

D3.3.1. – Collection of the main automation innovations that could affect the area in the next five years

Elevante srl

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INTRODUCTION

The purpose of this deliverable is to collect and map out the main innovations in automation systems affecting freight and/or passenger mobility.

This activity was carried out by Elevante Srl (freight) and UniTS (passenger), with the contribution of Actual and University of Rijeka, according to the methodology prepared by Elevante Srl and then presented and approved by all partners.

Collected innovations will be briefly described and presented in order to allow partners to appraise, rank and ultimately select those innovations that are most important and relevant to them. The ranking process will be carried out by means of a comprehensive online survey tool. In the subsequent activities, a more in-depth analysis of some selected innovations will also be carried out.

Collected innovations are divided into:

- Ready-to-be-used and already happening;
- Disruptive innovations (not ready to be used, still being experimented).

AUTOMATION SYSTEM IN PASSENGER AND FREIGHT LOGISTICS

Automation is the technology by which a process or procedure is performed with minimal human assistance. Automation is the creation of technology and its application in order to control and monitor the production and delivery of various goods and services. It performs tasks that were previously performed by humans. Automation is being used in a number of areas such as manufacturing, transport, utilities, security, facilities, operations and lately, information technology. Automation is also one of the key factors to innovation in the transport sector.

Ever since the introduction of automated stacking cranes at the European Container Terminal in Rotterdam in 1990, automation in ports has firmly progressed. Automation has developed into almost all terminal functions ranging from water to land side; from ship-to-shore activities straight across the terminal into and including the handling activities on or from the land connected modes.

The extent of automation ranges from remote controlled operations under safe and efficient conditions to fully autonomous terminal operations.

The first fully automated container terminal was created in Melbourne, Australia in 2017 –it has an annual capacity of one million TEUs and it also has a dedicated empty container depot that has a capacity of 280,000 TEUs per year.

In the field of safety there is continuous progress with research projects such a SaLSA that aim to safely test autonomous transport vehicles in yards that link into the Internet of Things world. Sensors installed in the yard infrastructure enable vehicles to detect other objects and their position which allows the combined operation of automated vehicles, forklifts, and people in an efficient and safe manner.

Software is also used to monitor and optimise the flow of goods through the port, which provides savings in time, fuel and personnel and optimisation of capacity and space. The drivers of automation are cost of labour, land cost and the need for efficient handling of larger sized ships.

The trend in ever larger ships enabled further by such events as the expansion of the Panama Canal, as well as those of the increasing costs of labour and ever more efficient and low cost of technology, will further push the need and desire for automation.

The most advanced and also the most “visible” types of “robot” being developed in all forms are autonomous vehicles, from small last mile solutions to full sized autonomous sea-going vessels. Next to the already described terminal dedicated autonomous vehicles such as autonomous straddle carriers, the type of vehicles being developed will undoubtedly have an impact on the way operations will have to be organised. The development and implementation of these “robots” in the relative short term will entail its own threats and opportunities.

In general, many innovations within automation systems are related to unmanned services within logistics hubs, may they be ports, interchange points or large warehouses.

PARTNERS

Partners participating on WP3 are

- PP2 – ELEVANTE Srl
- LP – University of Rijeka, Faculty of Maritime Studies Rijeka
- PP1 – CFLI, Intermodal Logistics Training Consortium
- PP4 – University of Trieste
- PP5 – Actual I.T.
- PP6 – Cluster for Innovation in Logistics and Transport System
- PP7 – Port of Rijeka Authority
- PP8 – Port of Sibenik Authority
- PP9 – Rovinj Port Authority

Partners for Freight sector:

- PP2 – ELEVANTE srl
- PP5 – Actual I.T.
- PP6 – Cluster for Innovation in Logistics and Transport System

Partners for Passenger sector:

- PP4 – University of Trieste
- PP 7 – Port of Rijeka Authority
- PP 8 – Port of Sibenik Authority

Partners for both Freight and Passenger sector:

- PP1 – CFLI, Intermodal Logistics Training Consortium
- PP 9 – Rovinj Porth Authority

WP COORDINATION

- Start Date 1.4.2019
- End Date 31.10.2019

Coordinator PP2 - ELEVANTE srl

Involved Project Partners:

- PP2 – ELEVANTE srl
- LP – University of Rijeka, Faculty of Maritime Studies Rijeka
- PP1 – CFLI, Intermodal Logistics Training Consortium
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- PP9 – Rovinj Porth Authority

AUTOMATION SYSTEMS: DISRUPTIVE INNOVATIONS

Joint desk research carried out by Elevante Srl and UniTs (with contributions from Actual and University of Rijeka) has brought up a number of innovations within the automation trend that are not yet ready to be used. Some of them may already be taking place but in very limited testing environments, very often still requiring regulatory frameworks to keep the pace with technology advancements. Others are in the course of being implemented and turned into real-world applications. Finally, some are still being explored and investigated at a theoretical stage or exists in form of innovative start-up companies fuelled by venture capitals and gathering the interest of investors.

Collected innovations are described very briefly. They will be presented to PPs for their appraisal, ranking and final selection, according to what is important and relevant to each PP. This process will be carried out by means of a comprehensive online survey tool designed by Elevante (as WPL) and implemented by UniTS.

In-depth analysis of some selected innovations will be carried out in later stages of WP3.

Innovations are listed here in no particular order.

Automatic digital identification of passengers (in compliance with GDPR)

With smart sensors, IoT solutions, computer vision, thru personal mobile devices. Heathrow Airport is working with Yoti's digital identity app on a test that enables passengers to navigate using their smartphones and biometrics in order to simplify passenger transport. Currently with manual authentication passengers need to present different forms of identification documents while with digital recognition, while with the use of this technology, it will be enough to have a smartphone to speed up the boarding time.

Fully Automated Container Terminal (freight)

Includes automated application interfaces between the vehicle booking system (VBS), the terminal in/out gates, the movement of automated container carriers (ACCs) and automated stacking carriers (ASCs), the primary terminal operating system (TOS), and all other automated

systems associated with the operation of quay cranes. Container terminal automation is still at relatively early stages: 1% of terminals are fully automated and 2% that are semi-automated.

Electrified Lift Solution (freight)

Fully electric empty container handler. The new machine, expected in 2021, is compliant with strict airborne and noise emissions standards, is expected to reduce overall fuel costs for customers without limiting performance. The electric empty container handler is more cost-effective to maintain, due to having fewer moving parts and lower rates of wear and tear than diesel-powered handlers.

Smart Connected Lift Trucks (freight)

Equipped with TruConnect Remote Services, allowing to track the usage of vehicles, as well as data on their carbon footprint and fuel consumption.

Automatic container carriers/truck handling systems (freight)

A versatile lift truck is a machine that allows two empty containers to be handled simultaneously. The equipment is specially designed for dual and industrial handling and, as a result, is less sensitive to "eccentric loading." In addition, the use of this solution is able to reduce fuel consumption and coal emissions by up to 15%.

High Bay Storage Systems (BOXBAY) (freight)

For container storing and handling, instead of stacking containers directly on top of each other, BOXBAY places each container in an individual rack, making each one directly accessible.

Autonomous Trucks/Busses (passenger/freight)

Autonomous technologies and vehicles will be the solution to the growing problem of the shortage of truck drivers. Platooning combines several autonomous truck that follow one single manned vehicle.

Last-minute shipments or shipments with unexpected zero-hour are causing unpredictable delays and added costs that are a huge business prevention that can affect competitiveness lately.

The use of autonomous vehicles would reduce the need to find drivers by zeroing the time of search and waiting before the departure of the load.

Unmanned ships/autonomous vessel (passenger/freight)

Ships without crew on board, based on completely automated systems and, eventually, remote-controlled from onshore fleet operation centres. Deployment of autonomous navigational technology to a vessel for commercial operations, for enhanced performance and safety. Vessel can also be equipped with SceneScan, a laser-scanning dynamic positioning system, which does not require the positioning of a shore-based target to operate.

Autonomous tugboats (passenger/freight)

To make vessel calls at port more efficient.

Maritime transport chain (freight)

Is a digital network through which carriers, ports and freight forwarders are interconnected in the movement of goods. The use of this technology facilitates, by the carrier, the choice of a maritime transport chain, on the other hand, decreases the time of choice of a maritime transport chain by the port.

Event data certification (passenger/freight)

Data certification manages scheduled data validations within a database. Information is added to the database by importing it from third-party technologies or manually, then checked for accuracy and certification. The program then generates a checklist for data verification. The data certification is done following a specific certification calendar, the certification activities are created and assigned automatically.

Unmanned warehouse: Intelligent robots for warehouse (freight)

Autonomous robots are part of a modular goods-to-person system that also includes mobile storage racks and fulfilment stations. Each robot will be able to move a rack weighing approximately 500 to 1500 kg, bringing it to a station where a worker can fulfil up to 48 orders simultaneously. The entire process will be controlled by warehouse management system.

Drones for WMS (freight)

Drones and robots can do several tours of a warehouse, compare results and identify discrepancies. Drones using optical sensors (cameras) which can help locate an item in a warehouse or scan the respective RFID tags at a distance of tens of meters. In larger warehouses, a drone system can be used to gauge inventory levels and transmit the data directly to the warehouse management system (WMS).

AUTOMATION SYSTEM: READY-TO-BE-USED INNOVATIONS

Desk research carried out by Elevante Srl and UniTs (with contributions from Actual and University of Rijeka) has brought a number of innovations in automation systems that are already available in the market and already used by a number of entities. These innovations could be brought to programme area without having to wait for further developments. However, local regulatory framework (if necessary) may still be lacking.

Collected innovations are described briefly. They will be presented to PPs for their appraisal, ranking and final selection, according to what is important and relevant to each PP. This process will be carried out by means of a comprehensive online survey tool designed by Elevante (as WPL) and implemented by UniTS. In-depth analysis of some selected innovations will be carried out in later stages of WP3.

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Automated mooring technologies (passenger/freight)

Recently several prototypes have been developed devoted to automate mooring operations. In this contest also the integration automated mooring and cold ironing (transfer of electric power from port grid to the ship at berth) is under development as well as automated bunkering solutions (especially for LNG).

Unmanned bulk cargo terminal (freight)

The world's first fully automated bulk cargo terminal is operating in Shanghai, powered by ABB unmanned cranes. It enables port operators to evolve from the world of manned cranes (where each crane has its own driver who receives instructions via radio from quayside control room) - to a fully automated, unmanned world of precision handling where each crane is operates automatically and is monitored from a single central control room. It also brings environmental benefits, increased productivity, reliability and environmentally friendly operations.

Automated Lighting and air-conditioning systems (passenger)

The adoption of sensors devoted to detect/count people in a specific room can be exploited to control lighting system and optimise the load of air conditioning system leading to avoid wastefulness, thus reducing the global energy demand of the systems.

Autonomous vessels for coastal navigation (passenger/freight)

An autonomous vessel is a ship with different degrees of automation. For short repetitive routes and coastal navigation fully autonomous vessels (unmanned) are particularly suitable in order to reduce operational costs (some pilot projects are already on the way).

Unmanned services (passenger)

The development of robotics and automation will allow to reduce the personnel providing simple services to the passengers, e.g. automatic cash registers, robotic barmen or waiters, machines capable to prepare food, robotic cleaning devices, etc.

ETA, Delivery of Notification (passenger/freight)

A port with rated Arrival Time technology (ETA) is able to predict with high precision the departure time of a ship from a specific berth location, thus increasing port efficiency by reducing waiting time within processes.

Remote Cranes (freight) and remote RTG

The new remote-controlled cranes represent an important step towards a higher degree of teleworking.

On the operational level, it will be possible to deploy equipment more dynamically to meet peak demand and to locate operators, ship controllers and their closest supervisors will lead to improvements in alignment and communication.

A new wheeled gantry crane (RTG) has a lifting capacity of 50 tonnes, a stacking height of 1 in 5 and a width of 6 TEU plus a truck lane.

Thanks to a system to prevent the oscillation of the container and a remote monitoring system, the RTG allows a higher speed even with containers at full load.

ASC Automated Stacking Cranes (freight)

Automated stacking cranes enable the highest possible capacity and stacking density. An ASC terminal optimises throughput and predictable and reliable performance 24/7.

RPAS drones to check ship emissions and air pollutants (passenger/freight)

RPAS measure the emission of sulphur to determine whether a particular vessel is compliant with EU rules on the sulphur content of fuels. The drones, which are fitted with a gas sensor known as a “sniffer”, fly in the plume of a ship to estimate the amount of sulphur in its fuel, before transferring that data to authorities for review.

ALP Automated Lashing Platform (freight)

Fully automatic device for container lashing that fits and removes twist locks for landside load and discharge. The ALP is compatible with almost all known twist locks and stacking cones. It generates cost savings and increases workplace safety of container handling. The device self-generates needed energy by using the container weight on impact. An integrated, hydraulic damping technology absorbs the forces and reduces impact on cargo, equipment and quay structure.

Automatic traffic routing (passenger/freight)

Ability to automatically react on the anomalies to prevent traffic congestion and wait times. Machine learning techniques, based on the real-time information of conditions of traffic (rail, road, also air, water) congestion, yard occupancy, route selection, multimodal selection/change, combined with historical video surveillance data with GPS data, can reduce congestion by providing users with information on where congestion is located and how to avoid it.

Deliverables Planning (freight):

Better planning of deliveries based on the real-time and predicted traffic conditions the travel-time information helps to save travel-time and improve reliability through the selection of travel routes pre-trip and en-route. In the application of logistics, travel-time information could reduce the delivery costs, increase the reliability of delivery, and improve the service quality.

Autonomous vehicles in port area (passenger/freight)

Integration of autonomous driving (robotic) solution in a restricted domain (port community) for traffic optimization.

WMS with voice integration

Today's voice applications combine the flexibility and configurability needed to improve workflow processes that already utilize automated barcode data collection technology. Voice integration provides greater visibility into inventory position, detail on item history, product traceability, ensuring picking accuracy, in addition to the advantage of enabling a hands-free workforce.

CONCLUSIONS

From desk research it emerged that several innovations within unmanned services and automation systems, are not yet ready to be used. Some of them may already be taking place but in very limited testing environments, very often still requiring regulatory frameworks to keep the pace with technology advancements. Others are in the course of being implemented and turned into real-world applications. Finally, some are still being explored and investigated at a theoretical stage or exist in form of innovative start-up companies fuelled by venture capitals and gathering the interest of investors.

A larger group of innovations is already available in the market and used by a number of entities. These innovations could be brought to programme area without having to wait for further developments. However, local regulatory framework (if necessary) may still be lacking.

Collected innovations will be briefly described and presented in order to allow partners to appraise, rank and ultimately select those innovations that are most important and relevant to them. The ranking process will be carried out by means of a comprehensive online survey tool. In the subsequent activities, a more in-depth analysis of some selected innovations will also be carried out.

ONLINE RESOURCES

- **Fully automated/automated cargo terminal**

- https://www.porttechnology.org/news/friday_focus_kalmar_navis_robotize_austria_terminal#kalmar_global
- <https://www.youtube.com/watch?v=k-YLAYH-vtU>

including:

- Electrified lift solutions
 - https://www.porttechnology.org/news/kalmar_expands_fleet_of_electric_equipment
- Automatic stacking cranes (ASC) systems
 - https://suppliers.porttechnology.org/kalmar_global/products/26472/Kalmar-OneTerminal/products/?pl=automatic-stacking-cranes-asc-
- Smart Connected Lift Trucks
 - https://www.porttechnology.org/news/msc_invests_in_fleet_of_konecranes_smart_trucks?utm_source=GatorMail&utm_medium=email&utm_campaign=Newsletter+daily+18-04-2019&utm_term=%5bPTI+Sunday%5d+INFORM+Releases+2038+Part+2+Teaser...CTAC19%3a+Leaders+to+be+Challenged+on+Automation...CTAC19%3a+Ask+an+Expert&utm_content=2940&gator_td=jKAIpdoDffnLy8RZ%2bcKIXaZ4jGrCcIupv6%2bM4%2bKqNaSr5NjYLS53WGIXHUta%2fZ3sTPaN6yjCjkikP8WrI6m98zzROGyYvBGdehD7jR4yYlggooda9MCW3CdbVJr1ciQHBQglHM1OJ5FSbU0Opg1nOQ%3d%3d

- Container storing and handling: High Bay Storage Systems (BOXBAY) – “the future is vertical”

- https://www.porttechnology.org/news/exclusive_paper_dp_worlds_terminal_of_the_future?utm_source=GatorMail&utm_medium=email&utm_campaign=Newsletter+daily+18-04-2019&utm_term=%5bPTI+Sunday%5d+INFORM+Releases+2038+Part+2+Teaser...CTAC19%3a+Leaders+to+be+Challenged+on+Automation...CTAC19%3a+Ask+an+Expert&utm_content=2940&gator_td=jKAIpdoDffnLy8RZ%2bcKIXaZ4jGrCcIupv6%2bM4%2bKqNaSr5NjYLS53WGIXHUta%2fZ3sTPaN6yjCjkikP8WrI6m98zzROGyYvBGdehD7jR4yYlggooda9MCW3CDbVJr1ciQHBQglHM1OJ5FSbU0Opg1nOO%3d%3d

- **Handling technology: remote cranes**

- https://www.porttechnology.org/news/remote_control_cranes_to_boost_felixstowe?utm_source=GatorMail&utm_medium=email&utm_campaign=Newsletter+daily+18-04-2019&utm_term=%5bPTI+Daily%5d+CTAC19+Preview%3a+Automation...Spanish+Navy+Rescues+Stricken+Vessel+from+Pirates...Hutchison%27s+Remote+Control+Cranes&utm_content=2940&gator_td=2HpqKRODnUlpHQS%2fAAaBaoxFOZOaqGCNA3%2b496uXKp%2f%2fDMJWUxXsFcLpGaPHcTGlsOHJm12EzrHXujCwqz15QRcXQp6NVOh9LZgqRSd9tMSZAdg23pGnHojlGRlrBciRja56nmMkKo1yS5ayMN9Blw%3d%3d

- **Autonomous vehicles in logistics and multimodality:**

- Drones: RPAS

- https://www.porttechnology.org/news/denmark_launches_sulphur_inspection_drones?utm_source=GatorMail&utm_medium=email&utm_campaign=Newsletter+daily+15-04-2019&utm_term=%5bPTI+Daily%5d+New+Iceland+Port+Receives+Green+Light...CTAC19%3a+Port+Planning+Expert+Confirmed...APMT+Unveils+Europe-China+Gateway&utm_content=2940&gator_td=30XeZsjJaZP8X%2ffoPENN3%2bwAaFjNaypGOxM%2bbP7MxhADNVnyCxKMOhedYjH9nh56lxbCIsIZ%2fVby1PKg3SyrIt51ZkLW%2bP4exOkfx8Dgyt1FhZ9pj4l0bNb7%2fnSsqIKO0WGF7tBUGMU7JaW9najaYg%3d%3d

- Autonomous tugboats

- https://www.porttechnology.org/news/friday_focus_mpa_highlights_maritime_innovation_lab?utm_source=GatorMail&utm_medium=email&utm_campaign=Newsletter+daily+12-04-2019&utm_term=%5bPTI+Daily%5d+US+and+China+Enforce+Trade+War+Resolution...CTAC19%3a+Credit+Suisse+to+Speak...Sri+Lanka+Kicks+Off+Colombo+Expansion&utm_content=2940&gator_td=rzH2NPCgUGnCiUZPj2BMinNUkPexixV%2fM9mfup4UFbnOG80Icwo8xA9GI2WyrIFaQLbrb%2b%2b2swSDwPnwGohbEVbNZe66zRHxYi7g%2bGwh%2fhcgPnp5ce8tDv%2bXHYtndvag1%2bOOeBbtKTEY6wKx4kzPw%3d%3d

- Autonomous vessel
 - https://www.porttechnology.org/news/world_first_autonomous_navigation_project_sets_sail?utm_source=GatorMail&utm_medium=email&utm_campaign=Newsletter+daily+11-04-2019&utm_term=%5bPTI+Daily%5d+Autonomous+Navigation+Project+Sets+Sail...Singapore+Plans+Digitalization+Drive...Navis+to+Optimize+Colombo+Terminal&utm_content=2940&gator_td=O75W96ak1QG266sRIe49naEKvq9khjqSsR%2ftaTCOpJvNHL%2btYELUHABN%2bas0QnWW9wA2XuTdmJUwdymAQfMS2CgLPCqqW3dQJCDIjuD4hW8I00req%2fd5jAAteE9uefdBJTUiszg1EVstQuyI%2bO%2fvmlA%3d%3d
 - https://www.porttechnology.org/news/waertsilae_claims_world_first_in_ship_guidance?utm_source=GatorMail&utm_medium=email&utm_campaign=Newsletter+daily+05-04-2019&utm_term=%5bPTI+Daily%5d+COSCO+Unveils+New+E-Commerce+Platform...Insight%3a+Retrofit...ABB+and+Ericsson+Strike+Industry+4.0+Deal&utm_content=2940&gator_td=5cTsYhVu0dqFEPDNKG1IshT2eue1JcVaArr4kGb9Dvgr2tNRVY5ckEsIH0f%2bg86ZADEwsOb9%2fd2anFTKthwbC%2bltdaU9RsgZjvBTLtyxDLgei%2bi0EUwugs42DtVBu7teSF9Ruwmamtkxs3Zzna7zA%3d%3d
- **Unmanned/automated warehouse:**
 - Intelligent robots
 - https://www.porttechnology.org/news/global_logistics_leader_unveils_robotics_plan
 - Voice integration
 - https://www.porttechnology.org/news/three_considerations_for_smart_port_collaboration
 - <https://appsource.microsoft.com/en-us/product/dynamics-365-for-finance-and-operations/bluehorseshoe.48b0b380-5ccf-4cbf-9051-8a39a7321aaa?tab=Overview>
 - <https://www.thesmsgroup.com/5-reasons-to-consider-voice-for-warehouse-picking-applications/>
 - https://www.irms360.com/blog_post/supercharge_your_warehouse_management_system_voice_solutions