

Research and development

One of HHLA's strategic objectives is to continuously improve the efficiency of its operating systems, and consequently its competitiveness, by developing application-oriented technologies. The main focus of these activities is therefore on engineering and IT-based innovation projects. Due to close collaboration with technical universities, institutes, industry partners and government authorities, joint projects can be planned, managed and developed by working groups.

In the 2019 financial year, HHLA mainly focused its resources and available capacity on research as part of the subsidy programme for Innovative Port Technologies (IHATEC).

Container terminal 4.0

The Container Terminal Altenwerder (CTA) is one of the most highly automated container terminals in the world. Since it opened in 2002, HHLA has constantly been researching and working on improving and expanding automation at the site. Right at the start, a paradigm was established whereby automated work areas are separated, isolated and off-limits to staff in order to guarantee occupational safety. This principle has always been upheld. Today, however, this paradigm is preventing the ramping up the automated processes, as it inevitably excludes them from areas used by people. The research project "Container terminal 4.0 – a paradigm shift in the automation of container terminals via human-machine interaction rather than separation" is to be conducted as part of the IHATEC subsidy programme. The project's main objective is to develop automation solutions for various container crane systems used at the terminal in work areas shared by people and machines (e.g. alongside ships and trucks) and to implement them as prototypes. At the same time, the experience, knowledge and evidence gathered during this process should play a fundamental role in establishing the safety standards needed to create a reliable framework for future automation projects.

INTERACT

HPC and Container-Transport-Dienst GmbH (CTD) initiated the IHATEC research project INTERACT (integration of autonomous trucks in container terminal operating processes) in conjunction with the Karlsruhe Institute of Technology (KIT). As part of the project, a feasibility study and a subsequent gap analysis will determine the extent to which self-driving trucks can be deployed simultaneously on public roads and in closed-off terminal areas – and what technical, operational and legal requirements should be imposed on the vehicles themselves as well as on the transport service providers and terminals involved. The result of the project will be a road map that outlines the necessary future development steps.

Hamburg TruckPilot

With the Hamburg TruckPilot field test, MAN Truck & Bus and HHLA are conducting a highly innovative research and testing project to develop automation solutions in road transport. The aim is to analyse the requirements for the customer-specific deployment and integration of self-driving trucks in the automated container handling process under realistic conditions, and to review its feasibility. The prototype trucks equipped with the corresponding electronic automation systems should be able to operate autonomously within CTA. The operational, infrastructural and IT requirements for the automated handling of self-driving trucks are also to be identified and specified. The project is split into three phases: the preparation phase, which ran until the end of 2018, served to define the underlying technical conditions. The project is currently in the testing phase, which is scheduled to run until June 2020. This comprises the technical development of the system at MAN's testing centre in Munich in accordance with the specific requirements identified during the preparation phase. The structure of the subsequent field tests from July to December 2020 will be determined by the results of the preparation and testing phases and conducted under conditions similar to customer usage.

AeroInspekt

Storage cranes at the container yard are the linchpin of HHLA's cutting-edge, high-performance container terminals. The crane rails are subject to extreme requirements in terms of maintaining an unchanged position and exact track guidance. However, the geomorphological composition of the port terrain continuously results in significant subsidence and shifts in the track network, which have to be monitored, measured and rectified on a regular basis. This measurement work results in operational interruptions. The IHATEC subsidy project AeroInspekt (automated multi-rotor measurement and inspection system for the rail systems of port handling facilities) – which HHLA is running in conjunction with the Technical University of Braunschweig (TU Braunschweig) – aims to develop a measurement system for crane rails in a fully automated container yard by means of automated multicopter systems and photogrammetric analysis before building and evaluating a corresponding prototype. The aim is not only to achieve significant efficiency gains, but also to optimise the safety of the required and currently time-consuming measurement of crane rails in a fully automated container yard.

BiSchi

In much the same way as feeder ships, calls at the port and the transfer of containers by inland waterway ship require a tremendous amount of coordination, as several terminals are served during each port call. Since the beginning of 2019, the Hamburg Vessel Coordination Center (HVCC) has been developing a new inland waterway ship platform which incorporates and takes into account the special requirements of inland waterway shipping companies. The IT systems for the

new inland shipping platform are being developed by DAKOSY Datenkommunikationssystem AG. Alongside modal 3 Logistik GmbH (an HVCC customer), Deutsche Binnenreederei AG, Carl Robert Eckelmann GmbH and Walter Lauk Ewerführerei GmbH are also partners in the project, which is funded by Hamburg's Departmental Authority for Economic Affairs, Transport and Innovation. The main objectives are to remove inefficiencies within the transport chain and to improve the reliability of handling through prompt, transparent planning for all parties involved: scheduling for the inland waterway shipping company, ship crew, terminals and HVCC all takes place in real time in a single overview and data set. The aim is to enhance inland shipping's position as an effective and environmentally friendly mode of transport and to make use of its great potential as a key pillar of hinterland traffic.

Hyperloop transport system

In December 2018, HHLA established a joint venture with the US-based research and development company Hyperloop Transportation Technologies (HTT) to explore possible applications of hyperloop technology for transporting shipping containers. The hyperloop concept is based on the idea of transporting people and goods at high speed through a tube. Using magnetic levitation technology, the transport capsules are to be sent through a tunnel with a partial vacuum at speeds of up to 1,000 km/h. Hyperloop is thus regarded as an additional mode of hinterland transport together with rail and road.

Initial plans are for the construction of a transfer station for testing purposes at CTA by October 2021, as well as the development of a transport capsule for standard shipping containers (complete with a section of hyperloop tube). The aim of the prototype is to visualise the handling process in a hyper port and, for example, to illustrate its integration with autonomous vehicles.

ZETT

Another project carried out by CTA as part of the IHATEC subsidy programme focuses on the "Zero-Emission Terminal Tractor" (ZETT). Within a port/terminal or logistics centre, containers are usually transported using diesel-powered terminal tractors. In order to reduce exhaust emissions and noise pollution, there is a need for alternative drive systems. As things stand, there is currently no alternative drive technology for these tractors with the technical maturity required for industrial use and that can be operated cost-effectively. The primary objective of this project is to develop a system solution for battery-powered electric transport that will allow the cost-effective achievement of environmental benefits in the medium term. Both the vehicle and the charging technology need to be designed in such a way that they can cover a very broad range of applications. The resulting economies of scale will support the goal of enabling cost-effective operation. The project is

primarily being run in conjunction with KONECRANES GmbH, the Institute for Automotive Engineering at RWTH Aachen University and BMZ GmbH.

FRESH

Harnessing consumer flexibility with regard to their energy demands is expected to play an important role in the success of the energy transition. The FRESH project (flexibility management and control reserve provision of heavy goods vehicles in the port, sponsored by the German Federal Ministry for Economic Affairs and Energy) builds a bridge between commercial electric vehicle fleets and the energy market in practice, thus tapping the potential for flexibility. At CTA, transport between the quayside cranes and the block storage units is fully automated with the use of driverless vehicles (automatic guided vehicles, or AGVs for short). The entire fleet of these heavy goods vehicles is currently being replaced by battery-powered vehicles using lithium-ion battery technology and fully automated charging stations. On average, however, an AGV spends about a third of its operating time in a waiting position. During this time, it is possible to postpone or interrupt the charging process, vary the charging capacity or even feed electricity back into the grid. The challenge is to continuously forecast the transport capacities that will soon be required of the vehicles and to plan the potential battery capacities and allocations of charging stations and vehicles, thus paving the way for the optimised use of available flexibility.

HITS-Moni

In partnership with the Department of Informatics at the University of Hamburg and DAKOSY, HHLA is conducting the IHATEC-funded project Harbour IT Security Monitoring (HITS-Moni). The project seeks to develop port company-specific processes, measures, concepts and rules for detecting and blocking cyberattacks on IT systems, improving and increasing IT security at companies in the port sector by linking the IT security tools of different companies, as well as expanding and implementing automation to protect employees against sensory overload. It is expected that the establishment of innovative IT security concepts and technologies within autonomous systems will boost productivity and efficiency by reducing the risk of potential system failures caused by cyberattacks.

UniPort 4.0

Hansaport has set up the IHATEC project UniPort 4.0 in partnership with Brunsbüttel Ports GmbH and other companies. Digitalisation in the field of all-purpose ports is still at an early stage. The often conventional work procedures and comparatively low level of maturity in terms of organisational and information technologies at all-purpose ports represent a significant obstacle. Whereas digitalisation at container ports is developing swiftly on account of global growth in consumer goods and the standardisation offered by containers, the core business of an all-purpose port lies in the handling of all kinds of break bulk

and dry bulk. These pose challenges for the ports in terms of handling technology and in relation to the various shapes, weights, volumes and batch sizes, as well as in terms of storage, safety regulations and the required transport modes. In light of the ever-changing goods and product sizes/weights, the processes at an all-purpose port must be structured in a sophisticated manner and, from a digitalisation standpoint, usually offer significant optimisation potential. The idea behind UniPort 4.0 is to apply digitalisation in a comprehensive manner at the various ports involved.

Artificial intelligence and machine learning

With its artificial intelligence (AI) initiative, HHLA is pursuing three key business aims: alongside new sources of revenue and increased customer loyalty, the initiative also seeks to boost productivity and throughput at the terminals. HHLA also feels that AI offers considerable potential when it comes to increasing occupational safety among the workforce.

The first AI pilot project was successfully completed in 2019: AI-based forecasts of container collection times result in increased yard productivity. The collection time of a container is a key factor in optimising yard operations, even though the dwell time of the container is often not known when it arrives at the yard. This situation occasionally results in unnecessary restacking. In a bid to optimise block storage, an algorithm was developed to forecast container dwell time. It is based on historical data but continuously optimises itself using cutting-edge machine learning methods. Further AI-based projects are to be implemented in future in order to leverage additional optimisation potential at various stages of the value chain.

Performance certified

In order to document their performance, the Container Terminals Altenwerder (CTA) and Tollerort (CTT) once again completed certification in accordance with the Container Terminal Quality Indicator (CTQI) in the reporting year. The standard, which was developed by the Global Institute of Logistics and Germanischer Lloyd, checks criteria such as the safety, performance level and efficiency of a terminal on both the water and onshore, as well as its links to pre- and onward-carriage systems. With their successful certification, the terminals once again confirmed their high levels of performance and compliance with all quality standards.

Purchasing and materials management

Purchasing is a shared service provided by the HHLA Group's management holding company in Hamburg. HHLA Group purchasing supports corporate strategy by means of its professional management of procurement activities. The aim is to establish a consolidated supplier base that is characterised by maximum value added, top quality and optimum life cycle costs.

The strategic purchasing function supports and advises Group companies as part of its holistic management of product groups, suppliers and contracts so that the service and performance requirements of internal customers are met as completely as possible. Market developments relating to new technologies, innovations and the service performance of specific suppliers are considered in close cooperation with the operations and technology departments. In this regard, the purchasing department ensures that all Group requirements for the procurement processes are observed in accordance with the framework guidelines. These guidelines are binding for all employees.

In order to develop viable future solutions for port infrastructure, HHLA remains committed to its strategic and collaborative partnerships with selected suppliers while taking into account both economic and ecological aspects. Products, facilities and processes are systematically enhanced in order to increase the degree of digitalisation. When selecting partners, great importance is attached to reliability, quality, innovative strength, cost structure, economic stability, sustainability and compliance. Compliance with these criteria is monitored by an IT-based supplier management system. All suppliers undergo this process, especially potential new suppliers. This also facilitates a continuous internal assessment. Strategic suppliers are evaluated annually by their internal customers and departments. The evaluations include experience on first contact as well as information about project procurement and processes. As a further enhancement, the details provided are processed in a new "key figures cockpit", which, for example, plays a key role when preparing for negotiations.

HHLA is continuing to drive the automation of purchasing processes for day-to-day requirements. In the reporting period, 32.9 % of all purchasing processes were handled fully automatically by means of e-procurement systems (previous year: 25.2 %). This enables us to streamline processes and ensure both non-bureaucratic procedures and compliance with process standards. By systematically continuing these optimisation and automation measures, further automation potential is expected for the 2020 financial year. These steps will enable us to drive the further strategic alignment of our purchasing activities.

HHLA's supply chains comprise capital goods (such as port handling equipment) as well as consumables and other services (such as maintenance). The overwhelming majority of suppliers are from Germany and other European countries. In 2019, equipment and energy accounted for 29.2 % of the Group-wide procurement volume, while information technology (IT) accounted for 14.5 %, construction for 26.7 %, MRO (maintenance, repairs and operations) for 13.9 %, and other indirect services for 15.7 %. The total managed purchasing volume amounted to approximately € 198 million.