some of the NON-stop ports have been interviewed to identify their digitalization journey and understand what their hurdles and obstacles are to have success in becoming more digital in their operations and maintain a positive relation to existing customers and be able to attract new.

This analysis will formulate a profile of a CDO to be used of small and medium sized ports in the future digitalization process.

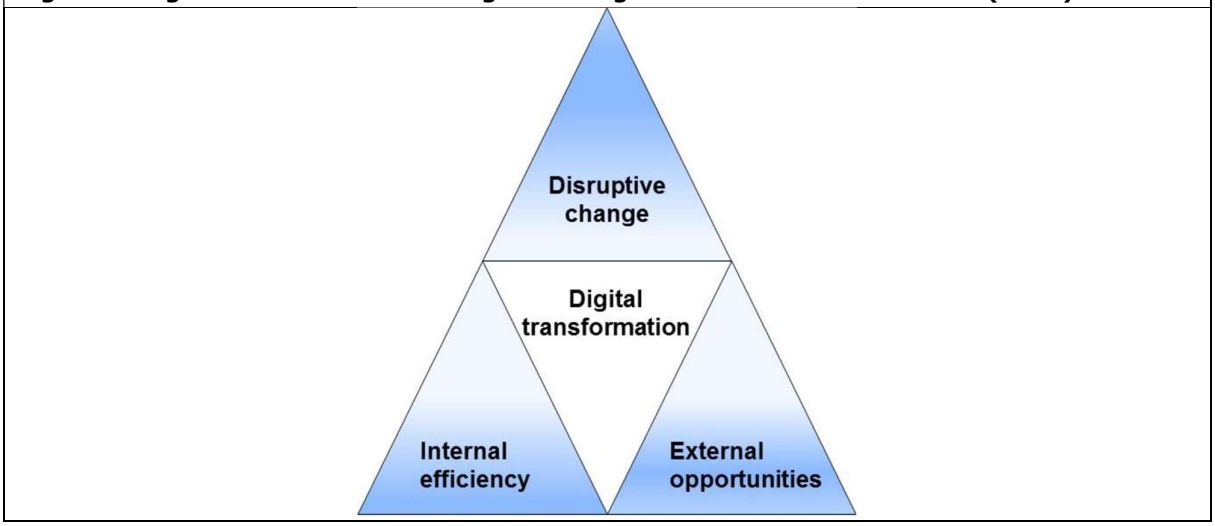
3 Goals of digitalization

Digitalization is impacting business environments and the corporate way of working. Digitalization impacts a company's entire operation environment and internal functioning and can bring new business opportunities, change the roles of operators in a value chain, and end existing business. This may be caused by direct access to consumers and the increased use of mobile devices. Thus, the impact of digitalization, and the goals of digitalization for an organization, can be identified from three different viewpoints[1]:

- **Internal efficiency,** i.e., improved way of working via digital means and re-planning internal processes.
- **External opportunities,** i.e., new business opportunities in existing business domain (new services, new customers etc.).
- **Disruptive change,** digitalization causes changes business roles completely.

Figure 1 below show the digital transformation seen from the three perspectives.

Figure 1: Digital transformation and goals of digitalization. Parviainen et al. (2017)



The analysis of the function of a CDO in small and medium sized ports is based on how the goals and focus of the digital transformation is defined in direction of, Internal efficiency, External opportunities, or Disruptive change.

In the NON-STOP Webinar on Digitalization Opportunities for Port Management a digital readiness index for ports was outlined. The index has five levels; Analog Port, Monitor Port, Adopter Port, Developer Port and Smart Port. This index will be used in the measurement of the ports and can be seen as the defining landscape and background for the CDO role.

[1] Parviainen et al. (2017): *Tackling the digitalization challenge: how to benefit from digitalization in practice* International Journal of Information Systems and Project Management, Vol. 5, No. 1, 2017, 63-77

4 Type and function of CDO's

According to Tumbas, Berente and Brocke (2017)[2] the CDO function can be judged and seen in different ways. In the article the authors outline three perspectives on the CDO-function:

- firstly, as an accelerator for the digital process,
- secondly as a digital marketer,
- thirdly as a digital harmonizer.

In some cases, the function will be a combination of all three dimensions.

There are several different approaches to a position as a CDO depending on the type of roles that the function should fulfill the size and ambitions of the company. Not all small and medium sized port would need a dedicated position as CDO but would rather need to buy such services when needed and have internal training inside the organization to handle the trajectory of the port toward being digitalization of relevant tasks.

There are thereby several reasons why organizations may decide to include a dedicated focus on digitalization, Tumbas et al. (2017) suggests among others:

- The IT department is occupied with large-scale operational projects and does not have the capacity to innovate and implement new digital solutions.
- The marketing department has a traditional focus on marketing methods, and new trends are not embraced to attract new customers.
- The organization has many local digital initiatives but lacks a strategic digital direction leading to too many initiatives that are not successfully implemented.

Tumbas et al. (2017) suggest that these different reasons for having an CDO is translated into different approaches or topologies of CDOs.

- **Digital accelerators** - Digital innovation, Experimentation and implementation
- **Digital marketers** - Data analytics, Customer intimacy
- **Digital harmonizers** – Customer engagement, Enterprise integration

[2] Tumbas S, Berente N, vom Brocke J. Three Types of Chief Digital Officers and the Reasons Organizations Adopt the Role. *MIS Quarterly Executive*. 2017;16(2):121-134

Table 1 below shows an overview of main dimensions the three types of chief digital officer should fulfill. Several digitalization processes cover components of all three dimensions.

Table 1: Chief Digital Officer function and roles.

Dimension	Digital Accelerator	Digital Marketer	Digital Harmonizer
Key Capability	Digital innovation	Data analytics	Customer engagement
Primary Objective	Experimentation and Implementation	Customer intimacy	Enterprise integration
Reason for Establishing the Role	To adopt bimodal IT while allowing the IT unit to focus on the underlying infrastructure	To create a consistent customer experience across digital and non-digital channels	When enterprise business silos are limiting the impact of digital innovation

Source: Tumbas, Berente, Brocke (2017): Three Types of Chief Digital Officers and the Reasons Organizations Adopt the Role, MIS Quarterly Executive, (16:2).

The three types of CDOs are further described in the article as:

The Digital Accelerator: Focus is on driving digital innovation and transformation within the organization. They are responsible for identifying new technologies and digital trends that could be used to create new business models or improve existing ones. They work closely with other executives and departments to develop and implement digital strategies that align with the organization's overall goals. In addition, they are responsible for creating a culture of innovation and experimentation, encouraging risk-taking and learning from failures.

The Digital Marketer: Focus is on driving the organization's digital marketing efforts. They are responsible for developing and implementing digital marketing strategies that leverage social media, content marketing, and other digital channels to engage with customers and drive business growth. They work closely with other executives and departments to ensure that the organization's digital marketing efforts are aligned with its overall strategy and goals.

The Digital Harmonizer: Focus is on integrating and optimizing the organization's digital systems and processes. They work closely with other executives and departments to identify opportunities for process improvement and optimization, and to ensure that the organization's digital systems are working effectively and efficiently. In addition, they are responsible for ensuring that the organization's digital systems are secure and compliant with relevant regulations.

4.1 Digital profiles and Small and Medium sized Ports

From a small or medium sized ports perspective it may be too great a role to have a CDO in the organization, but these three types of CDOs provide an overview of what roles such a position could embrace. The three types of CDO´s indicates some of the decisions to be taken by the management in the port defining the role and the focus.

From a port point of view the Digital Marketer function may play the obvious role as driving the strategy towards customers and business. A smooth digital function is an important component the ports image and a way to profile the port as a logistic hub. The Digital Marketer function can be seen as a proactive effort from the port.

The Digital Harmonizer role may in a port view been seen more as an internal item upgrading the port function. In this the digitalization is used as management tool to organize the different aspect of the port – activities not seen as direct customer-oriented functions. For a port business the involvement of new digital functions may just be done as part of the general digitalization process in the surrounding society and may not be seen as a proactive effort from the port.

The Digital Accelerator role is from a port-oriented view a more ambitious activity to do. In this way the port should play an active role formulating and developing new digital solutions. Small and Medium port's ability to play this role seems small and difficult due to lack of competencies, resource and ability. To play this role port could cooperated with other small and medium sized ports or with bigger ports already have made solutions. Cooperations around digitalization seems to be one of the ways small and medium sized ports could be able to play the role as a digital accelerator.

5 Examples of port digitalization from ports

The three different approaches to digitalization, *i.e.,* the Disruptive change, Internal efficiency, and External opportunities has been guiding the digitalization approach of many ports around the world. While most digitalization initiatives are initiated to provide a smoother and often less time-consuming operation in the port, there are several initiatives that also includes the port users and customers and add both responsibility as obligations to them to support a smoother operation. It is worth noting that many ports are likely pursuing efforts towards all three goals of digitalization to some extent. These goals are not mutually exclusive, and there are often synergies between them.

In the following, examples of these three approaches are provided and perspectives are given as to how small and medium sized ports can work with these initiatives.

5.1 Disruptive change

A great share of the digitalization that happens in ports is first initiated by larger ports and in many instances adapted and implemented to smaller ports that also sees the benefit of those achievements. In most cases, the larger digitalization approaches stem from a strategy that the port has developed to move the port in a certain direction. In the following, there are some examples of how ports have been making strategies and implemented them with a direct and tangible outcome. These two examples are according to Parviainen et al. (2017) considered "disruptive change".

Port of Rotterdam

PortXchange is a digital platform developed by the Port of Rotterdam to improve the efficiency of shipping traffic in and around the port. The platform provides real-time data on vessel movements, port infrastructure, and other relevant information to stakeholders such as shipping companies, port operators, and pilots.

One of the key features of PortXchange is its ability to provide predictive and proactive recommendations to port users. By analyzing data from a variety of sources, including weather forecasts, vessel schedules, and berth availability, the platform can provide recommendations on the best time for a ship to arrive, which berth to use, and how long it should stay in port.

PortXchange also has a communication system that allows different parties involved in the port operations to collaborate in real-time, share information, and make decisions together. This helps to reduce communication errors and minimize the risk of delays or accidents.

The platform uses advanced algorithms to optimize vessel turnaround times and reduce emissions. For example, it can suggest the optimal speed for a ship to travel based on factors such as the current weather conditions and expected arrival time at the port. By doing so, it can help to reduce fuel consumption and emissions, which is important for meeting environmental regulations and reducing the carbon footprint of the shipping industry.

Overall, PortXchange is a powerful tool for improving the efficiency and sustainability of port operations, and it has received positive feedback from stakeholders who have used it.

More information: https://www.portofrotterdam.com/en/services/online-tools/portxchange

digitalPORT@SG is a digital platform that was launched by the Maritime and Port Authority of Singapore (MPA) in 2020. Its main purpose is to provide a single platform for all maritime stakeholders in Singapore to collaborate, share information, and conduct their operations more efficiently.
The platform is designed to support the digital transformation of the maritime industry in Singapore, which is a key part of the country's efforts to become a global maritime hub. By connecting all stakeholders through a single platform, digitalPORT@SG aims to streamline processes, reduce costs, and improve productivity in the industry.
Some of the features of digitalPORT@SG include real-time vessel tracking, port clearance applications, and digital document exchange. The platform also provides access to a range of data analytics and insights that can help companies make better decisions and optimize their operations.
More information can be found here: https://www.mpa.gov.sg/finance-e-services/digitalport@sg

As these examples show, they are comprehensive and holistic digitalization achievements that includes several stakeholders, customers, and subcontractors. The digitalization activities of these large projects require a dedicated team to implement it in the organization and towards its users.

As a small or medium sized port, it is not possible to convince and ask customers to adapt to large digitalization projects like those described above and, in most cases, a collaboration with these larger ports may be the way forward. This indicates that while there are many initiatives that the smaller ports can take, there are also options to collaborate with larger ports and become a part of their digital ecosystem.

While these two examples show, large scale digitalization efforts may be complex and difficult or even impossible for smaller ports to initiate, however, joining forces and partnering up with these ports may be relevant.

Even though these examples, according to Parviainen et al. (2017) are considered as "Disruptive change", smaller ports may benefit from these initiatives.

5.2 Internal Efficiency

On a smaller scale there are several initiatives that ports can take to digitalize their internal operations or what Parviainen et al. (2017) refers to as "Internal Efficiency". In the following, a few examples of this internal efficiency are presented. The first one is from the Port of Esbjerg that has optimized their port operations through a digital twin and the second example builds on what is referred to at a Port Community System or PCS.

PORT ESBJERG

Port Esbjerg did in 2023 become the world's first wind port to implement a digital twin, enabling efficient deployment of offshore wind installations. According to the port, the digital twin can triple its annual shipping capacity for offshore wind from 1.5 GW to 4.5 GW within three years. The digital twin provides precise calculations regarding the storage space required for wind turbine components, optimal locations for storing components, and other practical solutions. It also determines the need for infrastructure improvements such as deeper basins and additional access routes.
The digital twin optimizes the port's operations, allowing for better decision-making, improved efficiency, and increased competitiveness. It eliminates guesswork, saves time, and minimizes mistakes in complex processes involving various ships, specialist equipment, and costly installation vessels. The digital twin is a computer program that incorporates real-time data, simulation, machine learning, and reasoning. Developed by Moffatt & Nichol, a ports and maritime engineering consultancy, it offers a powerful tool for planning, modeling, and optimizing port operations for the offshore wind industry.
By leveraging the digital twin, Port Esbjerg aims to meet the capacity demands of the green transition, contribute to Europe's offshore wind targets, and inspire other wind ports to adopt similar digital twin technologies.

portbase® DAKOSY mgi

A Port Community System (PCS) is an electronic platform that connects all the parties involved in port operations, including shipping lines, cargo owners, freight forwarders, customs officials, and terminal operators. PCS provides a common interface for these stakeholders to share information and collaborate on various tasks related to port operations. One of the features of PCS is its ability to facilitate automated invoicing.
PCS streamlines the invoicing process by eliminating the need for paper-based documentation and manual data entry. It automates the billing process by linking information on vessel calls, cargo movements, and terminal operations to generate invoices automatically. This not only reduces the administrative burden on stakeholders but also helps to minimize errors and discrepancies in billing.
In addition to invoicing, PCS also offers several other benefits for ports. It provides a single platform for stakeholders to exchange information related to port operations, enabling them to make more informed decisions and coordinate their activities more effectively. This can lead to improved efficiency, reduced transit times, and increased productivity.
PCS is a powerful tool for optimizing port operations and improving efficiency. By automating invoicing and streamlining the exchange of information between stakeholders, PCS can help ports to reduce costs, improve productivity, and enhance the overall customer experience.
There are several providers of PCS that through customization is fitted to the needs and requirements of the port and the customers of the port. Several PCSs are developed in collaboration between more ports and ensures a united collaboration between ports, shipping lines, cargo owners and other actors in the supply chain. Some providers of PCS are: Portbase (mainly the Netherlands), Dakosy (mainly Germany) and MGI (mainly France).

The two examples above illustrate how ports have been working with the internal efficiency of the port operations through digitalization.

While the Esbjerg case is very centered around the optimization of internal processes and space that is available at the port, the PCS example has a more holistic perspective with contact that includes and is targeted an external audience of shipping companies and truck operators that also need to engage in the digitalization process. However, the internal efficiency of PCS is apparent in the sense that it helps the port and ensure that the port saves time and money through time savings and greater dependability on e.g., automated invoicing system.

5.3 External Opportunities

In the following, examples of cases that has a more external perspective, where digitalization is introduced to provide a smoother operation of the port for both the port administration and its users. While both providing an internal efficiency, these initiatives also provide what Parviainen et al. (2017) refers to as 'External Opportunities'.

The HERIT-DATA project, funded by Interreg Mediterranean, aims to improve the monitoring and management of cruise passenger flows in Valencia. In order to do so, a pilot initiative was launched by Valenciaport, which includes data capture, data processing, and development of visualization tools.

A cruise management platform has been developed to manage reservations and keep authorities informed of excursions organized for cruise passengers. An IT platform has been developed to receive and process the data captured by these sensors, and to distinguish between cruise passengers, residents, and other tourists.

The solution in Valencia provides real-time knowledge and reporting of the number of people in tourist spots, knowledge of the behavior of cruise passenger flows in the city, and the percentage of cruise passengers relative to other visitors. Future work includes expanding the sensor network and measuring additional parameters related to the impact of mass tourism.

Gävle Hamn

The Port of Gävle in Sweden has implemented a unique queuing system called "Time Slot Gävle" that will be mandatory for vessels calling at one of the seven terminals that use Port of Gävle's energy quay. This system enables vessels to reduce emissions through "eco-driving" during their entire journey to the port from the continent. The queuing system replaces the old "first-come-first-served" system and allows vessels to plan their calls better, reduce speed during the journey, and save large amounts of carbon dioxide emissions. Port Activity App" was developed in collaboration with the Swedish Maritime Administration, Port of Rauma, Satakunta University, and the Finnish Transport Agency. The app has now been used for almost two years by the actors in Port of Gävle. Time Slot Gävle is a continuation of that work. The Port of Gävle has a vision to be a gapminder for green transition and hopes to inspire more ports to introduce similar systems.

More information: https://gavlehamn.se/en/unique-investment-in-port-of-gavle-enables-eco-driving-for-vessels/

The example from Valenciaport illustrates how a port has been working with obtaining an external opportunity through a better understanding of the entire cruise activity at the port and in the city of Valencia. Through a better understanding of the cruise guests and their behavior the Valenciaport may be able to be more attractive toward the cruise industry and be able to attract new calls and boost the activity on this business area.

The Gävle Hamn examples above put a greater responsibility on the users of the port, i.e., the shipping companies, logistics operators etc. but is time saving for the port administration and its users and when fully and well-integrated it will provide cost reduction to all parties. As it is the case with many digitalization efforts the Gävle case need a careful implementation and training of users in the app. There are several examples of app and other digitalization efforts that has been a complete failure because of bad integration and introduction towards its users.

The Gävle case is further an illustration of how a port has been working with ensuring a better environmental state of shipping and port activities through setting requirements and ensuring a smarter planning in the entire supply chain.

5.4 Summary of digitalization examples

The above examples of digitalization endeavors among various ports illustrated rather different approaches and outcomes and while some are large and comprehensive and perhaps too comprehensive for smaller ports to initiate, there are opportunities to get involved in these endeavors and obtain the benefits of the digitalization. These disruptive changes are those groundbreaking initiatives that when successful implemented will have an impact on the port that makes comprehensive changes in their structure and daily operations.

The disruptive change approach also provides external opportunities and the internal efficiency results in the port, but the examples illustrate that smaller and less comprehensive digitalization activities can be implemented to strengthen the ports.

While some of these examples of digitalization may improve the efficiency of the port, there are some trends that point towards that these digitalization initiatives are not only nice to have but evolves into something that may be a need to have. If the shipping companies and other logistics operators starts to invest in a specific system to ensure a smooth interaction with a port, that logistics operator may start to expect that the ports operation is compatible with this system. Being able to meet these digital needs from the customers may become a license to operate for the port for certain customers.

To be able to work with these digitalization processes there are needs of all three types of CDO, i.e., as digital accelerator, digital marketer, and digital harmonizer.

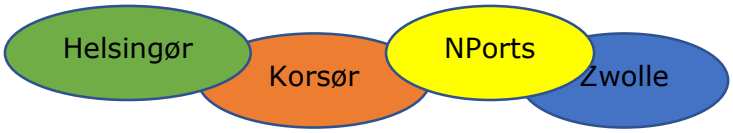
6 Survey objective and structure

Based on the different approaches to digitalization as described above it has been possible to assess the ports that are participating in NON-STOP and mapping of their digitalization efforts. A better understanding of the digitalization activities and what the ports need to increase their success with their initiatives is surveyed.

Understanding of the goal and intention of digitalization approaches or goals (disruptive, internal, and external), the process and hurdles that the ports are experiencing in their digitalization journey provides information and details into what support the ports need and hence help define the tasks of a CDO in the port. The approach and goal of digitalization will be matched against the three types of CDO, i.e., digital accelerator, digital marketer and digital harmonizer and a description of necessary competencies will be developed.

Figure 2 shows the ambitions of the survey to be able to describe the competencies that are needed for the CDO in small and medium sized ports.

Figure 2: Goal of digitalization for NON-STOP partners - placement

Focus of CDO effort:	Internal efficiency	External opportunities	Disruptive changes
Digital harmonizer			
Digital marketer			
Digital accelerator			

The ambition with the interviews with the ports are therefor to identify the digitalization direction the ports have taken and what the goal has been, and further to identify what capabilities the process required and whether the port in question were in possession of these competencies. This analysis should provide a better understanding of what a position as CDO requires and whether it is possible to ensure this in the port.

As it may be seen from figure 2 above the port's effort in the direction of digitalization is mostly focused on a role as digital harmonizer and/or marketer. The role as digital accelerator is only to a small degree tried by the Port of Zwolle combined with a disruptive view on the Harbour-fee system. Port of Korsør and Nports having focus on the external opportunities in the digitalization efforts. Port of Helsingør have higher level of focus on internal efficiency.

Figure 2 shows that the partners in NON-STOP have focus on the digitalization process but the focus is different.

The overview also shows the challenge for small and medium sized ports to cover the spectrum of the whole digitalization process this lack of capacity may be one of the most importance constrains to handle.

7 Results from interviews

Four of the NON-Stop partner ports were asked about their work towards improving their digitalization efforts in their port and what it has brought the port and what they need to further digitalize their activities. The interviewed ports are:

- Port of Helsingør
- Port of Korsør
- Port of Zwolle
- Port of NPorts

The following results are collected and analyzed on a thematic approach corresponding to the goal of digitalization i.e., the disruptive, internal, and external perspective. The results and discussion of challenges are ordered into these three goals of digitalization; however, these goals are not necessarily mutually exclusive, and there are often synergies between them.

The text below is rather seen as a discussion of what challenges and barriers that exists for the ports to excel in each of the three goals and does not go into great details about the digitalization achievements of the ports.

7.1 Disruptive change

The interviewed ports have not initiated any disruptive change in their digitalization efforts. However, there has been some processes around the Port of Zwolle that can be seen as disruptive and where the port has engaged in the process. The result of this effort is at this difficult to account.

While these large and disruptive digital port services are mainly developed by and for the larger ports there are opportunities for the smaller ports to be a member of the community.

This, however, often requires a subscription or membership fee to a system that the ports may not see the direct benefits from, and that these subscriptions and fees are rather costly. Also, it was expressed that being a part of these larger port community systems may require several large or small transformations of the port administrations and that just looking into these transformations in a busy daily operation seems overly difficult.

7.2 Internal Efficiency

The Internal efficiency is where the interviewed ports have been experiencing the main achievements. Several of the interviewed ports have implemented measures to handle the invoicing in a much more efficient and digital way leading to time savings in several parts of the organization.

As internal efficiency is fairly achievable for most ports to work with, and that these digitalization processes are often of rather incremental character, it is mostly dealt with in the organization without greater prior analyses, inclusion of external expert etc. However, these digitalization process include additional knowledge from the employees and there has been initiated training of employees in some of the ports.

It was highlighted in the interviews, that port workers today have much more academic and professional training today than some years ago. A port worker was traditionally unskilled manpower that e.g., moved goods from ship to quay or the other way around, however, more and more port tasks are automated and optimized and there is a requirement of much more high-skilled labor.

The ports, when challenged in the interview, are able to realize that several of the initiatives they have been taken over the years are actually digitalization efforts. Most ports have a digital system to ensure maintenance of their areas. All port employees and in some cases also port businesses that rent area at the port, can submit a claim that e.g., a road need to be maintained (e.g., too many holes in the pavement), or an entrance gate is not working properly. These tasks are reported in the system and the right persons will learn that they should be taking care of those issues.

7.3 External Opportunities

As the labor in ports have become higher educated, there has also been a tendency to explore new opportunities outside of the port. According to interviews the old-fashioned way to look at port operations is that it is all a zero-sum game where one port may expand only on behalf of a loss in another port. However, ports today have a much different perspective on this and sees opportunities to attract new business to their port.

Digitalization has on many occasions become a 'license to operate' and customers may not be interested in dealing with the port if a minimal degree of digitalization is not in place. Therefore, the digitalization effort on some elements of the daily operations is becoming necessary to include in the organization.

One interviewee argues that the ports already have multiple digital systems in place to manage various aspects of its operations, and integrating these systems can be a challenge. As a result, there may be limited visibility and coordination between different parts of the port, and this becomes an even larger challenge when there is a need for integrating their own digital systems with other business digital systems.

Another challenge that was mentioned on several occasions was the cybersecurity, data protection and data privacy. The interviewed ports see large challenges on these matters but are not always adequately equipped with the right competencies to deal with this. In the interviews it was mentioned that these issues are working as a hindrance to the ongoing digitalization. The ports acknowledge that these issues are of great importance but may not have the right skills to understand the complications of these challenges and thereby seeks to avoid integration of external systems into their own systems.

As many ports are based in a somewhat confined urban area, there are on many instances a great attention towards the port and its operations. In efforts to ensure that the attention remains positive, several ports have embraced social media platforms, mainly Facebook, to inform the inhabitants of said town about what happens in the port. This can be when a large vessel calls the port, when a quay is under repair or when entire port areas are expanded. This spreading of information through social media is, according to interviews, a way to include the local inhabitants and has a positive impact on the relationship towards the external society of the port.

8 Profile of Chief Digital officer (CDO) in small and medium sized ports

Based on the discussion and analyses above it is possible to extract some ideas about the profile of a CDO in a small and medium sized port.

It should be stressed, however, that a dedicated position as a CDO will not be relevant in many smaller ports, but a port employee that should be working with these topics will need some of the qualifications.

- **Technical expertise:** The CDO should have technical knowledge of digital technologies and trends, and preferable experience with data management and analysis. The CDO should be familiar with technologies such as IoT, data security, system integration, and preferable have experience implementing digital solutions in previous roles.

- **Strategic mindset:** The CDO should be a strategic thinker, capable of understanding the business needs of the port and identifying opportunities for digital transformation. The candidate should be able to create a digital strategy that aligns with the overall business strategy and supports the goals of the port.

- **Strong Communicator:** The CDO should be an effective communicator who can clearly explain complex digital concepts to non-technical stakeholders. A candidate should be able to build relationships and collaborate effectively with other departments within the port, as well as external stakeholders such as customers and vendors.

- **Results-Driven:** The CDO should be results-driven and focused on delivering tangible business outcomes through digital transformation initiatives. They should have experience developing and implementing metrics to measure the success of digital projects and initiatives.

- **Industry Knowledge:** The CDO should have a strong understanding of the port industry and the specific challenges faced by small and medium-sized ports. They should be aware of industry trends and best practices, as well as regulatory and compliance requirements that may impact digital initiatives.

9 Recommendations

The discussion and analyses in this report give rise to some recommendations across the different goals and types of CDOs:

- **Invest in digital infrastructure:** Given the increasing importance of digital technologies in the shipping and maritime industry, it is important for ports to invest in digital infrastructure to remain competitive. This could include things like upgrading IT systems, implementing automated container handling systems, port community systems and developing digital platforms for logistics management.

- **Make or improve strategy:** Many small and medium sized ports already have mentioning of digitalization in their strategy, but a strong and dedicated focus on this topic may improve the profile of the port. The strategy process sharpens the ports understanding of digitalization and may ensure that the efforts are put in the right direction.

- **Focus on data analytics:** Collecting and analyzing data can help ports optimize their operations and make informed decisions. By using data analytics tools, ports can identify areas for improvement and adjust their operations to maximize efficiency.

- **Collaborate with stakeholders and customers:** Ports should work closely with shipping lines, logistics providers, and other stakeholders to develop more efficient supply chain solutions. By collaborating with others in the industry, ports can streamline their operations and provide better service to their customers. Some existing port customers probably already have some digitalization experiences that could be beneficial for the port.

- **Prioritize cybersecurity:** As ports become more connected and reliant on digital technologies, cybersecurity is becoming an increasingly important issue. Ports should prioritize cybersecurity measures to protect their operations and prevent cyber-attacks. This could include implementing firewalls, antivirus software, and regular security assessments.

- **Cooperation between ports:** A local leveled cooperation and international leveled cooperations seems important as the stepstone for a stronger digitalization process in small and medium sized ports. This cooperation may be gathered in an international project creating the standards and roadmaps for small and medium sized ports in northern Europe.

10 Conclusions

The report highlights the importance of digital transformation in the port and maritime industry and illustrates how technology and digitalization can enhance the efficiency, safety, and sustainability of ports. The adoption of digitalization and new technologies can help ports streamline their operations, reduce costs, and improve their competitiveness.

The report emphasizes the need for skilled personnel, such as a Chief Digital Officer, to lead the digital transformation of ports. The CDO would be responsible for developing and implementing a digital strategy, selecting, and integrating the appropriate digitalization efforts and technologies, and building a digital culture within the organization. A position as CDO should have a strong understanding of the maritime industry and the various stakeholders involved.

While digital transformation offers benefits for ports, there are also challenges that need to be addressed. One of the major challenges is the integration of different systems and technologies, which requires an investment in infrastructure and coordination among stakeholders. Additionally, there are concerns around cybersecurity and data privacy that need to be addressed.

Overall, the report highlights the significant role that digital transformation can play for ports and the maritime industry, particularly for small and medium-sized ports.

To fully realize the benefits of digital transformation, it is crucial for ports to have a clear digital strategy, skilled personnel, and a collaborative approach with stakeholders. As the world becomes increasingly digital, ports that invest in technology and innovation will be better positioned to thrive in the local, national, and global market.