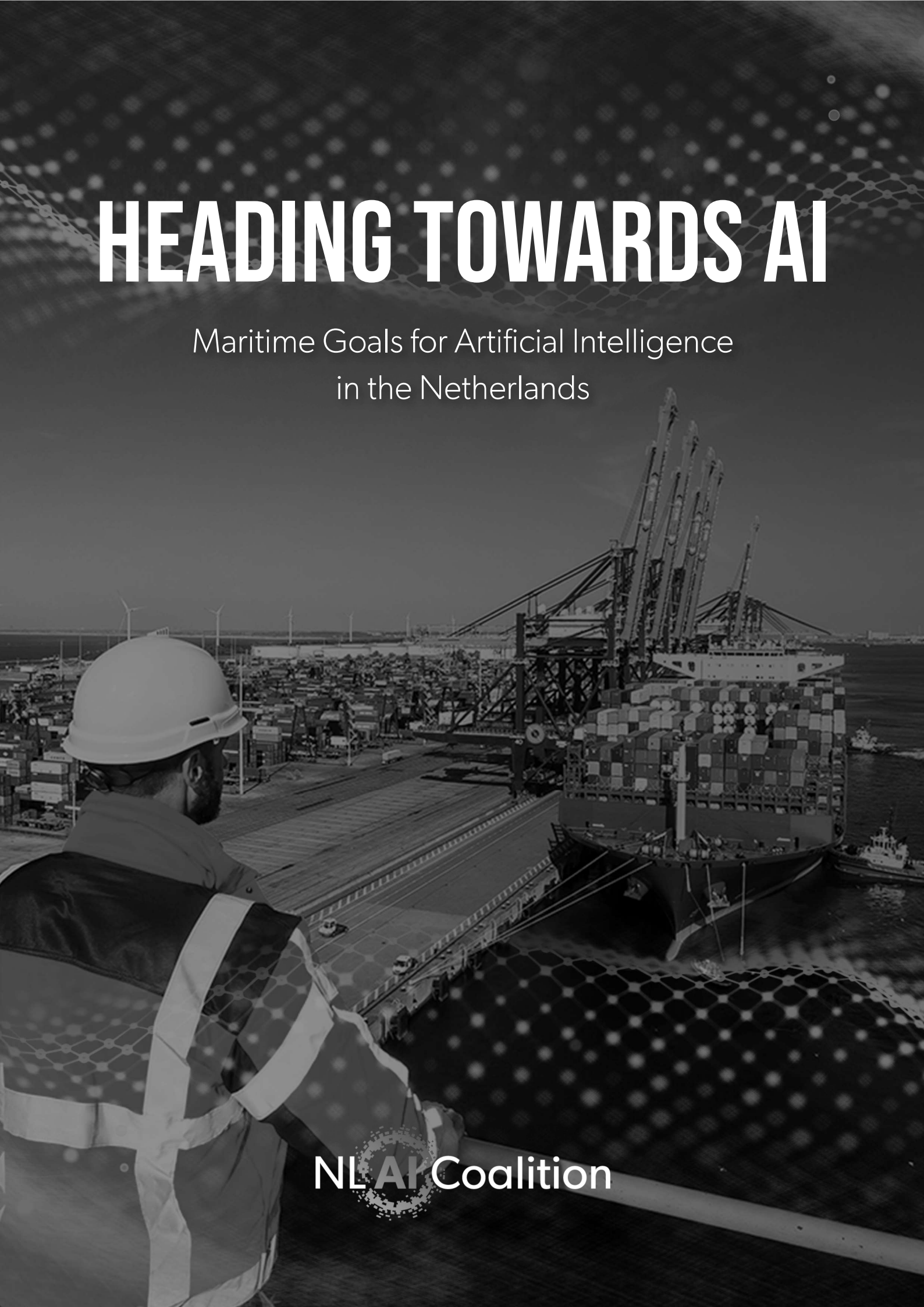
HEADING TOWARDS AI

Maritime Goals for Artificial Intelligence
in the Netherlands



NL AI Coalition

NETHERLANDS AI COALITION

Ports and Maritime working group

The Ports and Maritime working group within the Netherlands AI Coalition (NL AIC) arose thanks to interest from the maritime sector. The working group was set up by experienced stakeholders who are closely involved in technological innovations in the maritime sector.

The NL AIC is a public-private partnership in which governmental authorities, the commercial sector, educational and research institutions and social organisations work together to accelerate developments in AI in the Netherlands and to link AI initiatives in the country together. The aim is to put the Netherlands in a front-runner position in terms of AI knowledge and applications for well-being and welfare, taking due note of Dutch and European norms and values. Acknowledging the importance of AI and the strength of the NL AIC and those involved in it, the Dutch government allocated €276 million in April 2021 from the National Growth Fund to the first phase of the long-term AiNed Investment Programme. The programme accelerates the development and application of AI so that the Netherlands can reap the economic and social rewards of AI and keep pace with other leading countries.

The Ports and Maritime working group is working on a balanced implementation agenda that will assist the ports and maritime sector across the board in developing and implementing AI-related technology. The agenda focuses on pioneering projects as well as offering backing for companies that are in the early stages of applying AI.

Themes and existing initiatives

There are various ongoing initiatives and collaborations within the maritime sector for new technology, for instance such as SMASH! (the Dutch Smart Shipping Forum), the Maritime Master Plan (under the flag of 'Nederland Maritiem Land') and DigiShape. Participants in those initiatives are also involved in this working group. That is how the working group is trying to strengthen and link together those ongoing initiatives..

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INTRODUCTION

The maritime sector: heading towards AI

The Netherlands is in the global vanguard of the maritime domain, a position that maritime companies – in cooperation with governmental bodies and knowledge institutes – have managed to achieve through continuous innovation.

If it is to retain its innovative strength, the Dutch maritime sector will have to undergo a digital transition. We are in danger of falling behind in digital technology compared to competing regions abroad where governments and companies are investing heavily. A significant proportion of those investments are being made in Artificial Intelligence (AI). It is a key technology with massive opportunities for efficiency improvements, for new products and services, and for achieving societal goals such as waste reduction, harmful emissions or criminality. At the same time, AI engenders both societal risks relating to ethics, security and misinformation.

A common vision and strategy

The opportunities that AI offers for the maritime sector are copious, from both the economic and technological points of view. At the same time, though, there are causes of concern from the social perspective. These concerns focus on the one hand on the future of work and employment in the sector, while on the other it is important that no strategic dependencies arise in the sector; there are geopolitical pressures such as competition from companies subsidised by the Chines state.

It is therefore important that we in the Netherlands develop our expertise and know-how further about AI in the maritime domain. To do that, we must remain in the vanguard of international cooperation and must be ready for fierce competition for the knowledge and the talented individuals needed in data engineering, data analysis and AI. A shared vision and strategy for the maritime sector are needed to let us meet the challenge.

Facts and figures

The Dutch maritime sector is competitive globally and an important driver of the country's economy. Nationwide, it employs 385,000 people and creates added value of €45.6 billion. The cluster of five nationally significant seaports is central to this; In addition to Rotterdam, those are Moerdijk, the Amsterdam-Noordzeekanaal area, Eemshaven-Delfzijl, and Vlissingen and Terneuzen (North Sea Port).

Source: Port of Rotterdam. (2019). Havenvisie.

Artificial intelligence: a definition

The term 'AI' refers to systems that exhibit intelligent behaviour by analysing their environment and have a certain degree of autonomy in taking action to achieve specific objectives.

Source: European Commission

MARITIME SECTOR		
Shipping	Ports	Shipbuilding
Offshore	Dredging	Fishery
Martime Services	Maritime Suppliers	Maritime Institutes
Navy	Inland Shipping	Yachting

Developing a common maritime vision and strategy for AI is neither simple nor self-evident. This document outlines what will be done through to 2027 and identifies the priorities in four application areas and three fundamental building blocks. This has been done in close cooperation between scientists, companies and other experts, as a working group within the Netherlands AI Coalition.

Areas of application

Our partners from the maritime sector have highlighted four areas[1] where it is important to accelerate the application of AI:

- **Smart Shipping**
- **Smart Manufacturing**
- **Smart Port Logistics**
- **Smart Asset Management**

Building blocks

Broader foundations are needed in addition to the focus on a number of application areas. Various building blocks are indispensable for this:

Underpinned by people

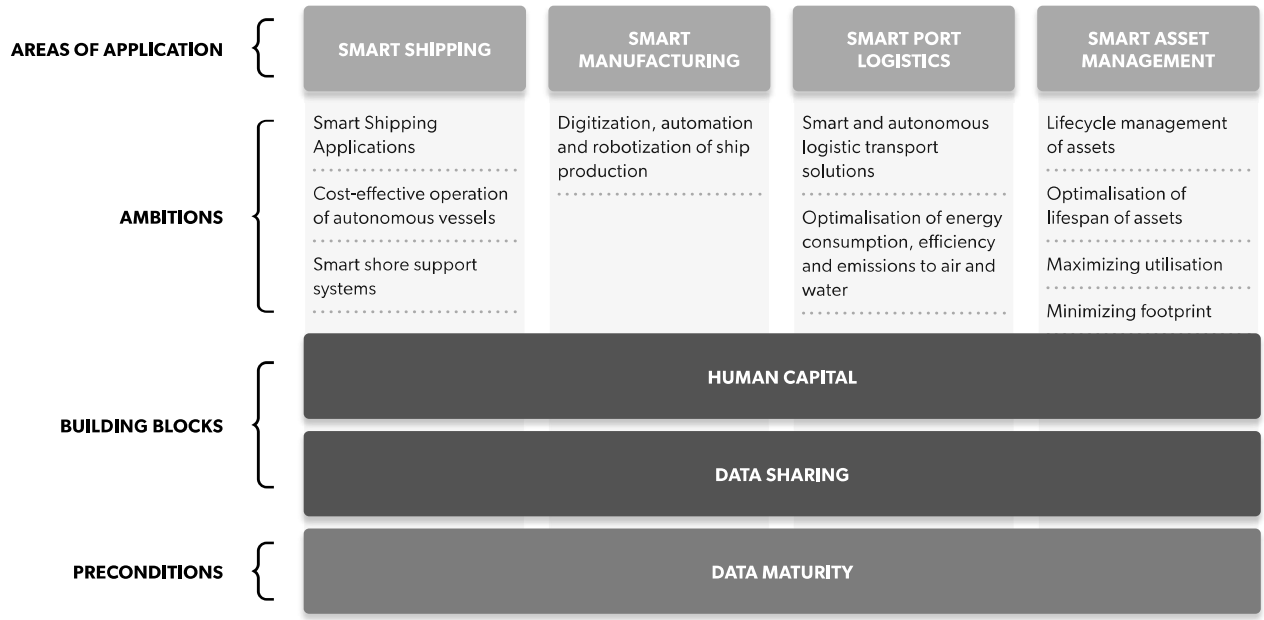
- Human Capital

If new AI applications are to be developed and used effectively, it is crucial that enough well-trained staff are available, both now and in the future.

Underpinned with data

- Data Sharing

To exploit the potential of AI, it is important that knowledge institutions, companies and governmental bodies share much more data with each other. For that to be possible, we need to work on getting high-quality data that is stored responsibly.



1 A fifth subarea that is also deemed important is Smart Energy. The Energy & Sustainability working group has been set up for this within the NL AIC, in which the maritime sector wants to cooperate with other stakeholders from the energy sector.

BUILDING BLOCK DATA MATURITY

Data maturity refers to how well-evolved the entire process for providing data and information is. It refers to both internal and external data throughout its whole lifespan. Organisations that want to use AI as a technological solution must have a certain basic level of knowledge about IT and digital infrastructures. On top of that, knowledge of 'datafication' is needed: the data groundwork of producing, storing and organising the use of data to assist and improve the business operations. Finally, an organisation has to know about the possible operational cases and commercial business cases that are based on applications of data and AI. That ultimately lets organisations achieve a higher level of data maturity, which is essential if AI technology is to be applied and developed.

Goal

To increase the data maturity level of companies in the maritime sector, especially SMEs. This is a necessary step if companies are to develop AI applications and if there is to be data-driven supply chain cooperation in the sector. Good data policies are also important for individual companies to let them share data with other parties.

Challenge

Although data is important for the sector, there is currently only limited assistance and independent advice available to help SMEs with this. Applications based on data and AI are an even greater challenge for SMEs than for large companies. It is a complex, uncertain and high-risk process. The success of AI applications depends on the data maturity of the organisation. To reach a certain level of data maturity, organisations need to know how to store data in databases, resolve quality issues and retrieve data automatically. SMEs are often relatively small-scale, making them less attractive for IT parties looking to embark upon long-term cooperation and customer relationships. What are the commercial earnings models of data-driven and AI-driven services? Helping to find answers to this question can make it easier for companies to justify the initial investments.

Improving the data maturity level

There have to be sufficient support opportunities in the short term for taking maritime SMEs up to data maturity Level 3. This will involve assisting maritime SMEs through knowledge networks and subsidy instruments for:

- Setting up or modifying their IT infrastructure
- Fnding reliable IT partners
- Acquiring enough basic knowledge about data and AI to understand its commercial potential
- Making data accessible on a platform

Data maturity model

	LEVEL 1 Survival	LEVEL 2 Taking the first step	LEVEL 3 To a higher lever	LEVEL 4 On top of the world	LEVEL 5 Over the moon
DATA SOURCES	Data sources not identified Location of data storage not known	Data stored mainly in excel/ pdf Limited access to data	Data sources identified and mapped Data stored in database Access allowed to selected persons	Internal and external datasources combined Data stored in data lake Almost free access to data and ample use of data	Internal and external datasources routinely combined Data stored in data warehouse Unlimited access to data within organisation and everyone uses of data
DATA ANALYSIS	Not performed	Performed in standard tools	Data analyses by combining various data sources Use of specialized tools	Algoritms for data analysis in development stage Use of specialized tools	Predictive and descriptive aloritms applied Use of specialized tools
DATA MANAGEMENT	No agreements on roles, rights and standards	Some agreements, not recorded in a formal way	Processes, responsibilities and data standards recorded Insufficient enforcing of agreements	Data standards and responsibilities integrated in daily work processes Management takes responsibility	Dedicated department responsible for datamangement and enforcing of agreements Cooperation with management
ORGANISATION	No use of data within the organisation	Limited use of data besides regular tasks Recruiting of staff is difficult	Some data analysts employed Providing daily data data analysis reports Recruiting of staff is reasonable	More data analysts and programmers employed Recruiting of staff is easy	More data analysts and programmers employed New staff attracted by organisation profile Data driven work processes in DNA of organisation
STRATEGY	No strategy available No need for investment; datadriven work regarded as cost	Ad hoc and limited investments Focus on reduction of coststand not development of new business	Yearly budgets for data driven work processes Development of data driven business small part of strategy	Ample budget available Development of data driven business one of the pillars of strategy Supported by the management team	Development of data driven business integral part of strategy One management team member responsible for data driven work (CTO/CDO)

Source: Onderzoek naar Datamaturiteit bij het maritieme MKB (Gemeente Rotterdam, mei 2021)

BUILDING BLOCK DATA SHARING

Data sharing involves various organisations making company-specific data available to each other. This will encourage cooperation across the boundaries of existing organisations, which is crucially important if AI applications are to have an impact on chains than transcend organisational borders.

Goal

Further development and implementation of a digital infrastructure that companies can exchange information securely and reliably through. This will let companies in the sector work together faster, more intelligently and more efficiently.

Ship production

The aim for ship production is to create a shared data standard and/or algorithms in the short term that convert data from one format to another. This will allow data to be shared with many different organisations.

A data-sharing infrastructure (including agreements about access, security and how data owners maintain control over their data) will make sure that the data is actually shared. In particular, the organisations' trust in each other and in the agreements that have been made will be improved by a good data-sharing infrastructure.

As the maritime sector generally builds as one-offs or in very small series, with a great deal of overlap between the engineering process and the production process, continuously adjusting the production planning to fit the information available at the time is one of the big challenges if the efficiency of the construction process is to be increased. More details about the impact of data sharing on ship production can be found in the section about the Smart Manufacturing application subarea.

Port logistics

In the port logistics environment, work is being done to link up all the Dutch ports in terms of data. After that, a community environment can be created where not only data but also e.g. predictive models and other applications using that data are shared.

If we are talking about further upscaling, environmental data (e.g. meteorological information or public databases) will also be made available in the future through data-sharing platforms for use in supply chain partnerships. In the section about the Smart Logistics application subarea, we will take a closer look at the difference that data sharing can make in port logistics.

Benefits of data sharing

Many parties are partly aware of the benefits of data sharing and the associated business models, although they are still looking for good business cases and wondering what the benefits for their own companies will be. Numerous data exchange projects have previously failed in the maritime manufacturing industry in particular, raising doubts about how useful it is to help think about controlled ways of sharing data. It is very important to achieve a significant increase in the number of parties involved in data-sharing initiatives, because the better the picture that is obtained of a process and its data, the more AI can play a role in optimising that process.

Data can however be shared safely and reliably. This is already being done in various sectors.

BUILDING BLOCK HUMAN CAPITAL

The implementation of AI and the underlying infrastructure demands talented individuals and increasing the influx of such people is therefore important. The maritime sector can promote itself more strongly as an attractive employer among graduates and international knowledge workers with data skills and AI competencies. Further crucial factors are encouraging retraining opportunities for existing staff and supplementing the teaching materials for maritime students with AI content.

Goal

To prepare the current generation and the next for a maritime sector that will become more and more digitalised. The rise of data and AI mean that current roles will change or may even disappear and other, new roles will take their place. The key is therefore providing further training for existing staff and bringing enough new talented individuals through, so that both will be at home in the maritime sector of the future.

Understanding labour capital shifts

"What data skills and AI competencies do maritime personnel need – now and in the future?" That is the question we want to be able to answer in the short term. Additionally, we want a good understanding of the current data and AI skills of maritime personnel. We are also aiming for a clearer picture of absolute FTE numbers and the educational levels of the personnel. There is no such overview at the moment, which makes it difficult to formulate retraining and further education plans for the existing employees. Finally, we want to get a picture of how these figures relate to the job reductions, changes and increases that will be caused by the rise of AI.

Education

Free educational scope has to be made available for experimenting with data and AI material in education. Teachers will then see what does and does not work for that material, without affecting the final level achieved by a course. We propose developing a low-threshold, hands-on course as quickly as possible for maritime students, focusing on using data and AI in port logistics and maritime applications.

Which of the existing AI open-source educational packages are suitable for maritime education should be determined. Teachers of existing maritime courses should also be given the opportunity to be trained in AI techniques.

Retraining and further education

In the context of lifelong learning – in other words, retraining and further education – we want AI education programmes to be made available in future for the entire maritime professional population. The examples and applications that are the basis of those educational programmes must come from the maritime sector itself as far as possible. The programmes will be tailored to suit specific target groups, such as board members, engineers, etc.

Too little is currently done in terms of internal training for staff because this is largely handled on an individual basis by the larger companies. Research has for instance shown that 54% of the companies in the port of Rotterdam invest little if anything in innovation (social innovation in particular) and that only 22% invest in both technical and social innovation.

Attracting talented individuals and experts

To generate enthusiasm for the Dutch maritime sector among talented data and AI professionals, we want to promote the maritime vocations and courses nationally and internationally. What are the attractive sides of the sector? The technical challenges, perhaps, or the many career opportunities? Attracting high-quality staff for data and AI often proves very difficult, because of the limited number of people with the necessary skills and experience and because of the high demand for such employees. The pool is simply too small.

When specialist staff need to be hired, there is heavy competition from other sectors that may potentially be more attractive for talented starters because data and AI are already more mature there. There are for example more people there to learn from with data and AI experience. That is now creating a vicious circle in which the maritime sector is structurally losing the competitive race with other sectors.

Currently, staff are largely and consistently hired in through external parties; this is not a long-term option. A better approach for companies would be to ensure that they have the talents they need in-house, allowing AI to be applied in a scalable way. On top of that, external parties often lack the maritime sector knowledge that is needed for delivering projects quickly and successfully.

AREA OF APPLICATION SMART SHIPPING

Smart Shipping uses AI to assist or cut down on human actions during shipping movements, Increasing the effectiveness and efficiency of operational processes safely and sustainably.

Goal

Making smart shipping applications possible and demonstrating them in areas where it is currently not possible. This will improve the way the extensive network of rivers and canals in the Netherlands is used and replace less sustainable modes of transport. It will moreover also drive cost-effective deployment of autonomous vessels. To that end, we are facilitating the development of decision support systems and autonomous subsystems on board and on shore. Eventually, fully autonomous ships that exchange information with smart systems on shore and are monitored by them may also be developed.

Towards fully autonomous ships

We are aiming to create ships that can sail fully autonomously (hands-free) from one terminal to another in a test environment where other waterway traffic and obstacles are also present. This includes a modified vessel traffic services (VTS) system that can be used for real-time monitoring of autonomous vessels. Introducing autonomous ships requires further development of both the shipping system and the transport system in general. It is still insufficiently clear, moreover, which shipping applications AI-based decision systems will be commercially viable for. Autonomous and sometimes unmanned vessels will then have to interact with conventional crewed ships. The ultimate goal is to allow autonomously navigating vessels to move around safely and legally on Dutch waters.

Test environment

To test all of this, we would like a realistic port or lock situation as a test environment for autonomous vessels, including an accurate digital representation of that environment. AI systems that let ships operate independently (or more independently) are still under development. We are aiming to present smart shipping concepts that are economically viable as well as helping to achieve climate targets.

Human-machine interaction

We want to do further studies into the optimum interaction between humans and machines on a ship with partially autonomous systems. How do these kinds of autonomous systems deal with uncertainties in the functioning of sensor systems and communication systems? The current generation of ships have been designed with the assumption that human intervention is always possible. An affordable alternative is needed on autonomous ships for situations in which human intervention was previously required.

On top of that, an ethical and legal framework is needed for decision-making by autonomously sailing ships, plus a methodology for determining whether a fully or partially autonomous system is sticking to the rules of ‘good seamanship’ and the waterway rules. Without changes to the current legislation and regulations, autonomously navigating vessels cannot be used in practice on waterways.

The design, operation and maintenance of autonomous vessels require knowledge and competencies that are hardly present at all in the maritime sector as yet. Take a look at the section on Human Capital too: there are good reasons why that is one of the key building blocks in the future of AI.

AI applications required

- Real-time condition monitoring and real-time control of vessels, both on board and on shore.
- Decision support algorithms and systems that can deal with the specific challenges of autonomous and semi-autonomous vessels, such as limited situational awareness and interactions with conventional ships.
- Situational awareness systems for obtaining a picture of the waterway and objects/obstacles and their possible movements that is as complete as possible.
- Fault detection, isolation and diagnosis systems.
- Cooperative collision avoidance systems.

AREA OF APPLICATION SMART MANUFACTURING

Smart manufacturing applies AI in the design and production processes for ships to reduce costs, increase product quality and control complexity. This can for example be through automated production of one-off construction tasks, including integrated quality inspections and improved production planning that involves multiple suppliers.

Goal

Developing AI technology and using it in the production process of ships, thereby achieving far-reaching digitalisation, automation and robotisation in ship production (Shipbuilding 4.0).

Shipbuilding 4.0

We are aiming to set up production environments for Shipbuilding 4.0 projects that use AI applications in the design, production planning and manufacturing and in which experiments can be carried out using production robots and systems that are interconnected effectively. That requires specialists who know about robotisation and digitalised production environments.

Data sharing in the shipbuilding process

Introducing and utilising data-driven applications in the shipbuilding process (both at the shipyard and at the suppliers) is complex because a large number of specialist suppliers are involved in this production environment. These suppliers work using their own systems, without uniform data standards, in both the engineering and the production phase. A great deal of time is lost integrating the outputs of these systems on site. However, there will be no agreements about common data standards without intervention. The reasons for this include fragmentation of the market and previous failed attempts to agree such standards (see the Data Sharing and Data Maturity building blocks).

Cooperative links

The maritime industry consists of numerous SMEs producing engineered-to-order products in small series or as unique products (or sometimes whole series of similar but non-identical products). Because of their size, these companies have limited scope for investing. We see new and existing commercial partnerships as important because we expect that it will be possible in future to implement proven Shipbuilding 4.0 concepts at scale, especially within such partnerships.

AI applications required n

Ship design and engineering

- Hybrid intelligence: the transition from modelling to specifying and decision-making.
- Genetic algorithms and other optimisation techniques for optimising ship design based on multiple weighted variables
- Operational data feedback. Pattern recognition and classification: using AI to analyse sensor information datasets and Big Data from shipping operations. To improve digital twins and to optimise and validate digital design tools (long-term machine learning);

Project planning and production planning

- Algorithms to interpret and translate CAD data from the various systems and databases of the shipyards and cooperating specialist suppliers for dynamic integration into the distributed and complete product model of the ship that is to be built and as the basis for digital production control and planning.
- Algorithms that determine workloads and throughput times for each job, based on the continuously developing 3D digital product model and the digital control information for the digital processing machines as envisaged (and their occupancy figures).
- Decision support systems based on dynamic planning and pattern recognition. Feedback of real-time production data to allow risk-reducing adjustments to be made.

Digitalisation of production environments

- Techniques such as digital twins and data fusion for combining sensor data and pattern recognition from physical production lines with robot control info from the digital CAE product model. These are needed for implementing automatic and robotised production technology effectively (welding, assembling, coating, etc.).
- Data transparency and interconnectivity are primary conditions for achieving integration between product and production data within the CAD/CAE/CAM and MES platforms.

AREA OF APPLICATION SMART PORT LOGISTICS

Smart Port Logistics uses AI to achieve synergy benefits in the logistics supply chain by reducing inefficiencies, particularly in the way time and space are utilised. Information exchange between parties and decision-making based on that information (automated or otherwise) are important elements of this.

Goal

Achieving significant improvements in efficiency, energy consumption, air quality, industrial productivity and environmental noise nuisance by developing smart – and possibly autonomous – logistical transport solutions in the Dutch ports and their hinterland areas.

Optimisation of the complete logistics chain

Links in the logistics chain are often optimised with AI Individually, rather than tackling the entire supply chain. This is a consequence of the availability of information plus the obvious difference in muscle between large and small organisations. Moreover, the financial advantages of supply chain optimisation do not necessarily directly benefit the companies in the chain. This means it becomes less attractive for those parties to make the requisite investments.

We therefore want to set up and implement joint projects where the entire value chain is optimised and not just the individual logistics links. Together we can develop AI that weighs up the various priorities (e.g. efficiency or energy consumption) when making logistics decisions in practice in the ports. This can then be used in simulations and decision support systems, for instance.

The importance of data in port logistics

In logistics, the systems have a limited degree of connectivity and communication with each other. To improve the connectedness of systems, the data maturity of individual companies must increase and more parties must be ready to share data (see also the 'Data Sharing' building block).

Living labs

To create a positive impact on the environment, we want to get smart transport concepts up and running as soon as possible. Prominent aspects addressed by these concepts are air quality, health and noise pollution. The impact on logistics staff at the port is also taken into account.

It is difficult to validate smart transport concepts because there are no environments where they can be rolled out with zero risk, as most transport systems are already operational and consequently not easy to adapt. Setting up living labs therefore costs time and money. Using living labs will give the sector a better understanding of how smart transport concepts can be integrated into an existing, operational transport environment, which will in fact save time and money.

Digitalised goods transport chains

The goal is to lay the foundations for a fully digitalised goods transport chain in the Netherlands within ten years and eventually to implement it completely.

This goods chain will function as a single, large, interconnected network of transport modes in the ports and in both the vicinity and the hinterland. The chain will be controlled by a large number of intercommunicating systems. The earnings models underlying this virtual chain will be better understood by then and will drive further investment.

Investment and earnings models

Many logistics and transport companies do not have the financial muscle to invest in AI developments. In the case of the Port of Rotterdam, for instance, logistics and transport consist of about 75-80% SMEs, which are often at low digitalisation and data maturity levels. The position of SMEs may come under further pressure in a world of data-driven and self-organising logistics. Using intelligent algorithms will lead to new business models (such as booking platforms) that may change the playing field completely.

AI applications required

Independent planning systems and transport systems

- AI for resilient systems: operational planning systems that are robust in handling faults and unreliable data and information systems (e.g. due to defective sensors). Who does what and when, who or what shares which information at what points, where does which transport vehicle go when to pick up or deliver which cargo?
- Self-learning algorithms: new data is continually collected while the systems are operational. Machine learning can help adapt the internal prediction models ('adaptivity'). This also benefits the robustness, as the systems get better over time at dealing with uncertainties and varying circumstances.
- Decision support and planning algorithms: Using information collected in real time to provide information for decisions or to take them autonomously. This can be used to determine where and when which cargo is moved by what type of transport vehicle. This also takes account of e.g. energy consumption, emissions, etc.

AREA OF APPLICATION
SMART ASSET MANAGEMENT

Smart asset management involves using hardware and software for monitoring various performance and maintenance characteristics of physical objects, often automatically, and for giving recommendations about aspects such as maintenance. This could for example be done for installed systems, buildings, ships, quay walls and waterways. Asset management subareas include predictive maintenance and resource optimisation, for example, helping to cut operating costs and lengthen the lifespans of objects.

Goal

To implement lifecycle management of both natural and built assets in the maritime sector, with the aim of finding a cost-effective way of achieving the longest possible operational lifespan, for instance, or the maximum utilisation or minimum ecological footprint of the asset.

Sharing knowledge

The maritime sector wants to focus on increasing knowledge levels at companies whose asset management is a key element in their business operations. They need to have enough knowledge to prepare assets for automatic asset management solutions and the realisation of various proofs of concepts. It is important that companies take the step of automating the management and performance planning of those assets with AI, based on predictive and optimisation models on the one hand and the collected data on the other.

Predictive models and optimisation models

Predictive and optimising models need to be developed further. Predictive and optimising models such as wear-and-tear for components, performance models and fault models for subcomponents or entire assets all need to be developed further. There are as yet no known initiatives in which generic prediction and optimisation models are being shared. Sharing such models with others in the sector can shorten the development lead times hugely.

Smart asset management is indispensable

Eventually, asset lifecycle management will become an important aspect of the Dutch maritime sector for both natural and built assets. Lifecycle management solutions make it possible to optimise the performance, utilisation, ecological footprint and/or service life of the asset for the lowest possible costs. This also applies to assets that consist of subcomponents that are each supplied with their own asset management solutions.

AI applications required

- Computer vision: Extracting information (often classifications) from images or videos. In the asset management example, such methods are used for estimating the condition of assets or components.
- Anomaly detection: Supervised and unsupervised machine learning models – detecting abnormalities in an asset or part thereof by detecting significant deviations in sensor values or combinations of sensor values.
- Predictive modelling: predicting outcomes (time series, classification models). This can be used on the one hand to see how past events could be predicted and on the other, predictive techniques can be used to forecast future events. For example, when sensor values suggest that an asset is in danger of failing, that information is can then be an input for maintenance planning.
- Prescriptive modelling: The methods listed above aim to turn data (e.g. sensor information, images, videos) into information, on the one hand by classifying it (what is the status?) and on the other by predicting the expected future status. That information is then used to support decision-making through mathematical optimisation or simulation techniques, for example by optimising maintenance planning by taking the expected condition of an asset and its desired use into account (harmonising the ‘utilisation’ and ‘availability’ of the asset).

HEADING TOWARDS AI TOGETHER

As a working group, we want to drive investment in data and AI in our sector. The roadmap for AI described here shows where those investments should flow, but that is not all (of course). A ship is not made of targets, objectives do not make a port more efficient, and what we say here will not directly help a single employee to develop.

The next step that we need to take, as a sector, is putting all our shoulders to the wheel and backing this agenda. Whether that is at the shipyard or in the ports, at sea or on land. It is time to get things moving – genuine action. That is what the Netherlands has done in the past and it must remain so in the future.

And your contribution matters. Which of the themes covered here are you already working on? Which new themes have intrigued you? What projects would you like to get started that will help achieve the aims and goals in this document, and who would you like to work with?

We want to hear what you have to say, so contact us and we will be happy to think along with you about project development, setting up a consortium and the options for funding.

PARTICIPANTS

Over sixty representatives from the maritime commercial sector, knowledge institutes and the government have contributed to this publication by the Ports and Maritime working group. Our thanks to the participants from the core group in particular.

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