TRANSPORT 2040: AUTOMATION, TECHNOLOGY, EMPLOYMENT
THE FUTURE OF WORK

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Geneva, 13 February 2019
WORLD MARITIME UNIVERSITY
MALMÖ, SWEDEN

Mission
Educate future maritime and ocean leaders

Global Relevance
A UN specialized institution in Sweden

Postgraduate Programmes
7 master programs + 1 PhD program in maritime and ocean affairs

Alumni
More than 4000 maritime and ocean maritime professionals from 167 countries
Technological advances may disrupt labour markets as traditional jobs change or disappear, even as the number of young job-seekers continues to grow. Re-training will be needed at previously unimaginable scales. Education must adapt, from the earliest grades. And the very nature of work will change.

António Guterres, UN Secretary-General

25 September 2018
Address to the General Assembly
Report Launch

15 Jan 2019, IMO
1. TECHNOLOGY TRENDS: FOUR CLUSTERS

- Automation
- Maintenance
- New Interfaces
- New Services
WMU RESEARCH HAS IDENTIFIED SIX MAIN FACTORS THAT CAN ACCELERATE OR DELAY THE ADOPTION OF TECHNOLOGY

1. **Technology Feasibility**
   - Is the technology ready for its large-scale application?

2. **Economic Benefits**
   - Has a sound business model been drawn up?

3. **Labour Market Dynamics**
   - Is labour expensive?
   - Is there a labour shortage?

4. **Regulation and Governance**
   - Are regulations ready?
   - Are the authorities supportive?

5. **Knowledge and Skills**
   - Are users able to master the technology?

6. **Social Acceptance**
   - Does society accept the technology?
1. TECHNOLOGY TRENDS: S-CURVES

“The introduction of automation will be evolutionary, rather than revolutionary”

Autonomous ships with human supervision

World
2. TRANSPORT FORECAST: MODAL SHIFTS

EU

2015
- Road: 50.80%
- Maritime: 32.70%
- Rail: 12.30%

2040
- Road: 37.87%
- Maritime: 31.97%
- Rail: 15.67%

ASEAN

2015
- Road: 53.53%
- Maritime: 14.39%
- Rail: 12.30%

2040
- Road: 53.53%
- Maritime: 19.80%
- Rail: 20.08%

Notes: Figures relate to freight only. Computations based on tonne-miles. Aviation and maritime cover only intra-ASEAN movements of goods.
3. OVERVIEW OF THE LABOUR FORCE

168 Million Transport Workers

3.3 Million Sea Transport

12% High-Skill
- Ship Engineer
- Ship Officer
- Aircraft Pilot
- Air Traffic Controller
- ...

72% Medium-Skill
- Crane Operator
- Forklift Operator
- Heavy Truck Driver
- Ship Rating
- ...

16% Low-Skill
- Dock Worker
- Warehouse Porter
- Freight Handler
- Baggage Handler
- ...

2,000+ detailed work activities (all occupations)
70+ countries analysed
3. OVERVIEW OF THE LABOUR FORCE

TRANSPORT MODES:
- Road: 92%
- Rail: 8%
- Air: 2%
- Sea: 2%
- Support: 14%

GENDER SPLIT:
- Male: 80%
- Female: 20%

Sources: Bureau of Labour Statistics (BLS), Eurostat, ILO, WMU Analysis
Note: For the complete list of countries used see Appendix Table C.1.
### 3. OVERVIEW OF THE LABOUR FORCE

#### TRANSPORT WORKERS

<table>
<thead>
<tr>
<th>LOW SKILL</th>
<th>MEDIUM SKILL</th>
<th>HIGH SKILL</th>
</tr>
</thead>
<tbody>
<tr>
<td>15%</td>
<td>72%</td>
<td>12%</td>
</tr>
</tbody>
</table>

#### OCCUPATIONS

**LOW SKILL**
- Baggage Handler
- Warehouse Porter
- Dock Worker
- Freight Handler
- Move materials, equipment, or supplies
- Sort materials or objects for processing or transport
- Load shipments, belongings, or materials
- Mark materials or objects for identification

**MEDIUM SKILL**
- Crane Operator
- Forklift Operator
- Ship Rating
- Heavy Truck Driver
- Operate vehicles or material-moving equipment
- Follow safety procedures for vehicle operation
- Inspect cargo to ensure it is properly loaded or secured
- Secure cargo
- Monitor cargo area conditions

**HIGH SKILL**
- Air Traffic Controller
- Ship Engineer
- Ship Officer
- Airline Pilot
- Pilot aircraft
- Communicate with others to coordinate vehicle movement
- Monitor equipment gauges or displays to ensure proper operation
- Notify others of emergencies, problems, or hazards
- Respond to transportation emergencies
- Record operational details of travel
3. OVERVIEW OF THE LABOUR FORCE

AUTOMATION POTENTIAL

<table>
<thead>
<tr>
<th>Skill Level</th>
<th>Economy</th>
<th>Transport</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Skill</td>
<td></td>
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<tr>
<td>Medium Skill</td>
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<tr>
<td>High Skill</td>
<td></td>
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</tbody>
</table>

Employment-weighted probability of automation (%)


Note: For the complete list of countries used see Appendix Table C.1.
3. OVERVIEW OF THE LABOUR FORCE

Potential for Automation (Probability)

- Ship Ratings
- Locomotive switch operators
- Crane operators
- Dockers
- Railroad conductors
- Lift truck operators
- Cargo Agents
- Electronic technicians
- Aircraft mechanics
- Maintenance & repair workers
- Heavy truck drivers
- Bus drivers
- Dock supervisors
- Ship engineers
- Ship officers (except captains)
- Ship Captains
- Docking pilot
- Aircraft pilots

Current Automation (%)


Note: The blue line corresponds to a linear regression (y=0.81x+0.60; R²=0.37). The sample for the regression includes the subject of transport occupations that are plotted and that have a more than 50 per cent potential for automation.
WHAT FACTORS CAN ENABLE OR DELAY HIGHLY AUTONOMOUS SHIP DEPLOYMENT?

HIGHLY AUTOMATED SHIPS

ENABLERS

48% ECONOMIC BENEFITS
20% INTERNATIONAL REGULATION
20% GOVERNMENT SUPPORT

HURDLES

14% COST
25% ECONOMIC BENEFIT
39% REGULATION AND GOVERNANCE

COST OF DEVELOP AND DEPLOY
LACK OF ECONOMIC BENEFIT
PHYSICAL INFRASTRUCTURE
REGULATION AND GOVERNANCE
OTHER
3. OVERVIEW OF THE LABOUR FORCE

Sources: Historical data from ICS/BIMCO (2016); forecast used data from the start-up curves of Chapter 1 and UNCTAD maritime data; WMU forecast.

Notes: HAShips stands for Highly Automated Ships taking international voyages (average tonnage, average trade). The predictions are subject to a high level of uncertainty, quantified between -6 percentage points and +18 percentage points within a 95 per cent confidence interval. The crew reduction approximately follows an exponential process and by 2040 the crewing levels are assumed to be reduced between 16 and 24 per cent.
3. OVERVIEW OF THE LABOUR FORCE

Projected seafarers reduction due to highly autonomous ships (index, 2020=100)

- Officers (HAShips)
- Ratings (HAShips)
- Officers (trade)
- Ratings (trade)

Sources: historical data from ICS/BIMCO (2016); forecast used data from the start-up curves of Chapter 1 and UNCTAD maritime data.

Note: The graph displays a reduction in the demand for seafarers in comparison with the baseline (conventional ships, that is, no Highly Automated Ships, HAShips). A decrease in the graph corresponds to an increase in the demand for seafarers.
4. COUNTRY PROFILES

01 Technology & Innovation
02 Human Capital & Skills
03 Regulation & Governance
04 Infrastructure Quality
05 Business & Investment
4. COUNTRY PROFILES

Source: WMU Country Profiles – Technology Readiness: Maritime
Main conclusion:

Qualified human resources with right skills will still be needed in transport

Findings:

1. Gradual pace of introduction of automation and technology influenced by economics benefits, demographic trends and safety factors

2. Higher demands for transport resulting from continuous growth in trade

3. Effects of automation and technology are predictable and impact low and medium skill jobs most

4. Automation and technology is influenced by the local context
THANK YOU FOR YOUR ATTENTION