OPPORTUNITY. 機匯

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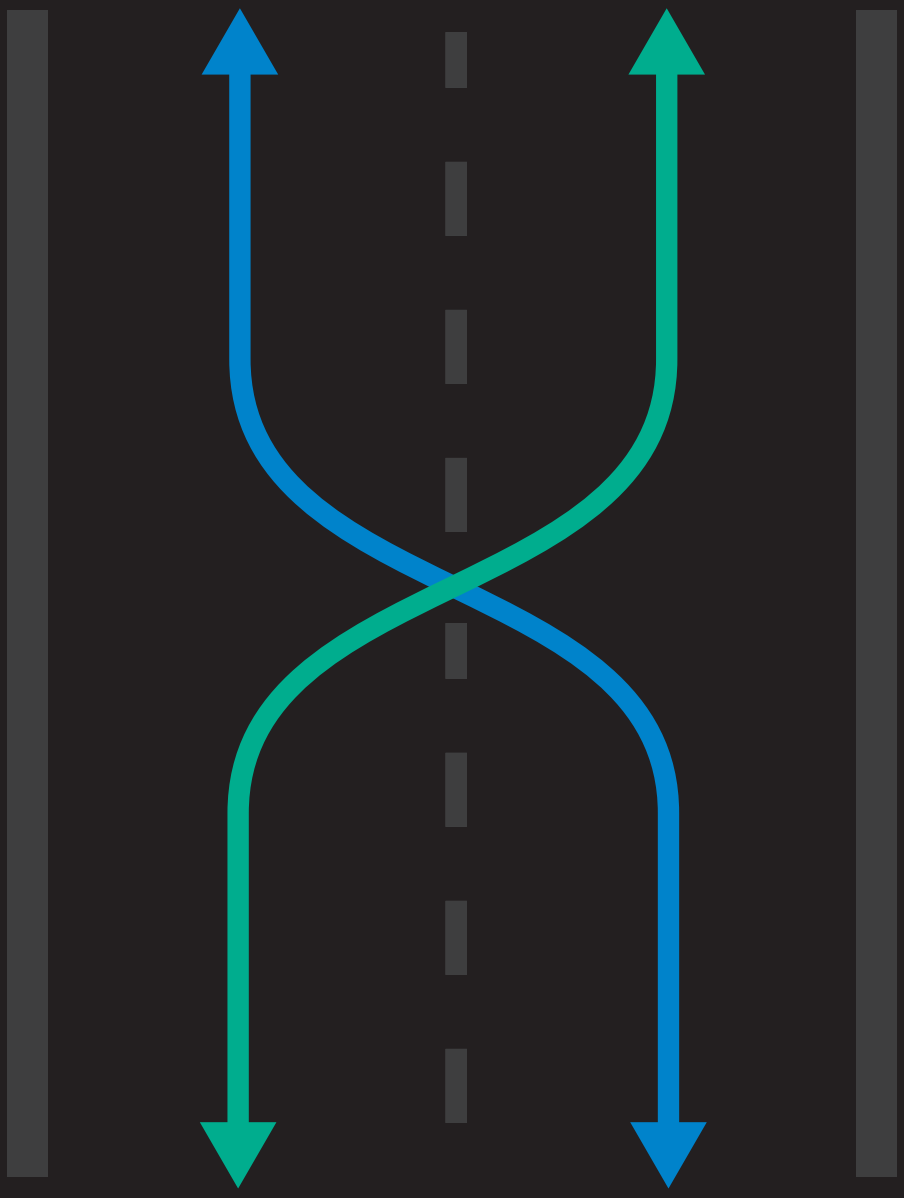

NEW AUTONOMOUS TRUCK ECOSYSTEM RESHAPES TERMINAL OPERATIONS

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TAKING ACTION, CREATING MOMENTUM

The focus towards a more sustainable future has gathered pace globally for all good reasons. In recent years, financial investors are increasingly looking for insights into company sustainability credentials and ratings when providing financing. The accelerated drive towards sustainability and its inclusion into good corporate governance will affect how shipping and port industries are going to operate.

Like many other companies, Hutchison Ports has made efforts on the sustainability front. Our sustainability strategy and actions address the risks posed by an evolving social, environmental and regulatory landscape. We have developed our own sustainable blueprint throughout our network of ports. This blueprint provides us with a framework to achieve greener terminal operations and to continue to look for ways to improve along this path.

For instance, apart from using more hybrid equipment to reduce emissions, we have been able to make a breakthrough in some of the operational challenges in the use of autonomous trucking at our terminal in Thailand. The application of these eco-friendly electric-powered autonomous trucks into a terminal environment is an excellent example of the capabilities that we possess to help drive us to further develop sustainable operations into the future, as well as the effort we have made to make a difference.

But navigating changing climates and continuing to make advances in sustainability efforts present a significant challenge to many companies, including ourselves. Making further breakthroughs to reach our sustainability goals will still require new initiatives, time and investment, and it will not be a simple path. At the moment, our development team is also exploring the application of alternative sources of energy, such as hydrogen to power our equipment fleet.

Global terminal operators are a significant part of international trade and the global supply chain, and have the responsibility to make a difference. For us at Hutchison Ports, some of our efforts have taken shape. We are exploring and experimenting with new technologies to make an impact, so that we can keep this momentum to support a sustainable future for the maritime sector.

Eric Ip
Group Managing Director
Hutchison Ports

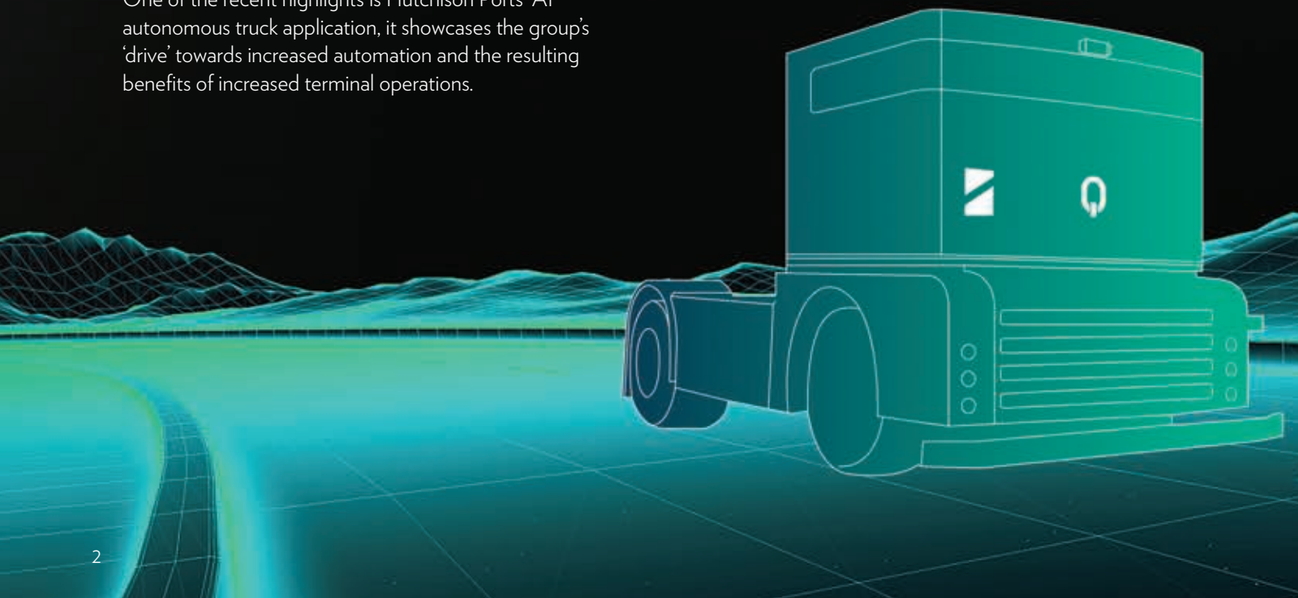
NEW AUTONOMOUS TRUCK ECOSYSTEM RESHAPES TERMINAL OPERATIONS

Technology has transformed how we communicate and interact with each other in every aspect of our lives. Changes and advances in technology, both big and small, have impacted how we communicate, how we live, how we travel, and how we work.

01

With specific regard to artificial intelligence (AI), this ever-evolving technology is no longer only used in high-tech specialised fields, but also in mainstream businesses and industries. In the ports sector, we are seeing the development of smart terminals, that utilise digitalisation and automation, such as 5G communications, blockchain, big data, automated vehicles, remote control equipment and highly sophisticated terminal operating systems.

Hutchison Ports has always been leading the way towards the next generation of terminal operations with its Smart Port Strategy, pushing forward with a global roll out of the many automated solutions. One of the recent highlights is Hutchison Ports' AI autonomous truck application, it showcases the group's 'drive' towards increased automation and the resulting benefits of increased terminal operations.



CREATING A NEW ECOSYSTEM

It has always been Hutchison Port's goal to focus on improved safety and terminal efficiency, while lowering costs and delivering greener solutions across the group's global network of ports.

Taking advantage of the latest technological tools available in recent years, Hutchison Ports is the first port operator to achieve 'true' mixed traffic mode terminal operations implementing AI autonomous truck technology into daily operations.

Hutchison Ports autonomous truck development team found the solution enabling the autonomous and conventional trucks to operate together without isolation and interacts with each other. Both manned and unmanned trucks follow the same traffic rules to create a dynamic operating environment to achieve maximum efficiency and flexibility. The new terminal operating ecosystem will lead to an optimised workflow and result in a higher level of efficiency to shipping lines and port users.

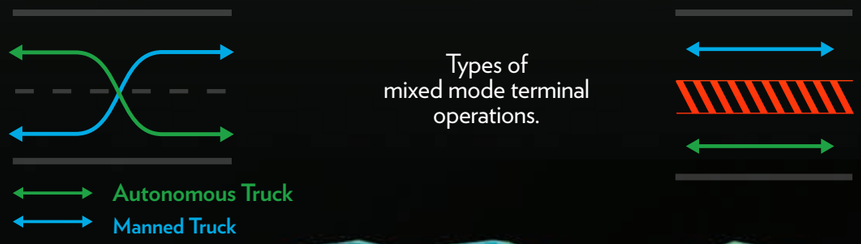
The development team unleashed the potential of autonomous truck technology with a unique re-designed operation workflow and traffic policies, leading to a more reliable and smarter terminal operations.

Today, a fleet of six autonomous trucks at Hutchison Ports Thailand Laem Chabang Terminal D are performing daily yard marshalling and regular vessel operation tasks. These autonomous trucks have already contributed over 20,000 production moves in the span of nine months, since September 2020.

The success of this innovative project has been made possible through the collaboration of Hutchison Ports' autonomous truck development team and the developers at Westwell, who specialise in developing a range of artificial intelligence applications across many industries.

In this special edition of OPPORTUNITY, we will take a look at the development of autonomous truck technology at Terminal D and explore how it will benefit the group's network of ports around the world and future plans.

Types of mixed mode terminal operations.



"We demonstrate the most possible path for the existing terminals to migrate into automated mode in the future."

ST Pak
Group Operations Director
Hutchison Ports

Hutchison Ports Thailand, Terminal D

02

FROM SMART TO GENIUS

Hutchison Ports has always been a leader of innovative ideas that have revolutionised terminal operations, and through a number of bold investments the group has aimed to reduce its carbon footprint, improve sustainability and efficiency.

When autonomous vehicles first became popular with test runs widely seen on public roads a few years ago, the Group Operations, Engineering and IT development teams were inspired by the technology and the potential to adapt it to container terminal operations. After some initial assessments and satisfactory proof-of-concept trials, Hutchison Ports decided to partner with Westwell to develop autonomous truck technology to the groups' network of ports in October 2019.

From its inception, Terminal D was designated to become a 'Smart' and 'Green' facility, which made the terminal the ideal location to kick off the journey of autonomous truck implementation. With the terminal's state-of-the-art infrastructure and technological resources, it had the capacity to support new technologies and readily open its doors to more technological optimisation and upgrades. It is the most suitable terminal to pioneer new technology, pilot projects and benchmark new digital solutions and equipment, a de facto 'laboratory' for the group.

Terminal D has already been crowned the world's first port to operate both remote-control quay cranes and automated rubber-tyred gantry cranes, and today it is the first port to operate AI autonomous truck in a 'true' mixed traffic mode terminal operations.

BRISTLING WITH NEW TECHNOLOGY

The autonomous truck is designed without a driver cab and built-in AI, advanced sensors, HD cameras and GPS to navigate around the terminal and perform specific tasks assigned by nGen (a proprietary Terminal Operating System by Hutchison Ports).

With numerous trial runs and safety test results verified by risk assessment experts, the autonomous truck operates like any ordinary conventional truck with a human driver, only safer and more efficient. The autonomous trucks at Terminal D have completed the first barge operation and first feeder vessel operation in September and October 2020 respectively. In January 2021, the autonomous trucks, together with other internal trucks, completed the first mother vessel operation.

Hutchison Ports has successfully adapted the autonomous truck from a concept vehicle to a pragmatic workhorse that has enhanced and improved productivity and safety levels at Terminal D.

Another important aspect of success in this project, has been the overall acceptance of innovation within the Hutchison Ports Thailand workforce. Staff are keen to work with new technology and have embraced the introduction of automated remote-control equipment. With the autonomous trucks already in production, staff can now perform new tasks and assignments to further improve terminal efficiency and productivity. It is a testament to the professional, progressive, and engaging project team which turn the autonomous truck concept into a reality.

SETTING NEW STANDARDS

Hutchison Ports set the standard for automation with its ECT Delta terminal in Rotterdam, the world's forerunner to Automated Guided Vehicles (AGV) in the 1990s. Through continuous investment, and especially the combination of advanced knowledge and technology, ECT Delta is still leading the way today in Europe.

Since then, the group has been rolling out many inventive terminal developments and projects throughout its network of ports. These cutting-edge developments have resulted in improved cost efficiency, increased productivity and reduced downtime. The benefits range from lower 'long-term' operating costs, energy efficiency, greener credentials and better staff welfare.

AUTONOMOUS TRUCK

The autonomous truck incorporates a neuromorphic chip that can teach, train and enhance the vehicle with a high level of integration and self-learning. The vehicle can then solve complex problems with its AI and respond and act independently to complete an action or task. Loaded with banks of advanced sensors and HD cameras, the vehicle gathers images of the local geography so it can navigate safely, effectively and freely through busy terminals without physical segregation from other manned trucks.

AUTOMATED GUIDED VEHICLE

The AGV is a driverless vehicle that tracks along the transponders below the terminal ground for navigation and use lasers for safety. The AGV operates in dedicated routes which limits its flexibility compared to AI enabled autonomous truck. The AGV operates in a dedicated area fully separated from other manned vehicles.

03

UNLEASHING THE POTENTIAL OF AUTONOMOUS TRUCK TECHNOLOGY

The success of implementing autonomous truck to Terminal D is reliant on its advanced technology and the re-creation of a new terminal operating ecosystem. It provides a perfect platform for the next generation of ports with safety at the heart to future developments.

"We focus on safety and driver education to make autonomous trucks part of our daily operations."

Dr. Ivan Lee
Senior Manager - Terminal Development, Operations
Hutchison Ports

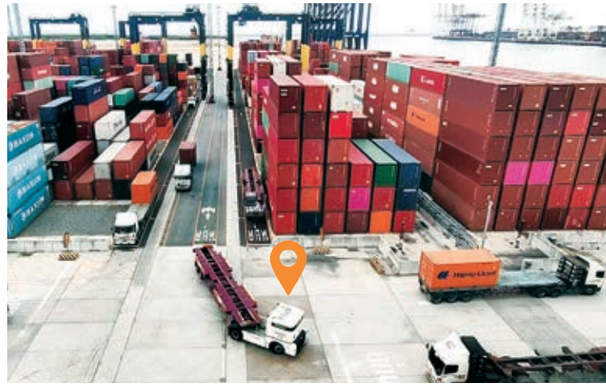
An Autonomous Truck overtakes another one upon receiving instruction.

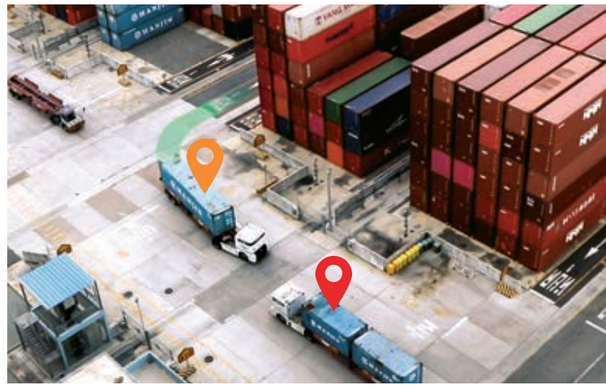
ARTIFICIAL INTELLIGENCE

Being able to make safe decisions while navigating a busy terminal is vital to any port operation. The on-board AI and the advanced sensors installed in the autonomous truck allow it to make safer decisions on the routes, including changes in direction and vehicle speed.

Like manned conventional trucks, the flexibility of last-minute change in the loading sequence is crucial to terminal efficiency. Having received instruction from the quayside checker, the autonomous truck can execute a newly assigned task to reduce downtime during idle mode in queue and adds more flexibility to the planned loading sequence.

The autonomous truck also has a powerful processing platform onboard which enables it to operate in a real-time environment with data collected from the sensors. Having rigorous end-to-end machine learning, the autonomous truck will be able to learn a set of driving skills, such as self-organising intelligence, lane-keeping, overtaking, obstacle avoidance and intersection turning in structured and unstructured roads.





Above & below: Autonomous truck turning from side road to main road and self organising intelligence at crossroad junction.

ADVANCED SENSORS & PRECISION

The autonomous truck has the advantage of 360-degree wide perspective providing real-time, all-round 'vision' enabling it to instantaneously 'see' everything in its vicinity to achieve safety and accuracy during navigation. With the support of Extreme Precise Position (EPP) system, it can achieve positioning accuracy of 2 cm and a steering angle within only 0.5 degrees. It can achieve a one-time position success rate of over 97 percent.

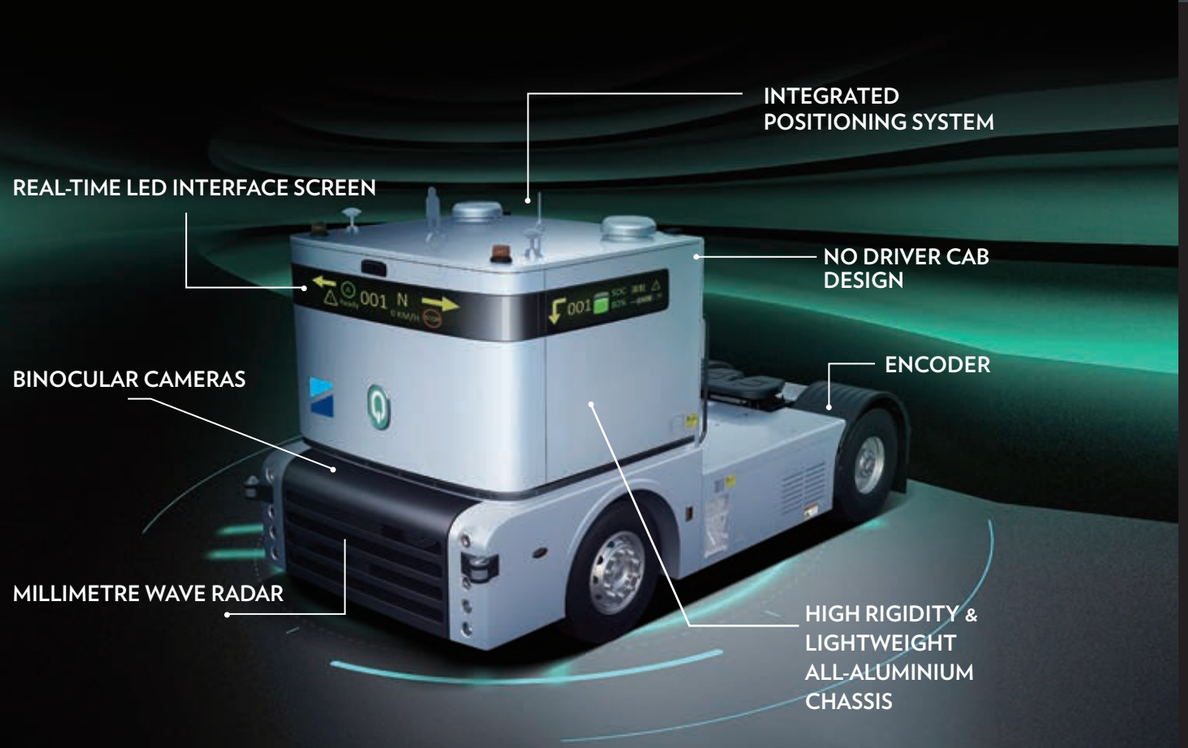
Unlike conventional trucks with mechanical control, the autonomous truck relies on electronic control signals, which allow for quick response time and enable safer and smoother manoeuvres. This is convenient and suitable for autonomous driving in enclosed areas, such as ports and terminals.

SAFETY FEATURES EMBEDDED

Safety is of primary importance to all technological developments and especially considered when introducing new technology into terminal operations around the world.

The autonomous truck has built-in safety features which allow the vehicle to navigate effectively and safely in harmony with the conventional trucks. An emergency safety stop function is embedded into each truck. For example, should a vehicle bypass yard traffic rules; unexpected human activity occurs or when unavoidable obstacles or aggressive driving are present, the safety stop function will be activated and engaged to ensure optimal safety.

The maximum speed is also pre-set at 30 km/h, which is the terminal safe driving speed limit for all trucks.



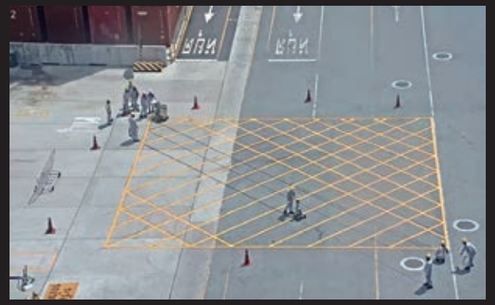
Centralised Twistlock Station.

OPTIMISED WORKFLOW

To increase the safety level of staff working in yard, the project team has introduced the centralised twistlock station into its daily operation flow. Stevedores are relocated from underneath the quay crane to the back-reach area, protected by the twistlock station, to ensure a safe working environment while securing or removing the twistlock cones.

The quayside checkers are now repositioned in a quay crane checker cabin on ground level to verify container conditions through HD cameras and confirm movements with nGen.

Quayside checker in quay crane checker bin.



Predefined landmarks.

TRAFFIC MANAGEMENT & EDUCATION

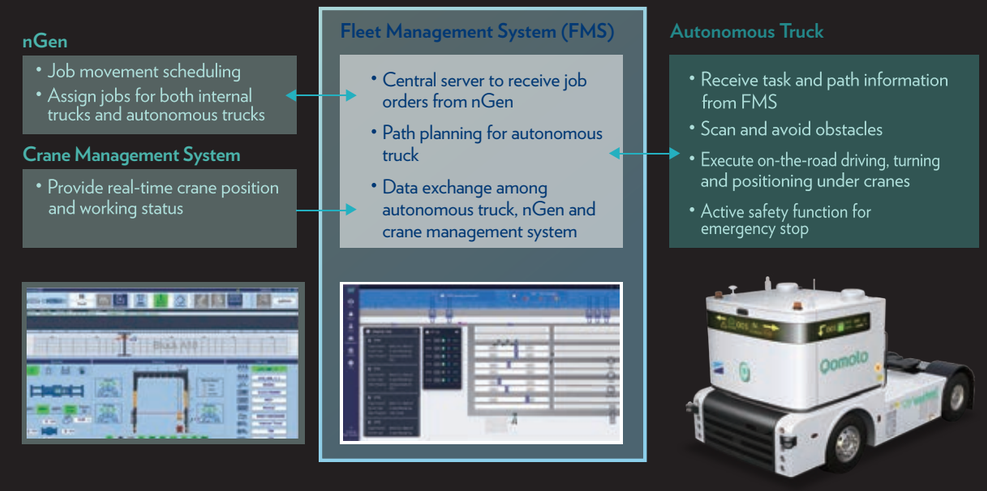
Junction management and the behaviour of an autonomous truck are critical to maintain safe and smooth traffic flow in the terminal. The predefined landmarks and traffic signs improve navigation and add clarity to terminal users, especially at road junctions and complex traffic conditions.

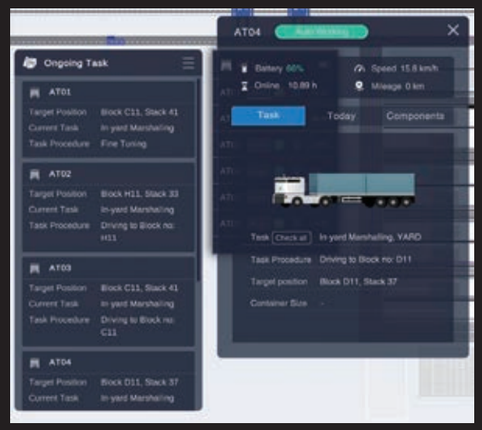
A new set of traffic policies have been introduced to external truck drivers and terminal staff on autonomous truck awareness. Multiple sessions of training programme have been held and targeted to reach over 30,000 truck drivers in the Laem Chabang port area to enforce terminal safety while working in mixed traffic mode at Terminal D.

Terminal staff training session.

SYSTEM INTEGRATION

Fleet Management System (FMS) coordinates and plans the routing for each autonomous truck. The FMS receives job order messages from nGen and then disseminates path planning from the autonomous truck's current location to the destination. It interacts with nGen and other crane management systems, which helps to extend the terminal's capability in becoming even more automated.





FMS serves as an interactive data dashboard with the detailed status of every autonomous truck, such as battery level, current location, destination and job order.

ENHANCED YARD SURVEILLANCE SYSTEM

By defining safety procedures and extensive education, the Group's Global Minimum Safety Standards (GMSS) Clause 12.11 requires that drivers of internal and external tractors to stay inside the vehicle except in emergency in order to realise a safe working environment in the yard.

To ensure yard personnel are not at risk, an intelligent yard surveillance system add-on software has been integrated to the current high-definition CCTV system to detect any human activities in restricted areas.

Any personnel that are in the vicinity of the autonomous truck during operations will trigger a warning alert. The safety team will quickly respond to maintain smooth yard traffic flow and personnel safety.

BENEFITS

RELIABILITY & ENDURANCE

With regular and unstable extreme weather conditions impacting the planet, ports are at the forefront of extreme heat and cold, high winds and rainstorms.

Autonomous trucks can operate around the clock 24/7 under extreme weather conditions. It takes approximately two hours to fully recharge an autonomous truck with expected 20 hours of operational time under normal operating conditions. The vehicle is purposely designed to handle a maximum of 80 tons of loading that caters for almost all practical scenarios.

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04

ECO-FRIENDLY

Autonomous trucks are powered by an electric motor and therefore environmentally friendly. Producing no emissions and reducing noise pollutions on the waterfront, makes them beneficial to the environment and the health of the yard personnel.

As part of the Group's Environmental Strategy, emissions reduction is an important initiative. Migrating from conventional diesel trucks to electric trucks with autonomous driving features would deliver the promise of a green port and the preferred partner for a sustainable supply chain.

Autonomous truck at recharging station.

UNINTERRUPTED BY PANDEMIC

With the huge impact of the COVID-19 pandemic, many normal business practices are affected. As a result, container yard personnel have not always been able to report for duty, due to illness or local quarantine restrictions which resulted in many ports having to deploy extra resources at short notice.

In these scenarios autonomous trucks can play an important role in delivering an unlimited level of support, as they can operate for days at a time, offering respite to any backlogs of containers and ensuring the continuity of regular services to the port.

LOW MAINTENANCE COST

Another positive outcome of adopting autonomous truck technology is the cost savings of repairs and maintenance. When comparing an autonomous truck to a diesel truck, it is more cost-effective as diesel engines are more costly to maintain and repair than electric vehicles.

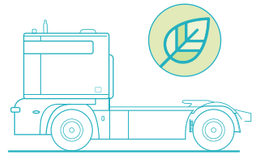
DESIGNED TO FIT VARIOUS CONFIGURATIONS

The autonomous truck technology has brought many possibilities to port operations and is designed to fit many operating configurations including manual, semi-automatic and remote-control terminals.

It adds flexibility across all types of terminals, such as the greenfield and brownfield sites, where it can meet the requirements of operating space, IT systems and local acceptance. This technology will also be very suitable for new terminals and terminal expansion projects as the terminal design layout and infrastructure can be autonomous truck specific.

AUTONOMOUS MODE REACHES NEW LEVEL

The Society of Automotive Engineers (SAE) has defined six levels of driving automation ranging from 0 (manual) to 5 (full automation). Terminal D's autonomous truck has attained in between level 4 to level 5 of automation, capable of doing all driving tasks under specific circumstances and within a certain area.



LEVEL 0	LEVEL 1	LEVEL 2	LEVEL 3	LEVEL 4	LEVEL 5
NO AUTOMATION	DRIVER ASSISTANCE	PARTIAL AUTOMATION	CONDITIONAL AUTOMATION	HIGH AUTOMATION	FULL AUTOMATION
HUMAN DRIVER DOES THE DRIVING	HUMAN DRIVER IS HELPED BUT STILL DRIVING	HUMAN DRIVER IS HELPED MORE BUT STILL DRIVING	SYSTEM CAN DRIVE IN SOME SITUATIONS, BUT THE HUMAN DRIVER MAY HAVE TO STEP IN	SYSTEM CAN DO ALL DRIVING UNDER CERTAIN CONDITIONS	SYSTEMM CAN DRIVE IN ALL SITUATIONS

Source: www.sae.org

05

GLOBAL ROLL-OUT STRATEGY

The demand for autonomous truck performance, productivity and reliability will exceed manned trucks with higher AI and better sensor technology available in the near future. The trend to adapt AI autonomous truck technology for terminal operations is becoming more acceptable and is expected to be widely introduced and in-use at new purpose-built automated ports, just like the automated rubber tyred gantry cranes, straddle carriers and remote control cranes.

After overcoming technical challenges from the development of autonomous truck applications in Thailand, Hutchison Ports is confident and ready to roll-out autonomous truck technology to its network of ports where applicable.

"We are ready to launch autonomous trucks to create a safer, smarter and cleaner port. Are you ready?"

Eddie Lee
Group Engineering Director
Hutchison Ports

Scan the QR code to learn more about Autonomous Truck operations at Hutchison Ports.

YEAR 1
ADAPTATION

In the first year, autonomous trucks are being used for auxiliary services such as yard marshalling and barge operations. There will also be a redesign of the electric truck from the developer when called upon. System integration and workflow re-engineering would have been completed.

YEAR 2
VESSEL OPERATIONS

In year two, autonomous trucks are expected to perform full feeder and mother vessel operations. These vehicles will also be deployed to empty container yard working with empty handlers. A review of the software algorithms when upgrade technology is available.

YEAR 3
IMPROVED PERFORMANCE & RELIABILITY

In line with the strategy of constant improvement, there will be an enhancement to the cycle performance and an increase in battery capacity enabling the vehicle to operate longer periods. The fleet size of autonomous trucks would increase gradually.

YEAR 4
LOWER COST

Moving forward there will be an enhancement to the speed and its reliability. By then, more reliable and advanced upgrade on sensors and other hardware will be available in the market at a lower cost. Majority of the movements would be handled by autonomous trucks with consistent and reliable performance.

YEAR 5
FULL DEPLOYMENT & HIGH LEVEL OF INTELLIGENCE

In the final year of the roll-out plan, the migration plan from diesel trucks to autonomous trucks will be fully completed. The vehicle itself will have a higher level of intelligence, flexibility, and decision-making capability with the presence of smarter AI.

06

GROUP COMMITS TO A SUSTAINABLE FUTURE

Hutchison Ports announced the release of the first Sustainability Report for the year ended 2020. The report focuses on the environmental, social and governance issues that have the ability to impact and influence the group's daily business. The first group-wide environmental strategy 'Our Environment 2020' was launched last year and marked the company's first combined effort in framing environmental targets, uniting 52 Business Units worldwide.

This year the group has launched the 'Our Sustainable Future' programme designed to address the risks posed by a changing climate and an evolving social and regulatory landscape.

The programme is centred on three pillars: Our Environment, Our People and Our Business. Under 'Our Environment' the focus will be on Greenhouse Gas Reduction and Waste Reduction, 'Our People' will look at Health, Wellbeing, People Development and Community Engagement, while 'Our Business' is committed to Supplier Transparency.

Hutchison Ports' vision is to be 'the preferred partner for a sustainable supply chain.' This vision is focused on working in collaboration with colleagues, customers, suppliers and contractors and to engage with supply chain partners.

As part of the newly formed Hutchison Ports' sustainability programme, six focus areas have been agreed by the Group Sustainability Committee (GSC) for 2021, co-chaired by two executive committee members, Clemence Cheng, Managing Director Europe and Stephen Ashworth, Managing Director South East Asia. The committee is also complemented by members from a variety of functions and regions, who together lead the short-term target management and long-term strategic approach for the group.

Reductions achieved in 2020

32 GWH electricity

30,046 tonnes of CO_2e direct emissions

35,208 tonnes of CO_2e indirect emissions

11 million litres of diesel

2021-23 reduction target

1%

diesel consumption per TEU each year

2030 reduction target

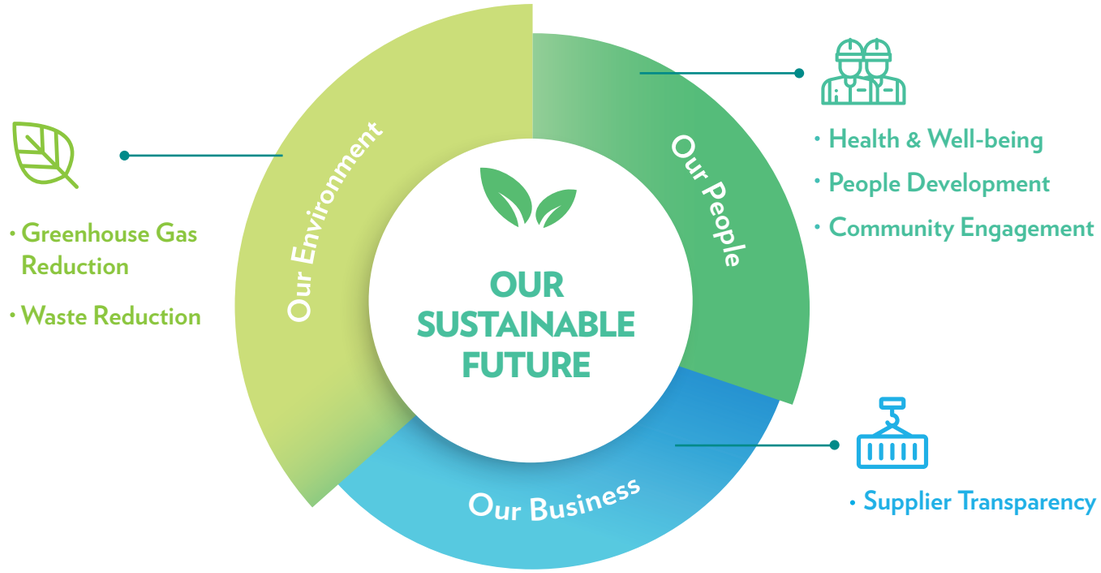
11%

CO_2 emission per TEU

(compared with the 2020 performance baseline)

"WE ARE OF THE VIEW THAT THE ISSUE OF SUSTAINABLE DEVELOPMENT RANKS AMONG THE MOST IMPORTANT CHALLENGES AND RISKS FACING US"

CLEMENCE CHENG & STEPHEN ASHWORTH, CO-CHAIRS OF THE GROUP SUSTAINABILITY COMMITTEE.



Each of the above focus areas is championed by a committee member, ensuring senior management accountability for enabling and ensuring the implementation and delivery of initiatives in each area in the coming year.

To learn more about Hutchison Ports' Sustainability Report please scan the QR code on the left and scan QR code on the right to view the 'Sustainability' video.

Report

Video

OUR SUSTAINABLE FUTURE

HUTCHISON PORTS IS GOING GREEN

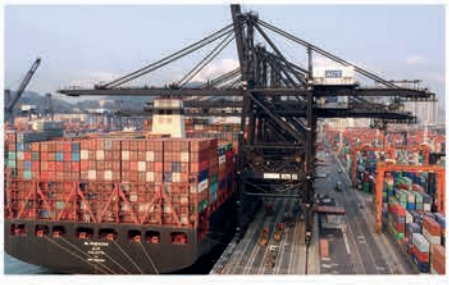
OUR ENVIRONMENT

Hutchison Ports is committed to protecting the environment. We are working to mitigate against any adverse impacts caused by our operations, by adopting a strategy of reducing operational emissions and deploying the latest emissions saving technology.

OUR PEOPLE

Our people are our strength. We are fully supportive of our colleagues' career journey and development, whilst ensuring that our teams are inclusive, diverse and representative. We also engage in activities supporting our communities.

OUR BUSINESS



Our vision is to become the preferred partner for a sustainable supply chain. Through innovation and collaborative partnership, we are building smarter, more resilient and highly-efficient terminals and workplaces.

HUTCHISONPORTS

Find out more and read our 2020 Sustainability Report online at www.hutchisonports.com.