WORLD MARITIME UNIVERSITY

TRANSPORT 2040

AUTOMATION TECHNOLOGY EMPLOYMENT

THE FUTURE OF WORK

EXECUTIVE SUMMARY

TRANSPORT 2040

AUTOMATION, TECHNOLOGY AND EMPLOYMENT

THE FUTURE OF WORK

INTRODUCTION

WE ARE ABOUT TO EMBRACE WHAT IS NOW TERMED THE FOURTH INDUSTRIAL REVOLUTION, WHICH IS CHARACTERIZED BY THE INTRODUCTION OF ARTIFICIAL INTELLIGENCE, ROBOTICS, MORE AND MORE INTERCONNECTION, AMOUNG OTHER INNOVATIONS.

Industrialization and transportation have always been in close association. Increased levels of production and new technologies developed for the industry at large have engendered new solutions and forms of transport. Transportation was one of the key enabling factors for globalization. Every year 62.7 trillion tonne-miles of cargo are transported around the world.

Technological progress and innovation have occurred throughout history and changed its course, for example the Industrial Revolution in the eighteenth and nineteenth centuries. Currently, we are about to embrace what is now termed the Fourth Industrial Revolution, which is characterized by the introduction of artificial intelligence, robotics, more and more interconnection, among other innovations. There have been significant developments leading to the introduction of new technologies and higher levels of automation in transportation. The world is interconnected through global trade on the basis of a transportation industry striving to be more and more efficient. At the same time, new technologies and automation are displacing some jobs and creating new ones, thereby impacting employment in general. This has led to a wide discussion about the consequences of this development and the effects that this may have for society at large. If we look at the different stages of technological progress in history, the previous waves of technological development had significant impacts on jobs, employment and working conditions in general. As a result, there is a keen interest in the discussion of what the consequences of the current industrial revolution will be, and how society at large can be prepared for the transformations that may arise from further introduction of advanced technologies and automation.

This report is intended to address the issue of how transportation will change as a result of more technologies and automation. The study that provided the data for this report is the result of intensive research conducted by an interdisciplinary team of experts with input from academia, industry and regulatory bodies during the last 18 months. The research undertaken forecasts and analyses trends and developments in all four modes of transport up to 2040 with a special emphasis on jobs and employment.

This report is based on four pillars: a forecast of technologies; a forecast of global trade and transport; an analysis of the labour force involved in transport; and the development of country profiles that can be used to illustrate the local context for the introduction of technology and automation in a specific country. In this report, we conclude that the introduction of automation in global transport will be evolutionary, rather than revolutionary. While it affects mainly medium- and low-skilled groups, technological change is impacted by local factors. Despite high levels of automation, qualified human resources with the right skill sets will still be needed in the foreseeable future. This conclusion is based on four key findings.

KEY FINDINGS

1 Economic benefits, demographic trends and safety factors are catalysts for automation; but in many areas of global transport the pace in the introduction of automation will be gradual.

2 The increasing volume of trade leads to more demand for transportation in the future, while regional changes in transportation patterns are expected.

3 With the gradual pace in the introduction of technology and the increased volume of trade, their effects on employment are predictable. Low- and medium-skilled workers will be exposed to the high risk of automation. However, the pace of introduction and diffusion of technologies will depend on differences in the development stage of countries and their comparative advantages.

4 Automation and technology is influenced by the local context. The assessment of individual country profiles shows that countries and regions are not at the same level of readiness to adopt new technologies and automation. An analysis of relevant key factors highlights the gap between developed and developing countries.

SUSTAINABLE DEVELOPMENT GOALS

This study has been undertaken in furtherance of the purposes and objectives of the United Nations Sustainable Development Goals. It addresses the following Sustainable Development Goals in particular:

4 QUALITY EDUCATION
5 GENDER EQUALITY
8 DECENT WORK AND ECONOMIC GROWTH
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE
13 CLIMATE ACTION
14 LIFE BELOW WATER

1 WHICH NEW AND EMERGING TECHNOLOGIES WILL BE INTRODUCED IN GLOBAL TRANSPORT?

Across industries a number of trends have been evolving around digitalisation, increased levels of interconnectivity in production processes and advanced levels of automation. The implementation of these technologies has already started in many segments of the transport chain and will continue to have effects on all transport modes in the future.

Evolving technology trends can be discussed in the context of four technology clusters, addressing both the operation and maintenance of vehicles and the transport infrastructure, but also front-end customer service. Technologies within those clusters are reviewed with respect to their technical feasibility, the economic benefits they provide and the regulations and policies that need to be in place. The following conclusions have been reached based on the analysis of these clusters.

FOUR CLUSTERS OF NOVEL TECHNOLOGIES	
1	**Automation of vehicles and infrastructure** e.g. autonomous commuter trains, automated ships and airplanes, cranes, control centers
2	**Maintenance of vehicles and infrastructure** e.g. condition-based maintenance, inspection drones, repair robots, additive manufacturing of spare parts
3	**User interfaces for customers and equipment operators** e.g. chatbots for travel advice and ticketing, customer service robots providing information and catering
4	**New services** e.g. mobility as a service, cross-modal transport on demand, availability-oriented business models

1.1 THE INTRODUCTION OF AUTOMATION WILL BE EVOLUTIONARY RATHER THAN REVOLUTIONARY

Automation and new technologies will be introduced progressively in all transport sectors, but with sector-specific differences.

In the aviation industry, annual labour productivity has been growing faster than the overall economy. In addition to technological progress and automation, the growth rate has been the result of an increase in demand and change in the industry structure, such as the growth of low-cost carriers. Labour productivity in the airport sector appears to be more volatile than in the airline sector.

In maritime transport, the adoption of novel technologies tends to occur at a slower pace. Indications are that agreed international guidelines and regulations regarding autonomous transport are unlikely to be achieved within the next decade. However, if a strong economic benefit is expected and social acceptance exists, highly automated transport solutions could be implemented at the regional level and governed by national legislation or bilateral agreements among adjacent countries.

With respect to road-based transport, the introduction of these technologies and automation is likely to be evolutionary. In the case of transportation network companies in comparison to taxis, a much more immediate and disruptive effect may occur for certain uses, e.g. urban-shared mobility.

In rail transport, it can be assumed that using existing technologies could solve most of the technical and functional issues regarding fully automatic train operations.

Challenges that need to be resolved in all modes of transport are 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. While the above trend indicates a gradual introduction of technology, disruptive technologies may emerge in selected sectors, e.g. airport passenger operations, customer and sales services, passenger security check, luggage and cargo logistics, taxis, local buses and, in the case of Europe, in the train control system.

1.2 BEYOND LONG-TERM ECONOMIC BENEFITS AUTOMATION IS TRIGGERED BY DEMOGRAPHY, SAFETY AND EFFICIENCY

Technology and automation are often triggered by the safety and efficiency concerns of operations, and not always motivated by reducing labour costs. In particular, in emerging technologies requiring interconnected systems there is a strong emphasis on ensuring the safety and security of operations. However, in some transport modes, such as the road freight sector, labour costs are regarded as an important element in business cases related to autonomous and highly automated transport.

Automation is often used as an argument to respond to demographic challenges in some regions of the world. For instance, in Europe an ageing workforce has created a mismatch between labour supply and demand. In response, more automation has been introduced to the European rail industry to outweigh the consequences of a labour market mismatch, while maintaining high levels of safety. At the same time, capacity, punctuality and efficiency have increased, while costs and emissions have been reduced – resulting in improved competitiveness of the railway transport.

Most notably, safety aspects are frequently promoted when automation and technology are discussed. Autonomous or remotely controlled devices reduce the exposure of transport workers to hazardous environments. Examples include exoskeletons that assist workers in lifting and moving heavy items; remote controlled cranes that can be operated from a safe distance; and airborne and underwater drones which make it possible to inspect and repair parts of ships and offshore structures that are difficult to reach by inspection workers.

Apart from the safety aspects, efficiency is an important factor for the introduction of technology and automation. Innovations that allow for higher levels of efficiency are given high priority due to increased competition across all transport modes.

1.3 IN MANY AREAS AUTOMATION IS LIKELY TO RESULT IN A SHIFT OF THE WORKFORCE, NOT IN LABOUR REDUCTION

The objective of optimization in transportation is related to efficiency gains. Increased levels of technology and automation will contribute significantly to this objective.

In transportation, the highest potential for automation is in low-skilled jobs, which are intensive on predictable physical activities and data processing; therefore those jobs face a high risk of being impacted by automation. At the same time, the further introduction of automation will also create a demand for new types of jobs, such as remote operators, worldwide operating maintenance crews and mobility-as-a-service providers. As a result, the demand for labour will not completely disappear, but the requirements and skills needed for individual jobs will change.

For further predicting the impact of technologies and automation on the global labour demand for transport workers, projections and trends in global trade are needed to complement the discussion.

2 HOW WILL GLOBAL TRANSPORT DEVELOP UNTIL 2040?

Following the identification of technology trends, an evaluation is made of the development of global trade and transport. Experience shows that, despite increasing levels of technology introduced during the last decades, no decline in employment was noted as a result of an increasing demand for transportation. To assess the consequences of the further introduction of technology and automation, it is therefore important to understand how global trade will develop further. This applies in particular to the trade patterns and modes of transport used in global trade. The research undertaken has led to the following conclusions.

2.1 OVERALL THE TRANSPORT VOLUME IS EXPECTED TO INCREASE, BUT AT A DECREASING RATE

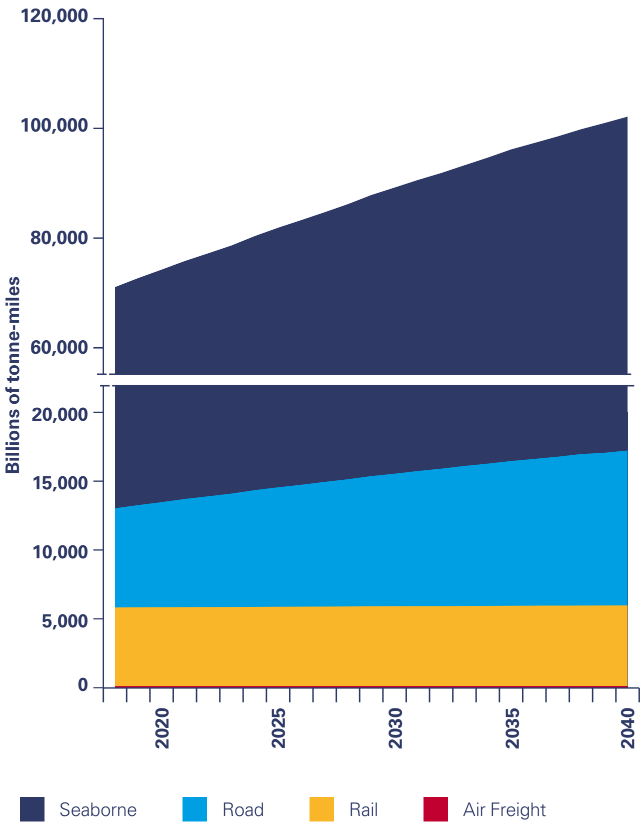
The demand for transportation is primarily in response to the economic environment and population growth. Historically, there has been a close correlation between the growth in the gross domestic product (GDP) and the transport volume, which means that economic activities and trade are among the main drivers of the demand in transport. This pattern is confirmed in this study.

From the perspective of the economy, the growth in GDP per capita has a positive effect on the volume of all freight transport. Even though the global GDP slowed down to 3 per cent in 2015 and 2016, the global GDP growth rates show an increase of 2.2 per cent to 3.2 per cent during 2017-2022. In respect of population, a higher population results in increasing trade demand. According to the projected population released by the United Nations[1] the world population is growing, but at a slower pace than in the past. It is estimated to reach 8.1 to 9.0 billion by 2040.

Regarding volume per commodities categories, it should be noted that as a result of international activities to mitigate climate change, renewable energy in general will be prioritized. As a consequence, the transportation of oil and related products will be reduced after 2030. Therefore, moving from 2030 to 2040, our projection shows that demand for maritime transport is likely to increase at a less rapid pace – with the growth primarily in non-energy commodities. However, it is expected that the slower growth in oil and related products after 2030, will be offset by a faster increase in trade volumes of finished and semi-finished containerisable products.

With respect to the volume per transport mode, aviation freight and passenger transport are both increasing at moderate rates. Seaborne trade and road transport enjoy a relatively high growth rate, but the growth rate itself is decreasing. It is forecasted that overall trade, measured as tonne-miles, will experience a 2.2 per cent annual growth over 2015-2030 and a 0.6 per cent annual growth rate per year after 2030 (Figure 2.1). The growth rate will decrease afterwards until 2040, although growth will still occur (Figure 2.2). This means that an increased demand for transportation is expected until 2040.

FIGURE 2.1 Global transport turnover: projected development to 2040



Source: World Bank, UNCTAD, International Road Federation, Institute of Shipping Economics and Logistics, DNV-GL, WMU analysis and forecast

[1] United Nations Department of Economic and Social Affairs Report: World Population Prospects: The 2017 Revision.

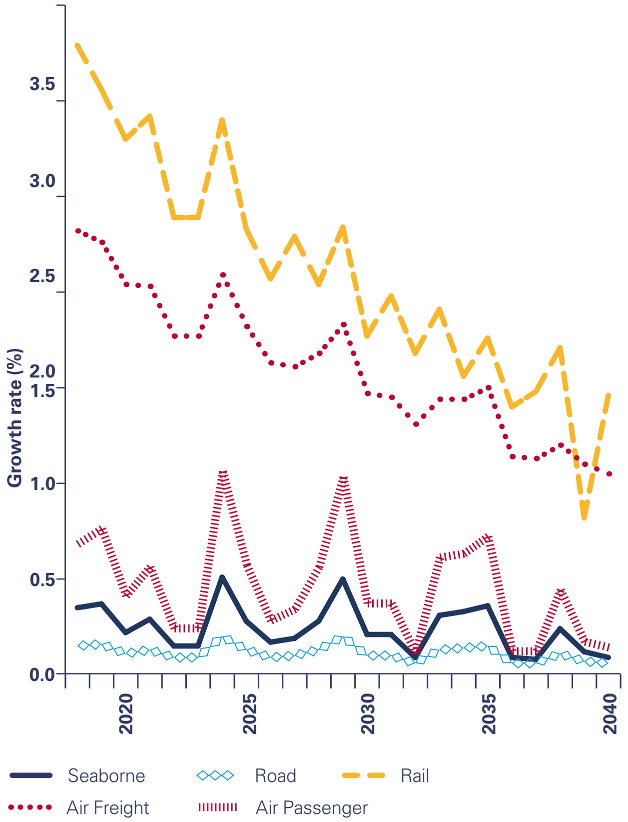
2.2 A NEW PATTERN OF TRANSPORTATION ROUTES WILL BE EMERGING

Turning to transportation routes and countries along these routes in coming years, one important factor to take into account is that the growth rate in China may decrease with time. Another factor is that growth rates for many of the developed countries may differ. France and Germany, for example, will keep their current level of transport demand, while demand in others, like the United States, is expected to grow until 2040. Emerging economies, such as those of Mexico and India, may enjoy higher growth rates since trends in transportation follow trading patterns.

New and emerging patterns of transportation routes will be reflecting the volume in global trade; seaborne transport will still remain the dominant mode of transport for world trade. Today, seaborne transport accounts for more than 80 per cent of international trade in terms of tonne-miles. In other words, deep-sea cargo-carrying ships dominate transport services, and four-fifths of vessel traffic is currently deployed in the northern hemisphere serving the West-East trade routes.

In line with the new pattern of transportation routes, vessel traffic will see an increase in the Indian and the Pacific Oceans, and seaborne transport growth is likely to be focused in the Asia and Indian Ocean regions, thereby highlighting the importance of Asian trade. Because of the changes in trade routes resulting in the growth of Asia's share in global trade, the transportation services servicing this trade will also increase in volume in those regions.

FIGURE 2.2 Growth rates in global transport: projected decrease to 2040



Source: World Bank, UNCTAD, International Road Federation, United States Census Bureau, WMU analysis and forecast

2.3 IMPROVED PRODUCTIVITY EXPECTED FROM TECHNOLOGY ADVANCEMENTS LEADS TO MODAL SHIFTS AT THE REGIONAL LEVEL

An important concern is that, to some extent, international shipping may be substituted by other transportation modes. This substitution is not foreseen to happen, however, as far as long-distance maritime transport is concerned, long-distance maritime transport still remains the leading mode in terms of the scale and volume of goods being carried.

In general, transport services will continue their impetus to achieve greater efficiency by reducing costs, improving utilization, lowering fuel consumption, increasing carrying capacity and deploying new technologies. Based on these, key concerns that could trigger game-changing modal shifts are energy use, emission policies, environmental awareness and technology development in transport. Figures from two regions are given to illustrate these modal shifts.

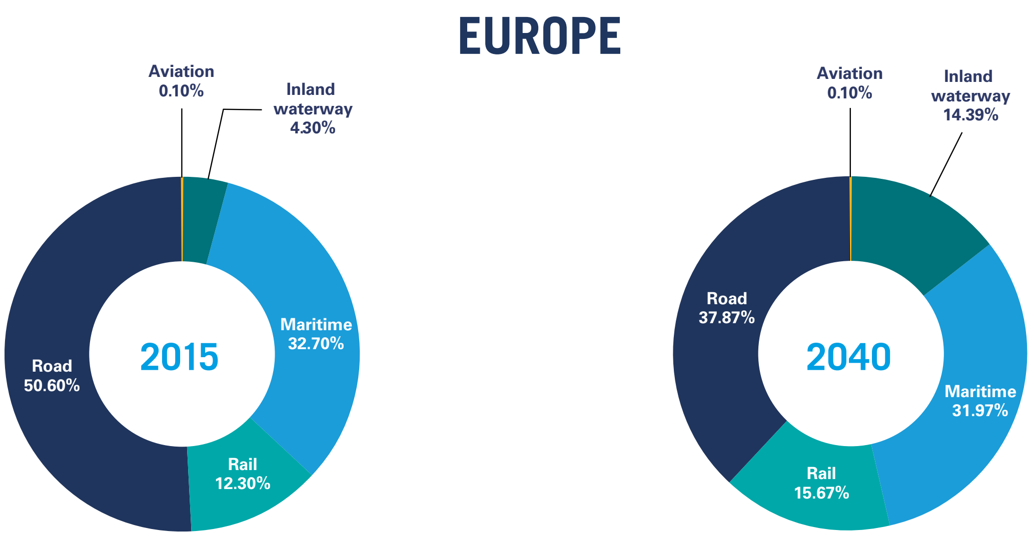
In Europe (Figure 2.3), the percentage share of inland waterway navigation together with rail transport in the transport sector is forecasted to increase as a result of the development of technology, emission control policies and renewable energy policies. For instance, by 2040, the inland waterway transport system is expected to increase up to 14.39 per cent in 2040 compared to 4.3 per cent in 2015. For its part, rail transport is expected to increase up to 15.67 per cent in 2040 compared to 12.3 per cent in 2015. Conversely, road transport will decrease. However, such trends must be seen in a regional context and will need to be examined further. ASEAN[2] countries (Figure 2.4) have experienced an increase of rail and waterborne freight movements over the last years. Historically, the inland waterway transport mode held an extremely low market share and was the least developed mode of transportation in terms of volume. The situation is expected to be changed in future, since the modal shifts in ASEAN countries will be led by emission-control policies and facilitated by infrastructure investment. More specifically, from 2015 to 2040, ASEAN might expect approximately 20 per cent of the total freight to be moved by rail, previously transported by road. During the same period, ASEAN might also expect to observe substantial increases in maritime transport including 6 per cent by inland waterways and 20 per cent seaborne. By then, waterborne freight to be carried would be approximately 0.8 billion tonne-miles. Subsequently, the projected road transport might decrease to 54 per cent by

[2] ASEAN (Association of Southeast Asian Nations) includes Indonesia, Thailand, Vietnam, Singapore, Malaysia, Philippines, Myanmar, Cambodia, Laos, Brunei

2040, a significant drop from the current 91 per cent.

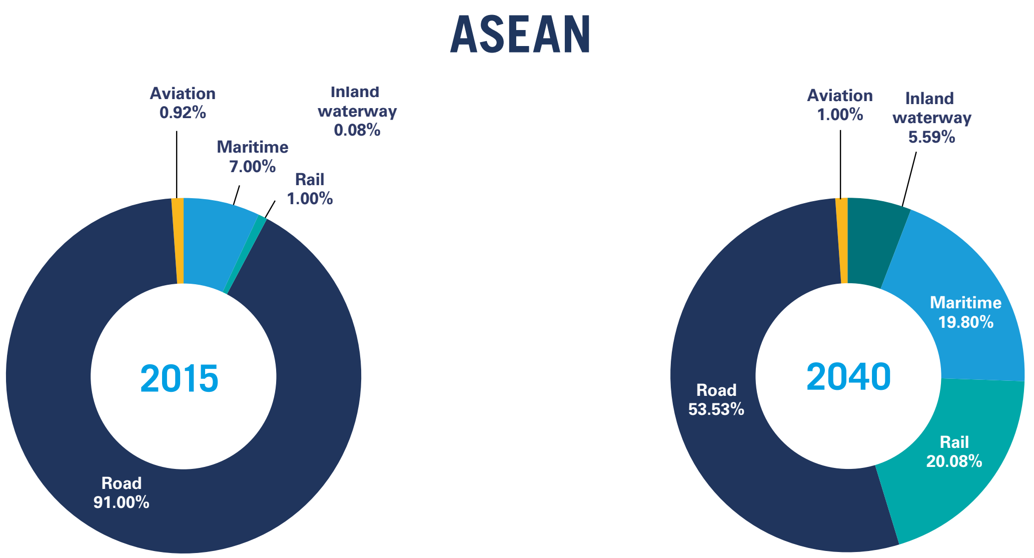
Our transport forecast highlights a situation that, while a familiar one, is a sector that has undergone significant changes, including the introduction of new technologies. Because technology enables quicker and more economic transport, it causes changes in trade patterns and modal shifts. It also influences employment whose professional categories will change as a result of shifting patterns in trade and modal shifts. This trend is highlighted in the next section.

FIGURE 2.3 Projected modal shifts in European transport: 2015 to 2040



Source: Eurostat, WMU analysis and forecast
Note 1: Figures relate to freight only
Note 2: Aviation and maritime cover only intra-European movements

FIGURE 2.4 Projected modal shifts in ASEAN transport: 2015 to 2040



Source: ASEAN StatsDataPortal, WMU analysis and forecast
Note 1: Figures relate to freight only
Note 2: Aviation and maritime cover only intra-ASEAN movements

3 WHAT ARE THE EFFECTS ON THE TRANSPORT LABOUR FORCE?

The third pillar of the analysis relates to a sectoral assessment of the transport sector labour force. The overview is one of the first to focus on this topic in transportation and covers almost 60 per cent of the world labour force from more than 70 countries. This assessment contributes to the discussion of how further technology and automation will affect the current and future jobs of transport workers.

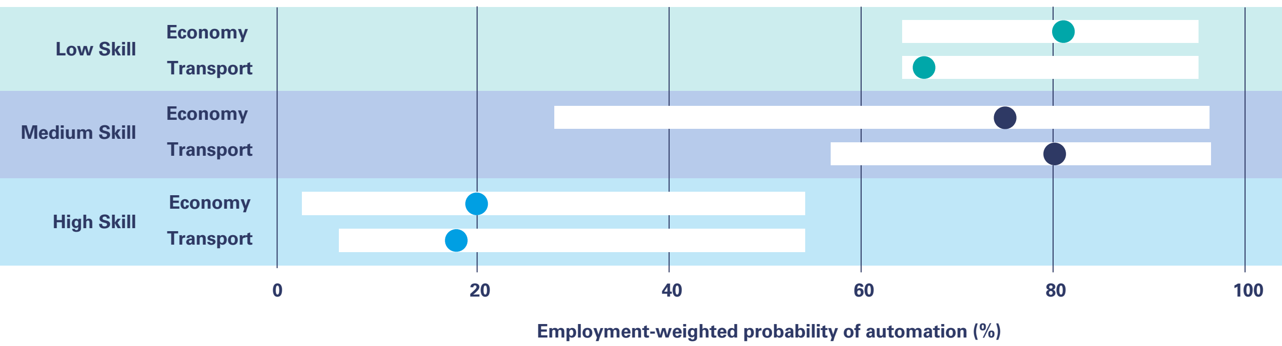
3.1 TRANSPORT HAS A HIGH POTENTIAL FOR AUTOMATION, LIKE OTHER INDUSTRIES, BUT AT SLOWER ADOPTION RATES

Research undertaken shows that transport workers face a similarly high risk of automation as their counterparts in other industries. The foreseeable advancement in automation technologies, such as artificial intelligence, mobile robotics, together with the declining price of computing power, is likely to have a similar impact on the tasks of workers across most industries. Figure 3.1 below shows the potential for automating tasks by 2040 among different skill groups. On average, the transport sector has a similar potential for automation as other industries, especially for the low- and medium-skilled groups of workers. The technologies and related applications to be introduced in various industries will also affect job profiles in transportation.

However, our research indicates that the pace through which the introduction of automation technologies takes place varies from industry to industry. Historical trends show that automation of routine-based tasks has led to the decline of middle-skill jobs, forcing those workers in the middle to shift to low-skilled and low-paid jobs. Only a small share of workers has been upgraded for high-skilled and high-paid jobs. The introduction of more advanced automation technologies, such as machine learning, can open the way to the automation of a wider range of tasks, thereby amplifying the downgrading effect of automation technologies on jobs and mid-level workers.

A closer look at the tasks involved in different jobs carried out by transport workers shows similarities across task profiles for sea, land and air transport in terms of the complexity and frequency of the tasks involved. Based on a composite task measurement indicator, it shows that tasks associated with rail transport are less prone to automation (higher score), while passenger road transport is the most likely to be automated (lower score). The potential for deep-sea transport is similar to the that found in air transport. Task profiles are more diverse within the supporting activities of a specific transport mode, such as cargo handling in ports or airports. Supporting activities for road freight and deep-sea transport have the greatest potential for further task automation (lower score), while further automation is more difficult to be achieved in the supporting activities for rail transport (higher score). The variance found across tasks indicates that some industries will experience automation earlier than others, even when it relates only to their technical feasibility, that is to say, from the point of view of using current or foreseeable technologies to automate tasks.

FIGURE 3.1 Automation potential in relation to skill groups in transport



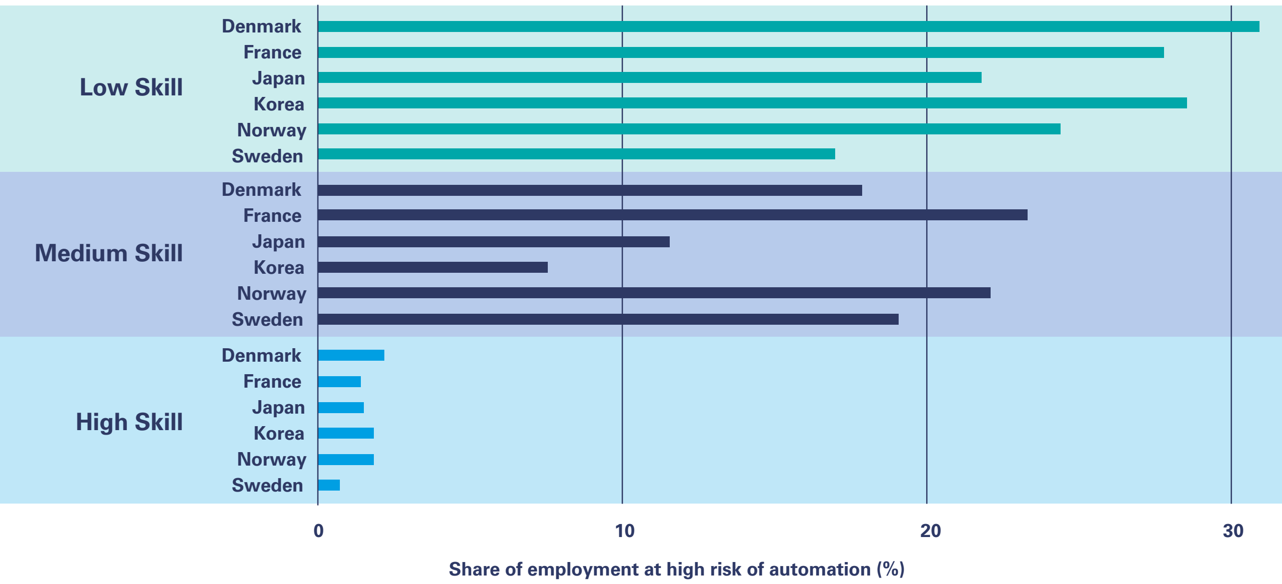
Source: Frey and Osborne. Tech. Forecast. Soc. Change. 114 (2017), BLS, ILO, Eurostat, WMU analysis

3.2 AUTOMATION TECHNOLOGIES HAVE THE POTENTIAL TO REDUCE THE GLOBAL DEMAND FOR TRANSPORT WORKERS

The potential for reducing the demand for transport workers as a result of the introduction of technology varies among different transportation modes. Foresight simulations undertaken for the maritime sector show that the introduction of highly automated ships will lead to a decrease in the global demand for seafarers by 2040 vis-à-vis the baseline projection based on current technology. The introduction of highly automated ships[3] can reduce the global demand for seafarers by 22 per cent. The simulations show that such effects are not compensated by the increase in volume of seaborne trade projected for 2040, and they reduce the effect of automation on demand by eight percentage points. Similarly, further introduction of automation technology in other transport modes and supporting activities will lead to increasing labour productivity gains, and, with other conditions remaining the same, lead to a reduction in labour demand. However, an unpredictable product market demand and spill over effects can dictate the extent to which labour demand will be affected.

Estimates for a group of countries participating in the Organization for Economic Co-operation (OECD) and Development Programme for the International Assessment of Adult Competencies survey show that between 5.7 per cent and 50 per cent of the low-skilled workers (e.g., dockers, baggage handlers) are exposed to the high risk of automation (more than 70 per cent of the tasks that are automatable), and their jobs will not exist in the current form by 2040. The same applies to the middle-skilled group (e.g., able seafarer, heavy truck drivers), where the share of employment at high risk of automation is as low as 7 per cent or as high as 23 per cent depending on the job responsibilities. What is consistent across countries, however, is the relatively small portion of jobs (not exceeding 2 per cent) of high-skilled workers that are at high risk of automation (Figure 3.2). The high-skilled group (e.g., ship officers, aircraft pilots and professionals) has the least estimated job losses resulting from the introduction of automation technologies. The estimated numbers refer only to their technical feasibility; the magnitude of the estimates could be reduced when considering factors other than technical feasibility (e.g., economic benefits, regulation and governance, or labour market dynamics).

FIGURE 3.2 Variation of automation risk across skill groups



Source: Arntz, *et. al.* OECD Social, Emp. and Migration WP. 189 (2016), WMU analysis

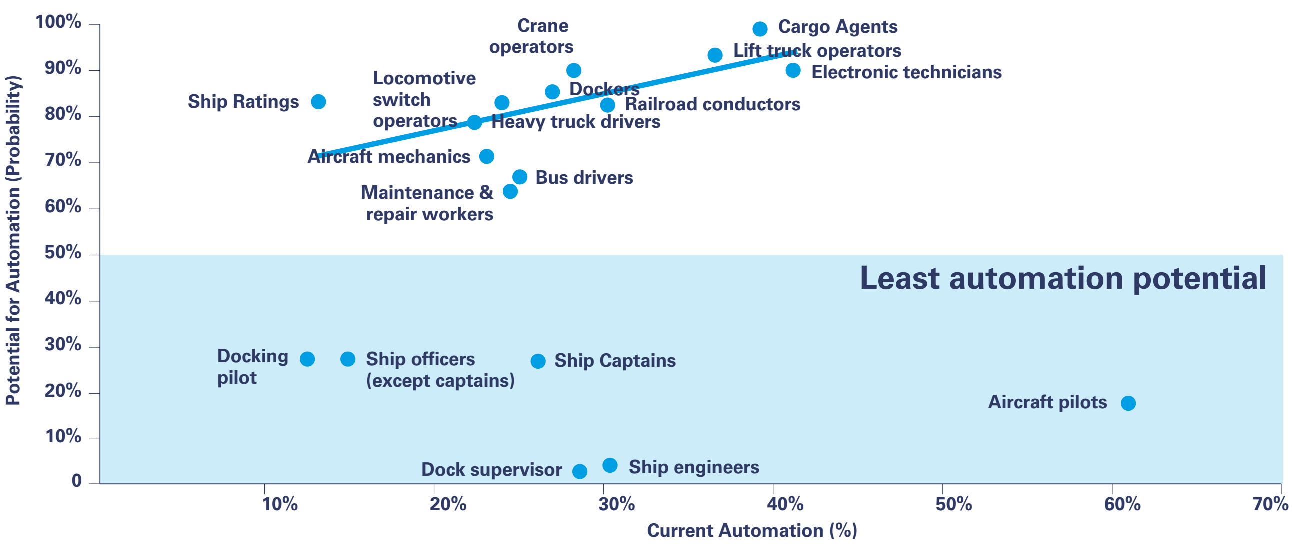
[3] A highly automated ship refers to a vessel whose technical system can take most decisions and actions. Based on the degree of autonomy, the role of the human operator ranges from taking some decisions and actions, intervening and overriding, or engaging only if the systems make a decision to those ends.

3.3 THE IMPACT OF AUTOMATION ON THE TRANSPORT LABOUR FORCE VARIES ACROSS SKILLS AND TASKS

From a technical perspective - if one does not take into account the economics of automation - the current degree of automation can be considered a good predictor of future automation for the low- and middle-skilled occupational groups. Figure 3.3 shows that low- and middle-skilled jobs (e.g., dockers, crane operators or truck drivers) currently facing a high degree of automation have a higher likelihood of further automation, with the consequence that most tasks forming part of their job responsibilities will become obsolete. Naturally, the further introduction of automation technologies that is expected to make some low- and middle-skilled jobs redundant will vary from country to country as factors other than technical feasibility come into play. Conversely, this linear positive relationship between current automation and further automation does not apply to the high-skilled group (e.g., ship captains, officers and aircraft pilots). Figure 3.3 shows that current vehicle, infrastructure and systems design open the door for automation of tasks performed by low- and middle-skilled workers, whereas tasks performed by the high-skilled group are least prone to automation. For the latter group, automation and technology are often introduced to assist them, so that individuals can concentrate more on their core tasks. The objective is to complement their work rather than replace them, whereas for the other groups a large proportion of core tasks might be automated.

A review of the skills distribution across different geographical regions indicates that the reliance on medium-skilled labour across the industry sectors opens the door for automation, as automation technologies are primarily substituting tasks mainly performed by the low- and medium-skilled groups. In that regard, all regions have a relatively high risk of automation of work processes from a technical feasibility viewpoint. However, our analysis also shows that not all demographic groups are affected by automation in a similar way. Ageing and/or comparatively high-wage workforces face a greater risk of being impacted by a higher degree of automation, while the economic incentives for automation are less advantageous for younger and/or lower-wage workforces. Consequently, the variation in the socioeconomic and demographic composition of the different countries leads to variations in the implementation schedule of automation across different geographic regions, notwithstanding that a similar technical automation potential exists.

FIGURE 3.3 Automation potential for job profiles in transport



Source: Frey and Osborne. Tech. Forecast. Soc. Change. 114 (2017), Occupational Information Network (O*Net), WMU analysis

4 WHAT IS THE IMPACT OF LOCAL FACTORS ON THE IMPLEMENTATION OF TECHNOLOGY AND AUTOMATION?

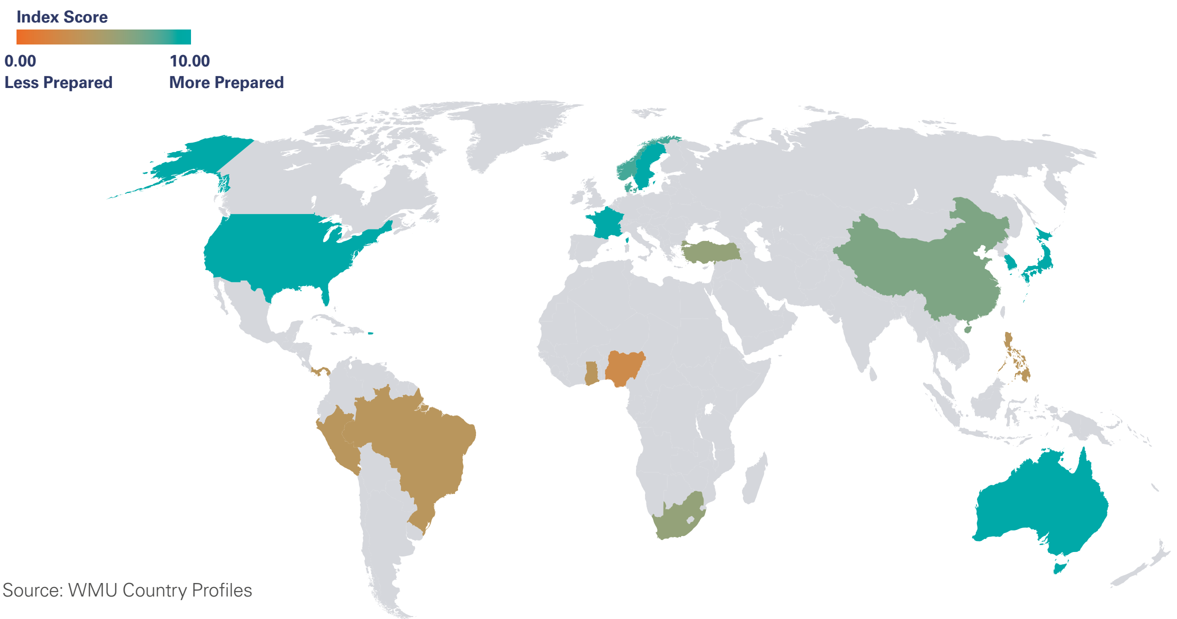
Automation and technological advances are driven by the local context. To provide a snapshot of the individual factors in a specific country, country profiles have been developed. The country profiles have been used in the context of 17 countries[4] to discuss the challenges and opportunities related to the further introduction of technology and automation in transport. A special emphasis was accorded to maritime transport in this section of our study.

4.1 AUTOMATION WILL BE DEVELOPED AND IMPLEMENTED AT DIFFERENT RATES IN DIFFERENT REGIONS

The pace and extent of introduction of new technologies and further automation vary from region to region. Countries and regions will experience the impact of new technology, but both its momentum and impact will vary. The change will depend on a number of factors. Regulation and human capital are just two examples. The pace of adoption also depends on the benefits that automation is expected to contribute to socioeconomic progress in a country. Technological change has always been regarded as an indispensable ingredient of development strategies throughout the world. In some countries, the necessary infrastructure and relevant business models do not exist, which delay the introduction of new technology and automation.

Based on the results of our research (Figure 4.1), countries with a higher readiness to introduce new technology and automation are located in Australia, East Asia, U.S. and Europe. African countries, as a bloc, are lagging behind in terms of technological advancement and investment, regulation, governance and infrastructure in all economic sectors, including in the maritime transport sector. Countries in South America are also in the same position.

FIGURE 4.1 Readiness level for the introduction of emerging and new technologies



Source: WMU Country Profiles

[4] 17 countries are: Australia, Brazil, China, Denmark, France, Ghana, Japan, Nigeria, Norway, Panama, Peru, Philippines, Republic of Korea, South Africa, Sweden, U.S. and Turkey.

4.2 THERE IS A READINESS GAP AMONG DEVELOPED AND DEVELOPING COUNTRIES IN THE MARITIME SECTOR

The successful introduction of high levels of technology requires significant investment and other inputs, such as education, training and research in order to provide suitable conditions to successfully introduce technologies and automation. In that regard, while some countries in our study are trying to become leaders in the field of automation and technology in the maritime sector and their maximum efforts are focused on building the requisite foundation, other countries will not rapidly introduce the emerging new technology because their priorities are developmental, or focused on meeting the basic needs of their population: food, healthcare and education.

4.3 MANY COUNTRIES HAVE NOT DEVELOPED LONG-TERM PLANS FOR AUTOMATION IN THE MARITIME SECTOR

Although a number of ongoing discussions about automation and further technological innovation are taking place in the context of the maritime industry, the maritime sector is still at an early stage of transformation. Many countries have not developed strategies for automation. In addition, while some countries are seeking to become leaders in a number of domains, for example, in the development of relevant regulations, infrastructure and competences, these countries are still at an early stage of setting up policies and strategies in response to anticipated developments in the industry.

In that regard, the international maritime community has just begun discussions about the regulation of autonomous ships. Many countries in our study are active in that regard, such as Australia, China, Denmark, France, Japan, Norway, Republic of Korea, Sweden and U.S. However, no country has to date unveiled a comprehensive strategy for maritime transport in 2040, one that combines regulations with innovation, competences and skills, infrastructure and future business models.

World Maritime University
PO Box 500
S-201 24 Malmö
Sweden
www.wmu.se

The World Maritime University was established in 1983 under the auspices of the International Maritime Organization, a specialized agency of the United Nations.