ENTERING THE MARITIME SECTOR

LOGISTICS 4.0

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The steam engine. Electricity. Automation. The Internet of Things: these 4 terms describe the evolution of industrial progress in roughly the last 2 eras. The Internet of Things – also addressed as the fourth wave in industrial development, or as the 'digitisation' of industry – offers various opportunities to the port sector. Machines, devices, containers, trucks and even infrastructure have the potential to become intelligent: each element along the logistics chain carries vital information regarding destination, purpose and specific contents. What stands out most however is the large scale robotization that is now taking place in ports in Rotterdam, Sydney and Long Beach.

Since the early nineties, terminal operators have been working on robotising equipment at their facilities, and with the recent openings of new facilities at Maasvlakte II, robotisation in the container industry has reached its all-time high. However, should we expect others to follow quickly, or will another period of stunted development take place? Other questions include; what are the social impacts of on-going robotisationm, what are the technologies available, has integration reached a level of maturity, or are projects still 'state-of-the-art' in the worst sense? This paper addresses these issues, but firstly it is important to explore other forms of automation.

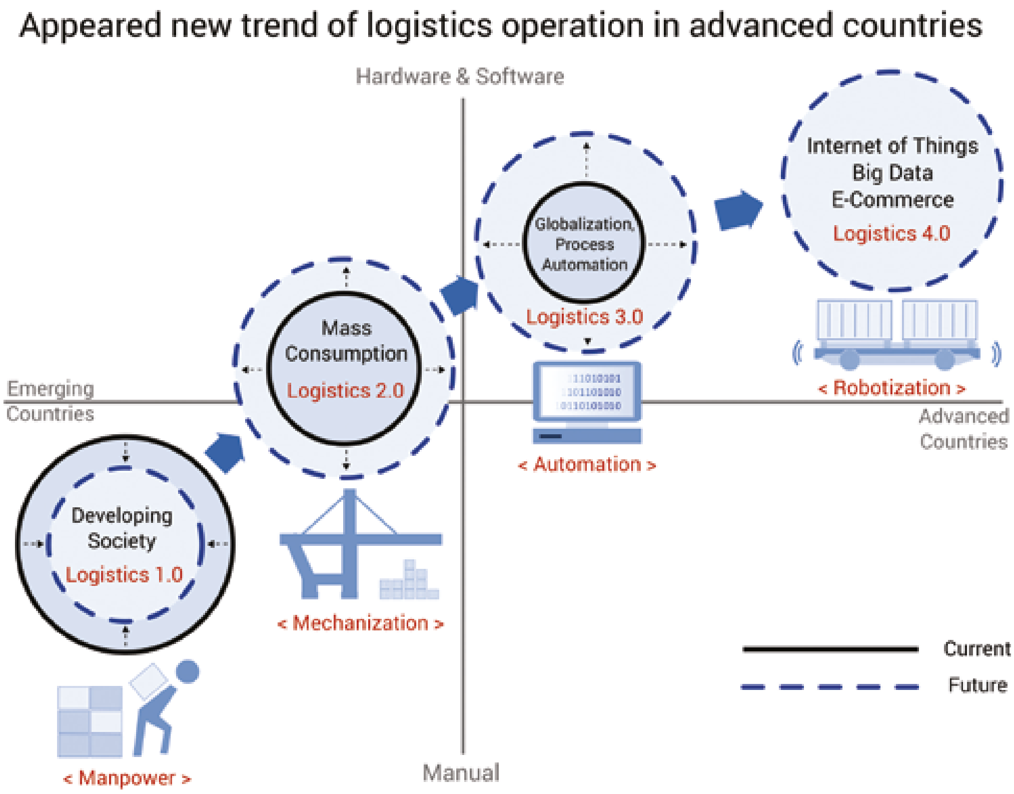
PROCESS AUTOMATION

This category of automation contains technologies that typically replace clerical labour such as identification, inspection, registration, and similar tasks. The most common application is gate automation, where truck and container, and increasingly damage and seal presence are automatically identified and registered. It is also quite common for position detection systems (PDS), which assist the terminal operator in locating containers and equipment, to be part of the process. Both types of technologies have been successfully implemented and are offered by a broad range of vendors.

AUTOMATED DECISION-MAKING

Another category of automation that needs to be mentioned is automated decision-making. Here, another hype word is present; big data. Fostered by the interconnectivity of things, more and more data is being collected, which facilitates data processing which in turn leads to quicker and better decision-making (at least in theory).

A recent analysis by McKinsey indicated that less than 1% of data gathered is actually used. A wealth of data about the supply chain could largely improve the efficiency of terminals: lesser



unproductive work, lower dwell times, faster vessel handling, all driven by intelligent use of data.

So why is the adoption of technology in terminals going at such a slow pace? We see terminals invest in an additional berth – with 4 quay cranes and associated yard equipment – but not in technology that increases terminal capacity by the aforementioned benefits. Where the implementation of technology is slow, robotisation is even slower, and is still by many seen as a white elephant.

At first glance, robotisation appears to have so many advantages: it replaces heavy, dangerous and repetitive work – clerical functions are much lighter. All the more reason to implement robots. We have to see the introduction of such technologies in the context of terminal operations, which can be characterised as highly dynamic, or even, unpredictable, badly planned, and erratic. This is caused on the one hand by the poor information basis underlying terminal operations. It remains remarkable how much container information changes when a container has arrived at a facility. On the other hand it is process interconnectivity that is causing one process disturbance to have ripple effects on other processes. We will come back to this issue later, when we discuss the importance and complexity of integration. In the next sections, we will try to answer the questions raised in the first section.

IMPLICATIONS FOR THE SECTOR

Generally, automated terminals offer a more stable level of performance at a lower cost then their conventional siblings. Ask shipping lines and they would name CTA (HHLA) and Euromax (HPH) among the best terminals in Europe, if not the best. Not only do they offer more reliable service levels, they are more cost-effective, work 24/7, and are less sensitive to high occupation rates. This means that other terminals face increased competition when one of their competitors – serving the same market – introduces automation, or develops a new automated terminal.

A good example is the semi-automated DP World terminal in London (London Gateway). It offers a high service level, high capacity, and is situated close to the hinterland. We expect that it will have an effect in the middle to long term on terminals such as Thamesport, Tilbury and Felixstowe; its main competitors.

A similar impact, or even greater, can be expected from the fully-automated terminal in the Port of Los Angeles/Long Beach, being developed by OOCL. The terminal will bring a substantial new chunk of capacity in a highly competitive market. The capabilities of the terminal in terms of handling speed and capacity are (by far) the highest in the port, and even on the entire West Coast of the US. Its cost base will be substantially lower than any other terminal on the West Coast of the US, also. Impact is imminent and guaranteed.

SOCIAL IMPACT

When discussing automation we cannot go beyond the social question. The direct impact on dock workers is obvious and painful. We argue that here we have to take a broad and long-term perspective. First of all, the jobs that are being replaced are hazardous, repetitive and isolated. They are (partially) being replaced with office jobs, with no risk, and in a more social environment. Instead of spending a number of hours alone in a machine, people are together in an office carrying out operational tasks together.

Furthermore, new jobs are being created. Jobs that require higher education and better training, and jobs that are in general more attractive to a future workforce. Some studies even come to the conclusion that overall more jobs are being created than are disappearing. Also, one study indicated that 65% of the people that were losing their job could be retrained into new jobs.

Finally, the competitive edge of automated ports exceeds that of non-automated ones. As many ports are typically serving the same hinterland, an increase in capacity and efficiency makes ports more attractive, leading to more volume (in the long term), and if they do not, to a lesser volume. Therefore, not embracing new technology may lead to an obsolete port, and in the long-run, a larger loss of jobs.

This means that in practice we have to develop plans to make sure that as many people can be retrained as possible, which is always better than the long term perspective of a port that cannot compete anymore.

AVAILABLE TECHNOLOGY

In the contemporary era we are surrounded by technology. The same types of technology that enable the automation and robotisation in ports also assist us in daily life. We think communication and location determination is easy, however we tend to forget that our cell phone regularly has no reception, and our GPS is regularly off by more than just a few metres. The batteries in even the newest devices do not last for more than a day, and the automated cruise controls in cars can only be used as driver's support.

The precision, durability and reliability required for fully automated operations is still expensive and not yet commonly found off the shelf. Although it relies on the same type of technologies, the scale is much bigger (an AGV battery is about 5 times that of the largest electric car battery, the one of the Tesla S), the intensity is much higher (the equipment easily runs more than 5,000 hours per year, and then for 10 to 20 years, compare that to a road truck: it would mean a mileage of 3 to 4 million kilometres) hence the requirements for durability are much, much higher.

Finally, for reliable 24/7 operations, equipment and the processes really need to be automated. With no driver to correct the behavior of a robot in unforeseen circumstances – a recent report revealed that in the first 700,000 testing kilometres in (80) Google cars, the drivers had to intervene 341 times to avoid an accident; that means that without intervention, each car would have had an accident every 2,000 kilometres: not a good track record at all. Of course, automation on the public road faces many more complex circumstances than in a closed terminal environment, yet the last 10% of automation proves to be the hardest, mainly because of integration.

INTEGRATION

This brings us to one of the key remaining challenges in port robotisation and automation: the integration of pieces of kit (that are typically supplied by different vendors). Integration is a challenge not only applicable to the port industry: it causes headaches in each and every sector. One of the factors here is the lack of standardisation.

Integration complexity worsens in the case of full automation, as the humans involved in the process can solve small inconsistencies and improvise when a robot does not behave exactly like it should. Other automated parts are less capable to deal with another device's flaws. Machines operate (mostly) in a black and white fashion: wrong input means error, and error typically means "STOP". When many different pieces of automated machinery come together, it easily leads to something stopping, causing the entire chain of processes to cease.

This makes integration across vendors and technologies a key area of attention to achieve success. Continuous dialogue, joint specification work, early integration testing, and rigorous, rich and dynamic test environments are necessary.

Standardisation of communication protocols, communication buses, and integrated test environments are the answers to this complex puzzle, and slowly but steadily, they improve the ease of integration. By no means is the industry there yet, and every new development causes new challenges. A key solution here is to copy working solutions, instead of trying to reinvent the wheel over and over.

WHAT NEXT?

APMT and RWG have taken a bold step forward in Rotterdam by substantially extending the scope of robotisation. They have implemented remotely controlled quay cranes, fully automated horizontal transportation (battery driven, with automated battery exchange station), fully automated stacking cranes, including fully automated truck handling (only incident handling by a remote operator), as well as automated transport to the rail terminal in the case of APMT.

We should not expect any further major steps soon, other than more of the same. Two developments that needs to be taken very seriously are the automation of straddle carriers, and of rubber-tyred gantries (RTG's). The first, because it does not require large investments in civil infrastructure to enable the automation. Replacement of the fleet of machines, or even automation of the existing machines is required, and the additional communication infrastructure is quite limited.

The second development is the automated RTG. As RTG yards have over the road trucks amidst them, robotisation is tricky from various perspectives, with safety and liability as most important aspects. Several terminals are working on remotely controlled RTGs, but a large scale terminal has not yet gone into operation. Avoiding conflicts between the road trucks and the remotely controlled RTGs remains a safety risk. For now, we foresee that it will be limited to automated working inside the stack, and full remote control during the truck handling, as well as during the movement along the stack.

CONCLUSION

Automation and robotisation are the future for container terminals. The advantages simply outweigh the drawbacks. The associated investments, limited experience in the market, integration issues, social issues, and many other less important reasons will still cause terminal operators to choose simpler, quicker and more proven solutions. However, long term, container terminal operations will be robotised.

ABOUT THE AUTHOR

Dr Yvo Saanen is Managing Director and Founder of TBA; a leading terminal design, simulation and automation company based in the Netherlands that began operations in 1996. He is in charge of all port and terminal related projects globally, handling planning and the optimisation process of container terminals by means of simulation and emulation. He has participated in many projects, ranging from long term development, process improvement, terminal extensions and redesign of handling systems to design of greenfield terminals. Yvo holds an MSc in Systems Engineering and a PhD on the design and simulation of robotised container terminals, both from Delft University of Technology. He is a Lecturer at the Institute of Maritime Economics and Logistics (Erasmus University Rotterdam).

ABOUT THE ORGANISATION

Netherlands-based TBA is a leading international provider of consultancy and software. Its product and service portfolio concentrates on marine terminals and intermodal container and bulk terminals. Key services are terminal planning using simulation, support of complex software (TOS) implementations and TOS fine tuning using TBA's emulation tool CONTROLS, as well as the training of terminal planners. TBA is also a leader in equipment control software (ECS) for automated terminals, having supplied the Euromax in Rotterdam, CTA in Hamburg, Antwerp Gateway, and in the coming years Long Beach Container Terminal with TEAMS; TBA's Equipment Control Software. TBA's clients include all major terminal operators worldwide and many local port operators.

ENQUIRIES

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