Out of work?

by Przemysław Myszka

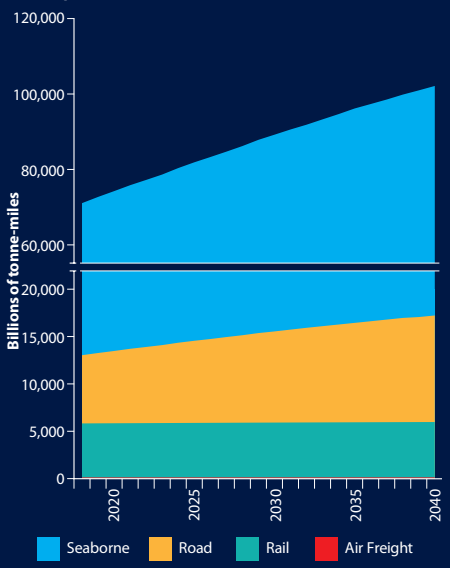
Take a brief moment to ask yourself the following question: am I 100% certain that no robot or software will take over my current work? Or for that matter – any future gig I might find myself occupied with? Can you imagine landing a dream job only to find out it's getting automated soon afterwards? While it's true that the up-to-date industrial revolutions created more employment, both in quantitative and qualitative terms, can the same be said about what lies ahead once we pass the gates of Industry 4.0?

"[…] Every new invention changes the nature of work. It may require new skill sets, or it may change working routines. It may lead to a reduced demand for workers of a certain profile and may create new demands for workers with different qualifications," said Dr Cleopatra Doumbia-Henry, President, World Maritime University (WMU) in the Preface to the University's paper *Transport 2040: Automation, Technology, Employment – The Future of Work*. In it, the authors set out to assess the possible impact technological advancements (first and foremost automation), coupled with changes in trade patterns, can have on future employment throughout the transport sector. What kind of occupation has the highest risk of being handed over to robots and software? Will the rise in global trade, hence transported volumes, make up for the employment losses brought about by automation? What can economies do to bank on this unknown? And if there are in fact measures thanks to which this potentially immense disruption can be tamed, which fields are likely to yield crops if only cultivated with enough care and foresight?

What can be automated…

In 2040, forecasts say, between 8.1 and 9 billion humans will be inhabiting our planet. More people, in general, equals economic growth, which, in turn, propels trade, hence the demand for transport services. Extrapolating the data from the International Monetary Fund (global annual GDP growth of 3% over the 2018-2023 period, trade up by 4-4.4% in 2018-2019), authors of the *Transport 2040* predict that transport work volume will rise from today's 62.7tr tonnes-miles (one mile counting for 1.852 kilometres) to 95tr-mi in 2040 (Fig. 1). The bulk of it will continue to be shipped in ship cargo holds. However, the researchers note, the speed of growth will eventually slow down, from +2.2%/year in 2015-2030 to +0.6%/year beyond 2030 (though with varying degrees for different transport modes). As also pointed out by another organisation, the International Transport Forum, climate change mitigation policies and an overall more eco-friendly consumer behaviour can noticeably cut into the demand for fossil fuels (read more in BTJ 6/18's *The rub of the green. Zero-emission shipping by 2035*); on the other hand, changing demographics will have a leverage effect on the transportation of finished and semi-finished goods, thus at least partially compensate for the lost oil

Fig. 1. Global transport turnover: projected development to 2040



Source for all tabs. and figs. (except Tab. 1): World Maritime University's Transport 2040: Automation, Technology, Employment – The Future of Work

Fig. 2. Automation potential in relation to skill groups in transport (Frey and Osborne, 2017)

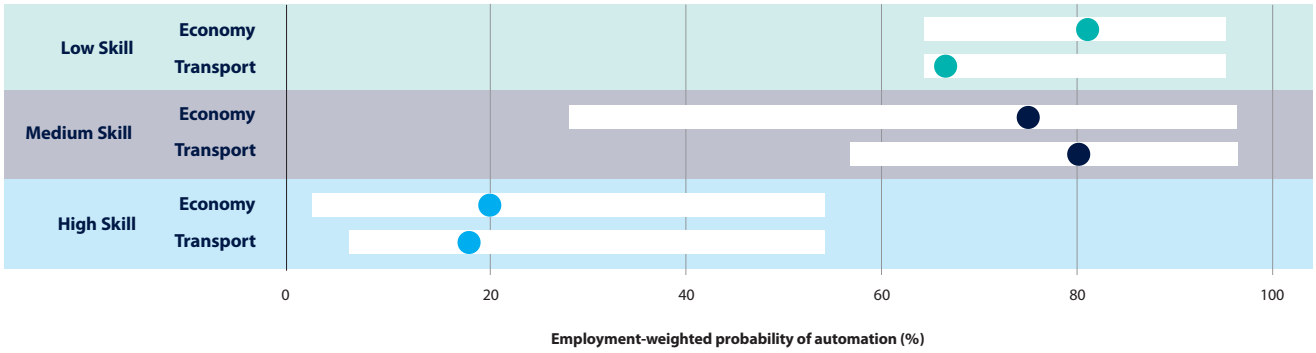


Fig. 3. Automation potential in relation to skill groups by transport mode

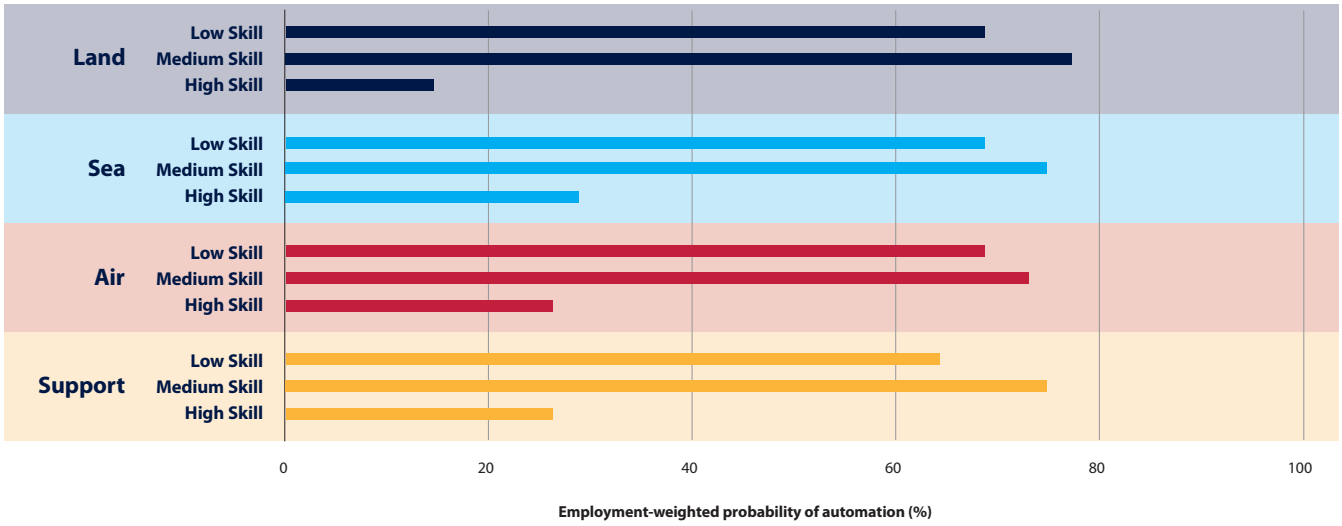
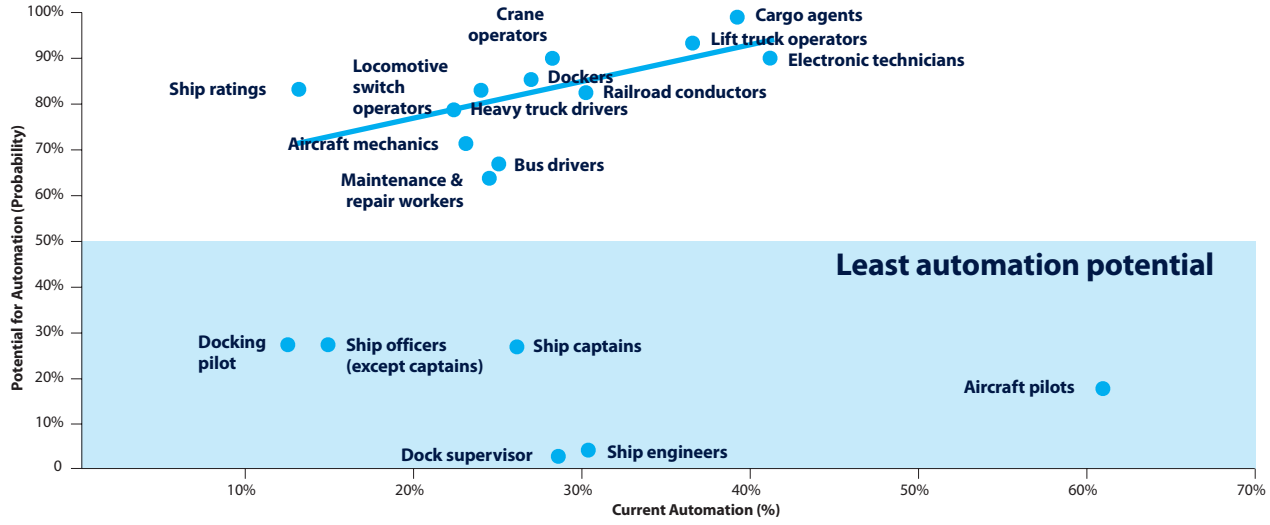


Fig. 4. Automation potential job profile in transport



and coal volumes (interestingly, looking at the breakdown of cargo types handled in Baltic ports, for instance, one can notice the rising share of general cargo at the expense of liquid and dry bulk).

So far that's good news for those employed in the transport sector, which in 2017 accounted for as much as 5% of all workers globally (7% if we exclude people working in agriculture). This percentage translates into 168m direct jobs (out of which 3.3m are employed in the maritime business), making transport the world's third-largest employer among the service-industries. Doing some haphazard mathematics, it means that a single transport worker is nowadays responsible for about 373kt-mi of transport work. In a 1:1 ratio, this would mean that over 254m workers would be needed in 2040 to handle 95tr-mi.

Having analysed a total of 630 occupations, Frey and Osborne estimated – in their 2017 paper titled *The future of employment: How susceptible are*

Fig. 5. Projected reduction on the labour demand for seafarers

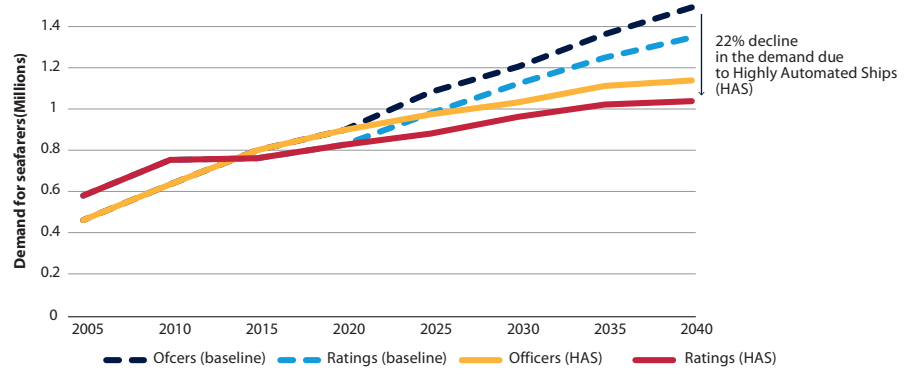
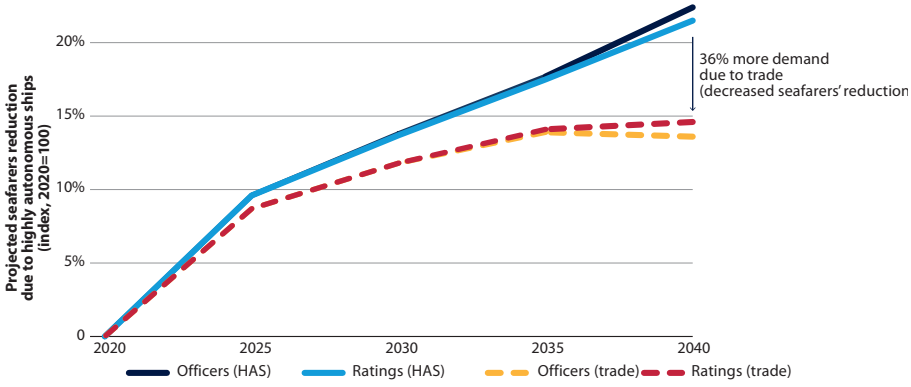


Fig. 6. Simulations for the demand for seafarers

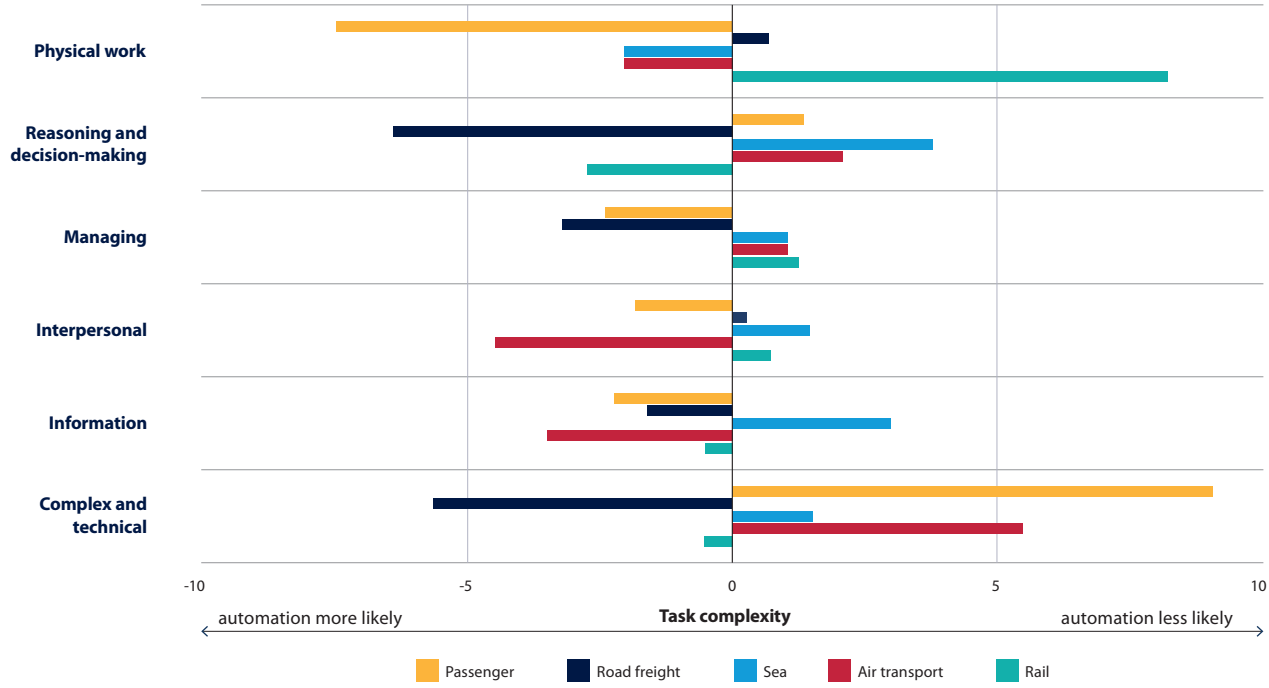


jobs to computerisation? Technological Forecasting and Social Change – that 47% of US jobs are at a high risk of being automated over the next one-to-two decades (Figs. 2-3). The OECD own research into 21 of its members' economies speaks of a far lower number of 14% (incl. 9% for the US alone). That said, the OECD's research highlights another fact, namely that more than 70% of these jobs' tasks will be fully automated within the next 20 years. While on the one hand, *Transport 2040* reads, "New technologies and automation are usually introduced with the objective of increasing the output/efficiency of individual employees. Because jobs are a complex bundle of interrelated tasks, the automation of tasks does not result immediately in jobs becoming obsolete," on the other, the report continues (Fig. 4), "[…] for lift truck operators the current automation level is […] less than 40 per cent on average but it could reach 90 per cent. By 2040, a rate of 90 per cent task automation is projected for crane operators and dockers in general."

A transport company can also be described as a "complex bundle," but this time from the perspective of the worker skills. WMU's research covered 60% of the global transport force from more than 70 countries. Analysing historical trends, the authors of the *Transport 2040* concluded that the automation of routine-based tasks has led in the first place to downgrading mid-skilled jobs to those requiring a less sophisticated set of competences as well as where they're being paid less. More advanced technologies currently making their way into the transport & logistics domain just amplify this tendency. Taken alone, highly automated ships, for example, are expected to decrease the global demand for seafarers by some 22%. This will be only partially offset (+8%) by the forecasted increase in trade and transportation. So, ultimately, making shipping near- or fully-automated

Photos: Rawpixel

Fig. 7. Industries relying more on low complex physical work and information input and processing are more prone to automation



will result in a 14% loss as regards employment demand for seafarers (Figs. 5-6). However, *Transport 2040* emphasises, more seafarers will be needed in absolute numbers; ship automation will just limit job creation of this particular occupation. Moreover, the issue is more regionally-nuanced, "Automation may not be adopted in regions or countries simultaneously or on the same scale. On the one hand, increased automation in some countries may help to fill in the gaps arising from an overaged, retiring workforce. On the other hand, other regions with younger workforce may lack the prerequisites for large-scale automation," WMU's paper reads.

Low-skilled workers (i.a., dockers, baggage handlers) will also face a high risk (6-50%) of losing their posts, or, alternatively, their jobs won't exist in their current form by 2040. For mid-skilled workers (apart from able seafarers also heavy-duty vehicle drivers), there's a 7%-to-23% chance of being ousted by machines or algorithms. For both groups, there's a positive linear relationship, meaning that jobs at present facing a high degree of automation – especially relatively high-wage, low-/mid-skilled jobs performed by older employees – are highly susceptible to be further automatised (Figs. 7-8). These figures take into account the economic and regulatory aspects. When looking solely at the technical feasibility of automating a particular job, there's a 68% risk of mechanising or computerising low-to-mid-skilled posts, with the latter group confronted with a 77% probability of receiving a pink slip. In the transport & logistics business, mid-skilled employees account for over 72% of all labour force (as much as 76% in the road business and 62% in maritime), while low- and high-skilled for approx. 15% and 12%, respectively. High-skilled workers (ship officers, aircraft pilots) are, to a certain degree, immune to this trend (risk of under 2%; up to 20-30% if technical feasibility is the only factor). First, some of these posts, like airmen, have already been highly automatised (>50% of their work). Second, the tech-solutions have been developed to aid them in their task, e.g. in decision-making, not replace them. "Context-aware apps," *Transport 2040* puts forward an example in this context, "[…] can provide

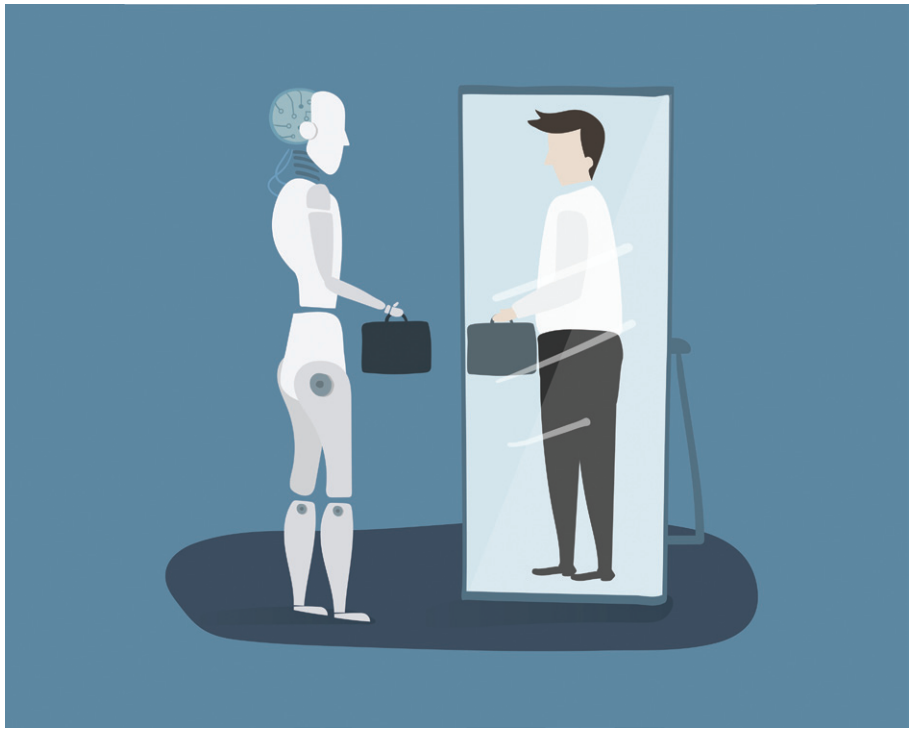


Fig. 8. Benchmark of the determination of automation

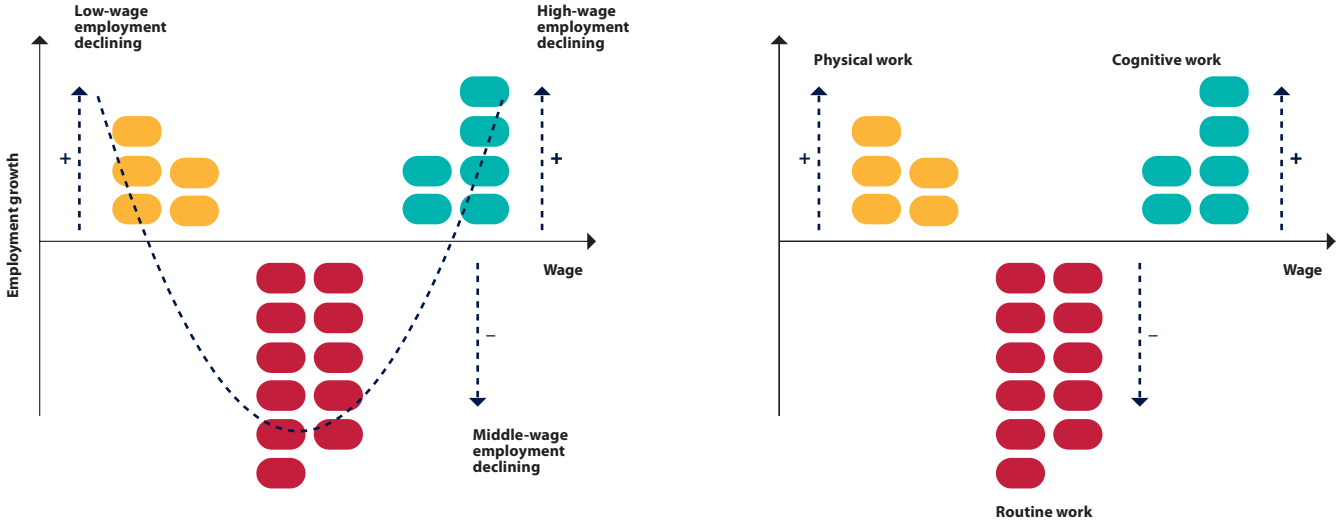
REGION	LABOUR COSTS	(%) EMPLOYMENT AGE >45 OR >50				TECHNICAL FEASIBILITY			
		Land	Sea	Air	Support	Land	Sea	Air	Support
Africa	-0.8	21	18	21	22	H	M	M	M
Asia and Pacific	-0.6	26	32	26	25	H	M	M	M
Europe	0.6	37	30	29	30	M	M	M	M
Latin America and the Caribbean	-0.7	37	37	15	30	H	M	M	M
North America	1.5	55	37	55	50	H	M	M	H

on-demand information supporting specific tasks, e.g. displaying to maintenance personnel technical details of the piece of equipment on which maintenance is to be performed."

In short, what can be automated doesn't necessarily (immediately) have to be. In fact, increasing automation of routine tasks in the past hasn't resulted in long-term unemployment. Authors of *Transport 2040* argue that so far, there hasn't been proof of what's called "technological unemployment." They also underlined, "Even when the automation of most work activities is technically possible, its implementation needs to be economically feasible. Studies [Acemoglu and Restrepo, 2017] have empirically shown that factors, such as the ageing of the population, are determining factors for adopting automation technologies, in particular, manufacturing robots."

Then again, there's evidence that technology has driven wage inequality (Fig. 9), "Because new technologies can generally be more easily acquired by those who are highly-skilled and educated, the demand

Fig. 9. Employment polarisation



for such workers has been rising in recent decades in parallel with the increasing use of technology in the workplace. In the process, the wages of high-skilled workers have risen sharply, while middle- and low-skilled groups have lagged behind. More recently, from the 1990s onwards, this trend has become more nuanced, with the demand for workers starting to polarize towards low-skill workers and high-skill and high-earning workers."

"Not inevitable"

Apart from the debates revolving around whether social media have been more or less intentionally designed (and not changed to do otherwise) to hijack our brains and wallets, destroy democracy, and surface what's worst in human nature, it's pretty much self-evident that meaningful technological advancements have made our lives better across numerous fronts. That's also the reasoning behind many solutions marketed to the transport & logistics stakeholders.

Air and underwater drones can work in hazardous environments in which people would risk the loss of life or limb. The same holds for remote operations of heavy-duty cargo-handling machinery, where the smallest mistake, e.g. on-board a gantry crane, can be grave. Truck platooning has also been devised with the intention to take driver fatigue out of the safety equation.

Fig. 10. Status of key technology categories and their effect on the workforce for selected applications across transport sectors[1]

KEY TECHNOLOGY CATEGORIES IN CLUSTERS, BY TRANSPORT MODE	QUALITATIVE JUDGEMENTS					
	Economic benefits	Regulation and governance	Technical feasibility	Social acceptance	Knowledge and skills	Labour market dynamics
Core automation functionalities						
Infrastructure						
Next generation air transport systems	●	●	●	●	●	●
Vessel traffic management	●	●	●	●	●	●
Rail traffic management	●	●	●	●	●	●
Road traffic management	●	●	●	●	●	●
Vehicles						
Airport automation	●	●	●	●	●	●
Ship automation	●	●	●	●	●	●
Train driving	●	●	●	●	●	●
Car/truck driver or operator	●	●	●	●	●	●
Automation of maintenance						
Air	●	●	●	●	●	●
Maritime	●	●	●	●	●	●
Rail (vehicle)	●	●	●	●	●	●
Rail (infrastructure)	●	●	●	●	●	●
Road (vehicle)	●	●	●	●	●	●
Road (infrastructure)	●	/	●	/	/	●
Customer interface						
Air	●	●	●	●	●	●
Maritime	●	●	●	●	●	●
Rail	●	●	●	●	/	●
Road	●	/	/	/	/	●
Planning and new services						
Air	●	●	●	●	●	●
Maritime	●	●	●	●	/	●
Rail	●	●	/	●	/	●
Road	●	●	/	/	/	●

● Negative effects ● Neutral effects ● Positive effects / Not applicable

[1] *The results in this table are presented from the perspective of the current workforce. For example, if the economic benefits of technological advances in road traffic management are high, this is likely to have a negative impact on workforce in that sector*

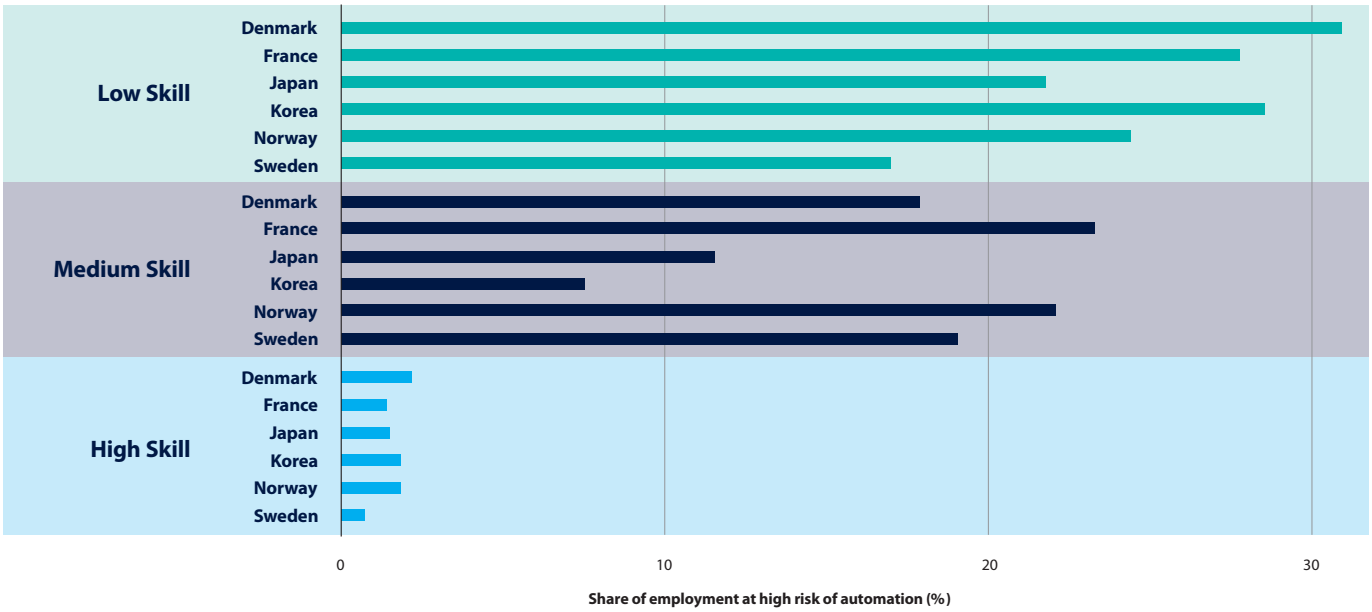
Artificial Intelligence and big data have already been successfully put to the test in screening ship holds in search for misdeclared, potentially dangerous goods. Predictive analytics can lead to substantial savings and safety improvements when it comes to maintenance (in the energy sector, the U.S. Department of Energy reports, it has resulted in up to 30% reduction in maintenance tasks and up to 75% in business interruptions). Augmented reality, through the use of virtual reality glasses for inspecting ship machinery or mounting sensors on transport infrastructure, can also make maintenance easier, faster, and, in the end, better. Additive manufacturing (3D printing) is likely to profoundly alter vehicle maintenance, too, especially that of ships, by making it possible to print spare parts on-demand and right on the spot. Taken as a whole, tech-enabled safety advancements – getting rid of the so-called d-tasks: dirty, dangerous, and difficult – are aimed at making transport & logistics more worker-friendly, so as to attract new generations or groups that have previously been excluded from working in the industry, such as people with disabilities, or who've perceived the occupation too dangerous, like women (who constitute only about 20% of all transport workers, incl. those office-based).

Other tech-developments promise to deliver greater efficiency – vessel voyage and port call optimisation tools save the supply chain time, hence money, as well as spare the environment the unnecessary emissions generated by ships queuing in wait for a berthing slot. Blockchain is seen not only as a means of speeding up import/export operations and executing associated handling & forwarding payments but also as something which will facilitate trustworthy data exchange in an industry sadly known for its distrust. As the authors of *Transport 2040* put it, "Connecting data streams from different transport modes and mining of 'big data' will make it possible to process logistics information, e.g. customs, security, health and waste, more efficiently. Efficiency will be improved when common data structures are used by all stakeholders." Data, the new fuel, also makes it possible to develop a digital twin of highly complex and interrelated areas, e.g. ports. This, in turn, can make it easier to simulate the soundness of an investment, i.e., whether all those taxpayers' or private investors' money will really improve operations.

While it's true that labour accounts for a considerable portion of costs in transport – according to the U.S. Department of Transport 26% in aviation, 27% in both road and waterborne, and 28.7% in rail across the US (2015 data) – exchanging a worker for a robot/software isn't as straightforward as doing a Windows update. Again, a job is a bundle of activities, often requiring, apart from the proper perception of surroundings and gear/software manipulation, also social intelligence and creativity. If automation stumbles somewhere along the work chain, it'll create an efficiency bottleneck, not gain.

So, if neither of the two extremes is the most plausible to turn into reality – i.e., business as usual or the revolutionary 'machines will take over next Monday' scenario – then what we're left with will probably be the prevailing approach. Companies will continue to explore new concepts more and more boldly, while countries, at least those forward-looking, will set up institutions that, on the one hand, will assist workers in their transition towards Industry 4.0-type-of-employment, and, on the other, will foster an environment that encourages

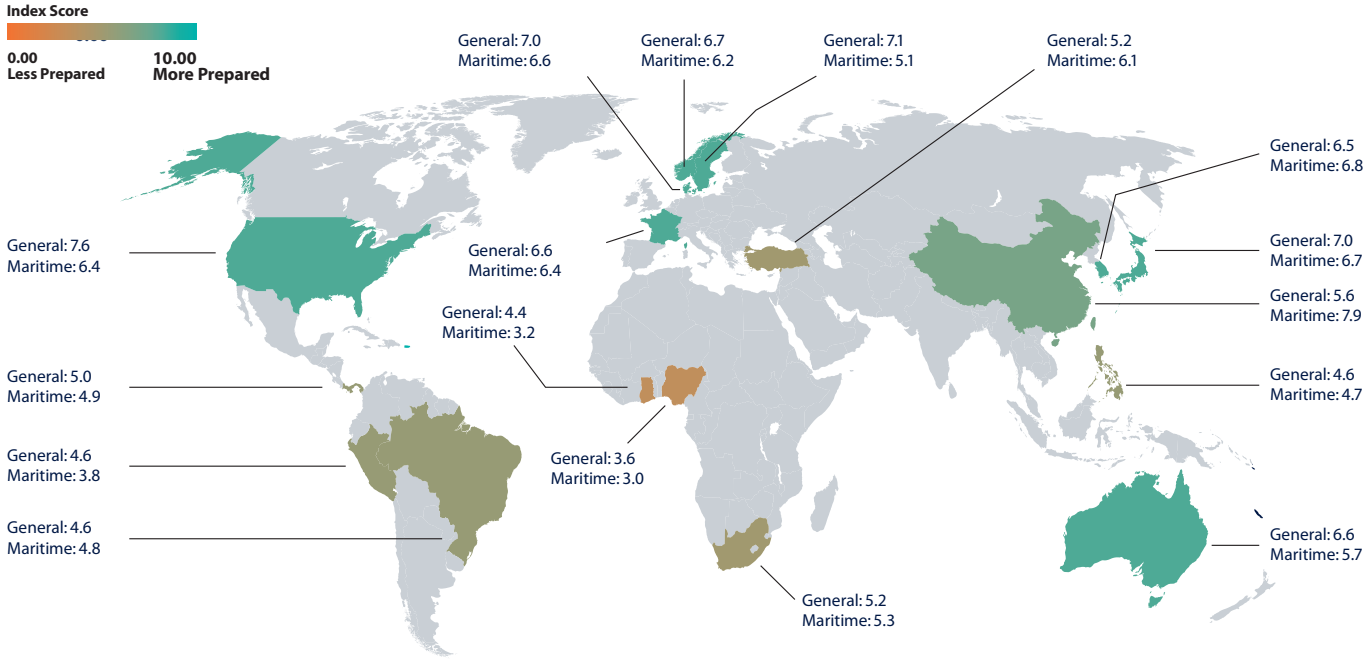
Fig. 11. Variation of automation risk across skill groups by countries



innovation and what's maybe even more important – how innovation is interwoven with the socioeconomic fabric. "There are many things we, as a society, can do to stop the harmful effects of technology. We can secure regulations. Workers can use new technology to organise," Stephen Cotton, General Secretary, the International Transport Workers' Federation. He added, "The effects of automation and new technologies are not inevitable; they are a policy choice. Politicians, employers and

Photo: Volvo Group

Fig. 12. Readiness level for the introduction of emerging and new technologies

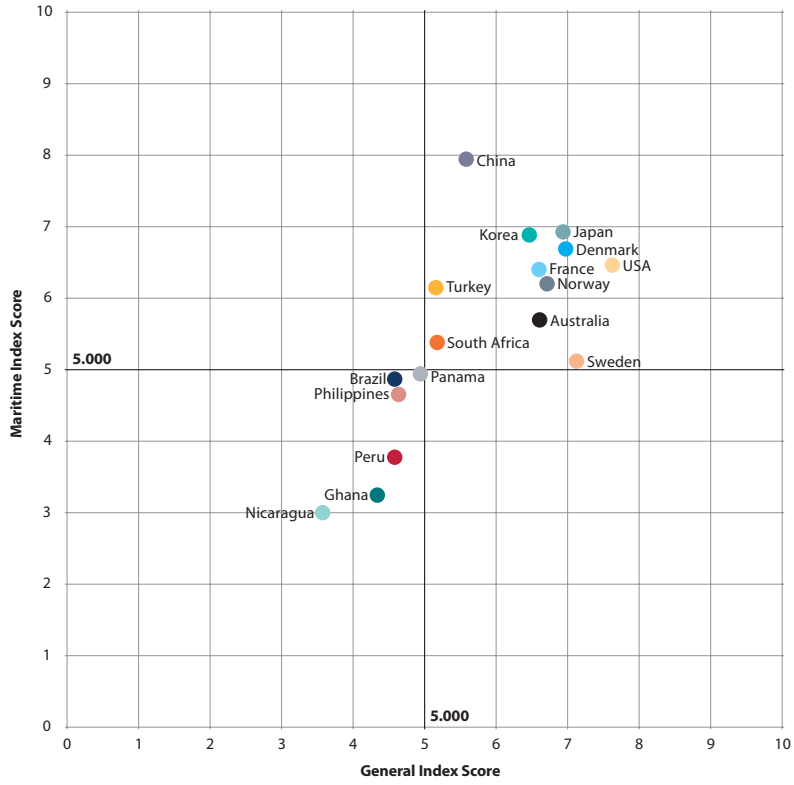


workers have the power to make digital technology a tool for positive change."

Are you tech-absorptive?

The World Maritime University in the *Transport 2040* paper also analysed what the authors dubbed "technology absorptive capacity." It's a tech-specific measure of what the World Economic Forum and the management consulting firm A. T. Kearney define as "readiness," i.e., "the capability to capitalize on the future, mitigate risks and challenges, and be resilient and agile in responding to unknown future shock." The WMU has scrutinised 17 countries (incl. two from the Baltic: Denmark and Sweden, and our closest neighbour, Norway; Figs. 11-13) through the lenses of five factors, all in order to score their tech-readiness as well as to create a data-based agenda that would point low scorers and other peoples in the right direction. These are Innovation & Technology; Infrastructure Quality; Regulation & Governance; Human Capital & Skills; and Business & Investment.

Fig. 13. Global map of readiness assessment result for the country profiles



The first one, Innovation & Technology, is the main driver of change in the maritime industry. Here, setting up secure and connected ICT infrastructure is of the essence for the development and adoption of new technologies. This factor also stands for a country's ability to foster and commercialise innovation (investment in research & development), but also to what extent hi-end ICT is available and actually used. This category relies upon Infrastructure Quality, as it makes no sense to digitalise highways made of potholes, decaying port quays and yards furnished with rusting cranes, or non-existent railways. Those who'll fail to integrate information technology with its operational counterpart, and vice versa, will blunt the opportunity to gain a competitive edge. On top of these two sits Business & Investment, i.e., how supportive, transport-oriented, and logistically performant is the environment in a given country.

Human Capital & Skills, as per OECD's definition, represents the "knowledge, skills, competencies and other attributes embodied in individuals or groups of

Photo: Rolls-Royce Marine/FinFerries

individuals acquired during their life and used to produce goods, services or ideas in market circumstances." In short, it's the country's ability to respond to shifts brought about by Industry 4.0 so as to long-term adapt its workforce. "Several studies suggest that there will be shortages of suitably qualified personnel in different industry sectors, including transport," *Transport 2040* notes and accordingly advises, "As part of a life-long learning process, transport workers need to be prepared to adapt to the changing nature of work and develop new skills and competencies. Examples include digital skills, such as data fluency, digital operation and basic software engineering." Remote-control drivers of port gantries are a case in point, "It is compulsory for the 'new' quay crane drivers to obtain general prior knowledge on mechanics and electronics, in addition to state-of-the-art handling skills on control panels," WMU observed in its research.

Regulation & Governance – as we know from, e.g., turning parts of northern Europe into 0.1% Sulphur Emission Control Areas (SECA) – can drive an industry to froth at its mouth or kick-start a game-changing wave of innovation, or both (as has been to a certain degree the case with SECA in the Baltic; luckily, the latter attitude taking the upper hand eventually). For instance, Filip Koscielecki, Claims Executive at UK P&I Club, noticed (in his highly recommended article *Revolution by evolution. Autonomous ships are hailed as the future of shipping. The technology is here, but are we ready for it?*), "There is currently no international definition of what an autonomous or unmanned ship is, what the various levels of autonomy are and whether an autonomous ship is a ship under international law. When definitions are in use in various conventions, they tend to be very broad and customs-made to cover the subject matter to be regulated. Attempting to build a unified legal and regulatory framework is extremely difficult if there are no preliminary agreements on the basic definitions."

That's why the up-to-date autonomous shipping trails have been performed under the auspices of governments that are in general known for their tech- and future-oriented mindsets, like Norway (piloting the *YARA Birkeland* project on the world's first autonomous container ship) and Finland (*Falco*, the first remote and autonomous ferry in the world) – with the support of such marine tech-heavyweights as Kongsberg and Rolls-Royce, interestingly, both from Norway (Figs. 14-15). "Challenges that need to be resolved in all modes of transport are

Tab. 1. Lloyd's Register's taxonomy of autonomy levels in maritime transport

Level of autonomy (AL)	Details
AL 0: Manual	No autonomous function. All action and decision-making performed manually (n.b. systems may have level of autonomy, with human in/on the loop.), i.e., human controls all actions.
AL 1: On-board decision support	All actions taken by a human operator, but decision support tool can present options or otherwise influence the actions chosen. Data is provided by systems on-board.
AL 2: On & off-board decision support	All actions taken by a human operator, but decision support tool can present options or otherwise influence the actions chosen. Data may be provided by systems on- or off-board.
AL 3: 'Active' human in the loop	Decisions and actions are performed with human supervision. Data may be provided by systems on- or off-board.
AL 4: Human on the loop, operator/supervisory	Decisions and actions are performed autonomously with human supervision. High impact decisions are implemented in a way to give human operators the opportunity to intercede and over-ride.
AL 5: Fully autonomous	Rarely supervised operation where decisions are entirely made and actioned by the system.
AL 6: Fully autonomous	Unsupervised operation where decisions are entirely made and actioned by the system during the mission

Source: LR Code for Unmanned Maritime Systems

Fig. 14. Enablers and hurdles of deploying highly autonomous ships

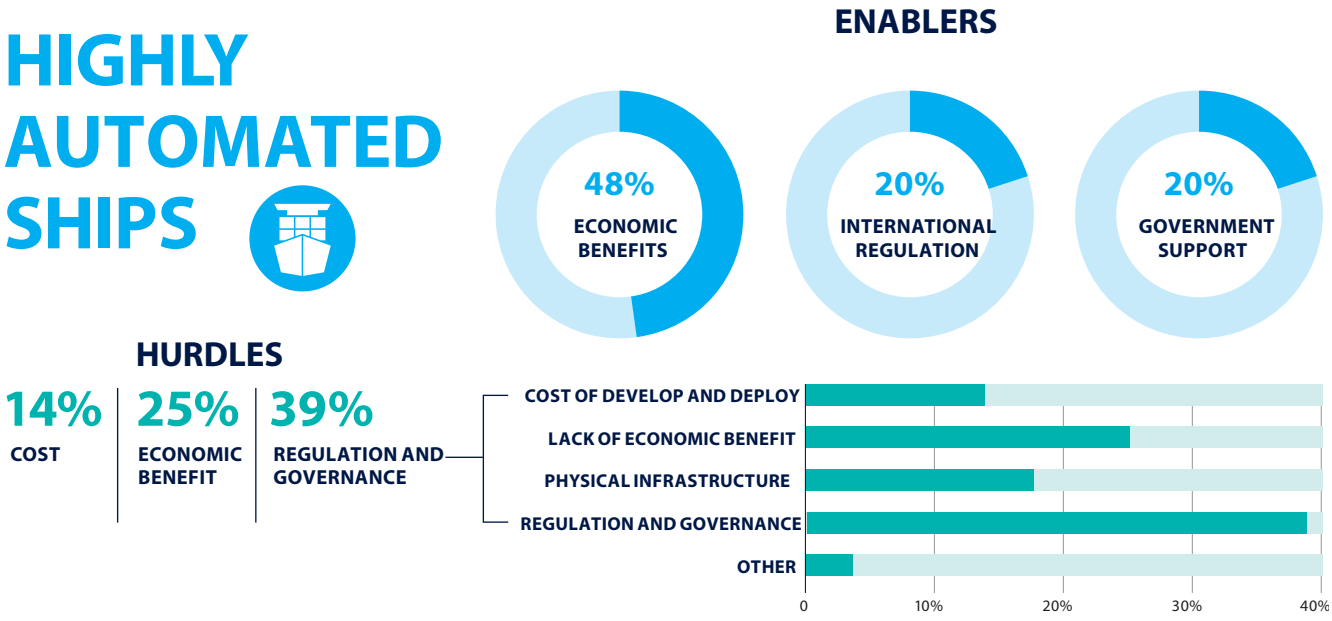
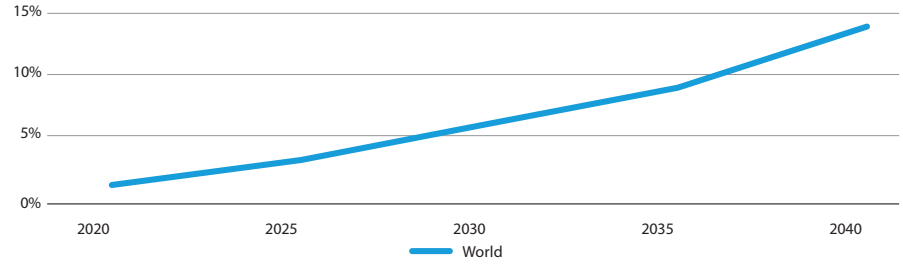


Fig. 15. Start-up-curves for autonomous ships with human supervision



mainly operational and legal ones. Within the next 10 to 15 years fully autonomous operations are expected to become possible with the technical and legal barriers having been resolved," the authors of *Transport 2040* conclude. That said, "autonomous" doesn't have to automatically mean "unmanned." WMU predicts that such ships won't be "[…] conventional vessels without a crew; rather they are a novel type of ship with fewer but highly skilled crew members who control an increasing number of autonomous functions and operations on board, possibly from remote control stations." So, back to square Human Capital & Skills.

The Big Transport Tech

More and more people from the transport & logistics industry, including representatives of technological companies, speak of thinking about transportation in terms of corridors, not whether a particular country, mode of transport, or seaport is better or receives more/less support than its neighbour (within a country or outside its borders). It should be clear that although the factors devised by WMU are used to assess the performance of a single country, the interconnected world the Big Transport Tech is brewing for us will sooner or later make it evident that, e.g., autonomous shipping, however successfully developed in country A, will bring no benefits unless countries B, C, and D, which are in the trade/supply chain, don't catch up. In the fields of innovation, technology, human capital, skills, regulation, governance, infrastructure, business, and investment to be perfectly exact. ■