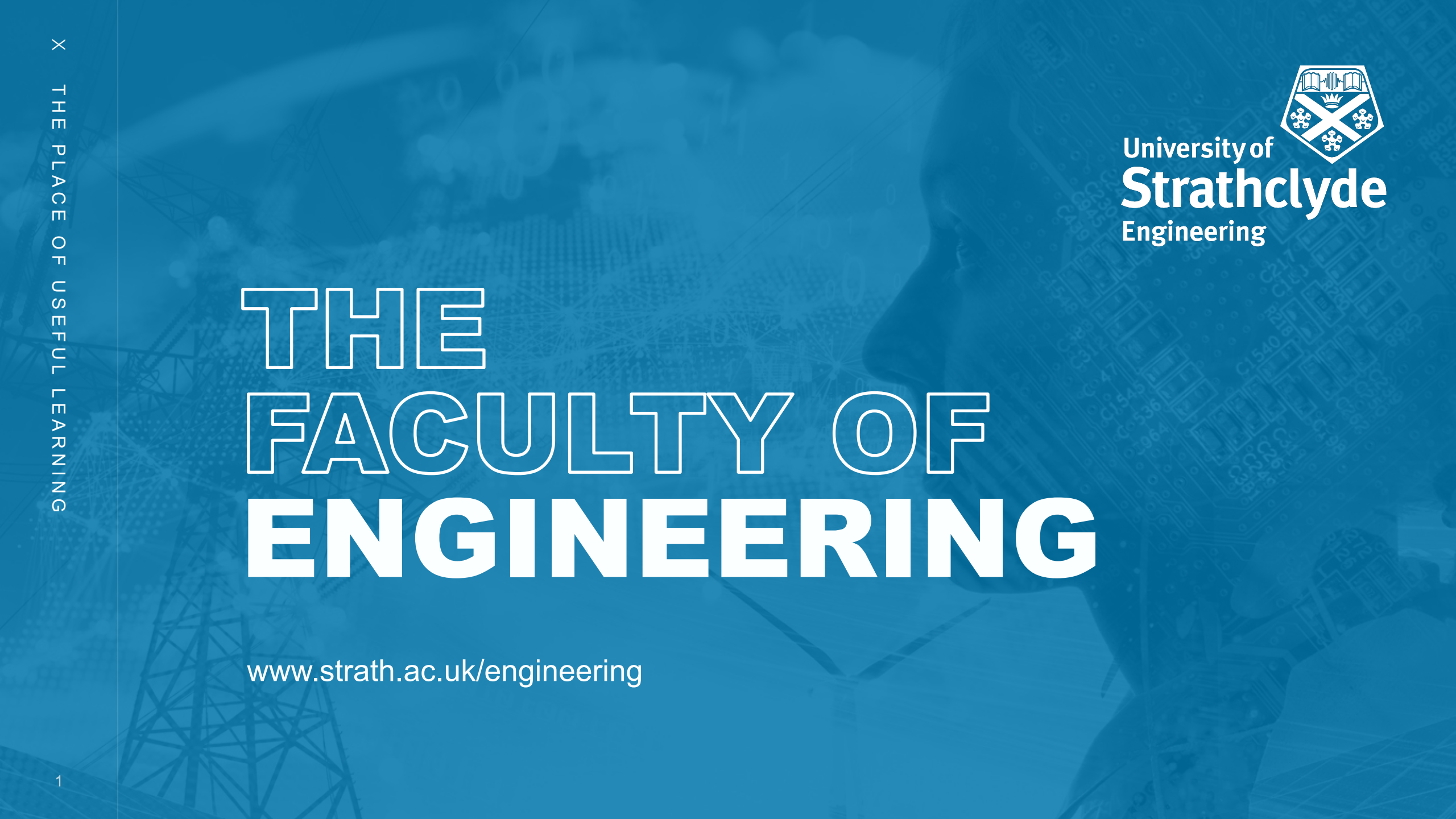
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University of Strathclyde Engineering
THE FACULTY OF ENGINEERING
www.strath.ac.uk/engineering
1

THE AWARDS 2019

WINNER
UK UNIVERSITY OF THE YEAR
FOR A SECOND TIME

THE TIMES THE SUNDAY TIMES
GOOD UNIVERSITY GUIDE 2020
SCOTTISH UNIVERSITY OF THE YEAR

THE QUEEN'S ANNIVERSARY PRIZES
FOR HIGHER AND FURTHER EDUCATION
2019

Times Higher Education University of the Year 2012 & 2019
Times Higher Education Widening Participation Initiative of the Year 2019
The University of Strathclyde is rated a QS 5-star institution

Who am I?

Dr Sefer Anil Gunbeyaz, Chancellor's Fellow
University of Strathclyde

2006 – 2011 – Bachelor's Degree – Istanbul Technical University
2011 – 2014 – Master's Degree – Istanbul Technical University
2014 – 2019 – PhD Degree – University of Strathclyde
2019 – 2020 – Research Associate – University of Strathclyde
2020 – current – Chancellor's Fellow

Who are we?

Maritime Human Factors Centre
Department of Naval Architecture, Ocean and Marine Engineering

Academics

Prof. Osman Turan
Professor

Dr. Rafet Emek Kurt
Senior Lecturer

Dr. Sefer Gunbeyaz
Chancellor's Fellow

Research Staff

Dr Pelin Erdem
Research Associate

Dr. Beatriz Navas de Maya
Research Associate

Dr. Onder Canbulat
Research Associate

Dr. Dogancan Uzun
Research Associate

Yaser Farag
Research Associate

Dogancan Okumus
Research Assistant

Alexander Senss
Research Assistant

PhD Researchers

Hadi Bantan
PhD Student

Courteney Flowers
PhD Student

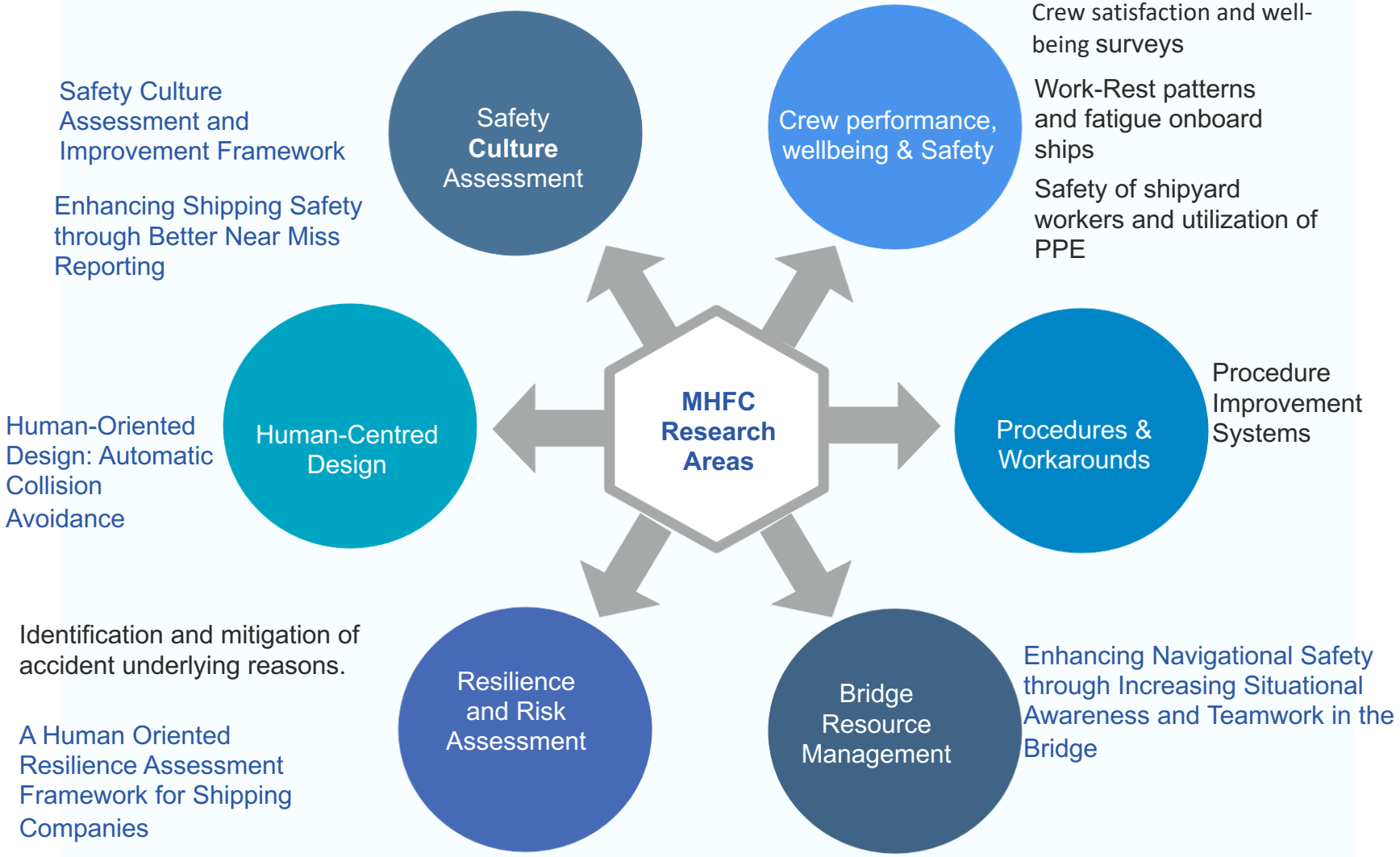
Siti Fariya
PhD Student

Ahn Sung Il
PhD Student

Dhruva Kumar
PhD Student

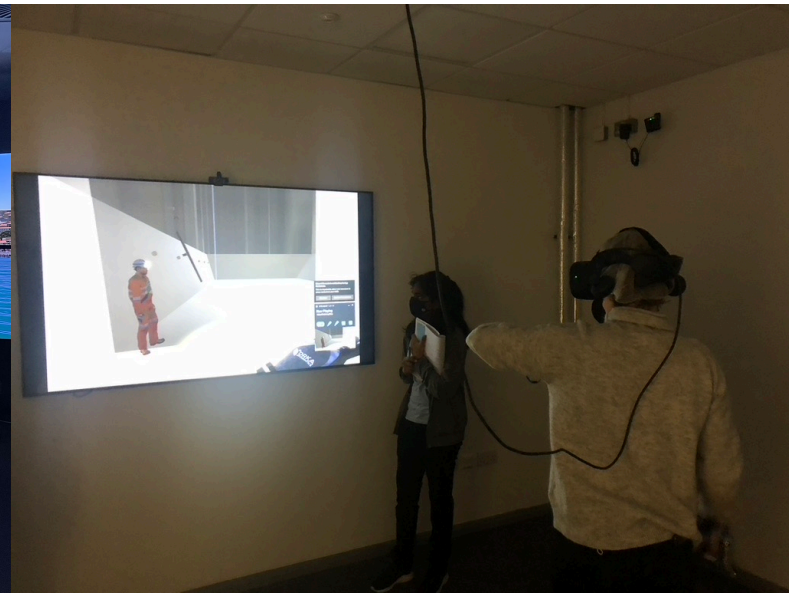
Ini Akhpadiya
PhD Student

MHFC Research Areas









Research interests

Ship recycling facility design and optimization, health and safety analysis improvement, training

Circular economy

Decarbonisation and the roles of port as a hub

Shipyard optimization and production enhancement

Circular Economy

"an economic system in which resource input, waste, emission, and energy leakages are minimised by cycling, extending, intensifying, and dematerialising material and energy loops. This can be achieved through digitalisation, servitisation, sharing solutions, durable product design, maintenance, repair, reuse, remanufacturing, refurbishing, and recycling".

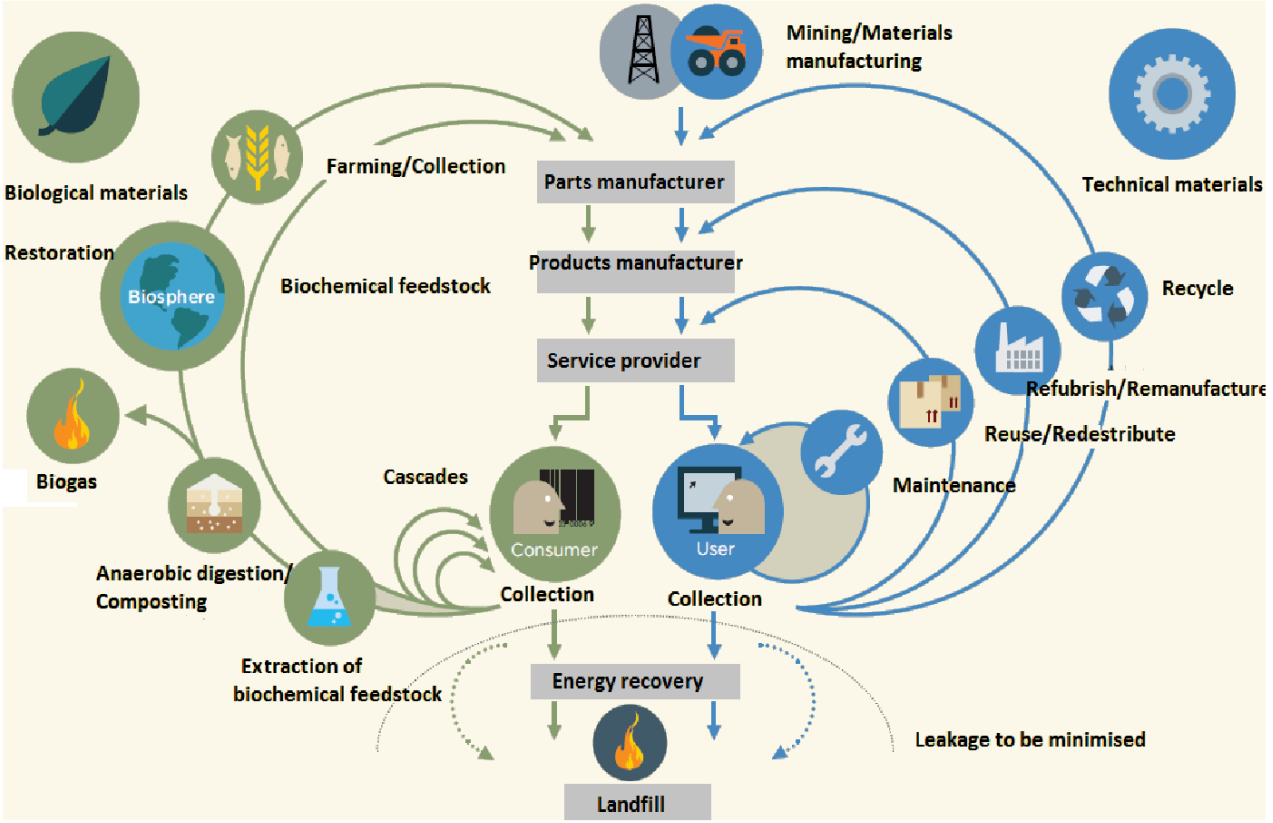


Image source: Ellen MacArthur Foundation, 2013

Maritime Industry

In the maritime industry, CE principles are limited with only recycling (98%). Therefore, materials and equipment from ships are currently being **underutilised** in terms of their potential for reuse, remanufacturing and repurposing.







Maritime Industry

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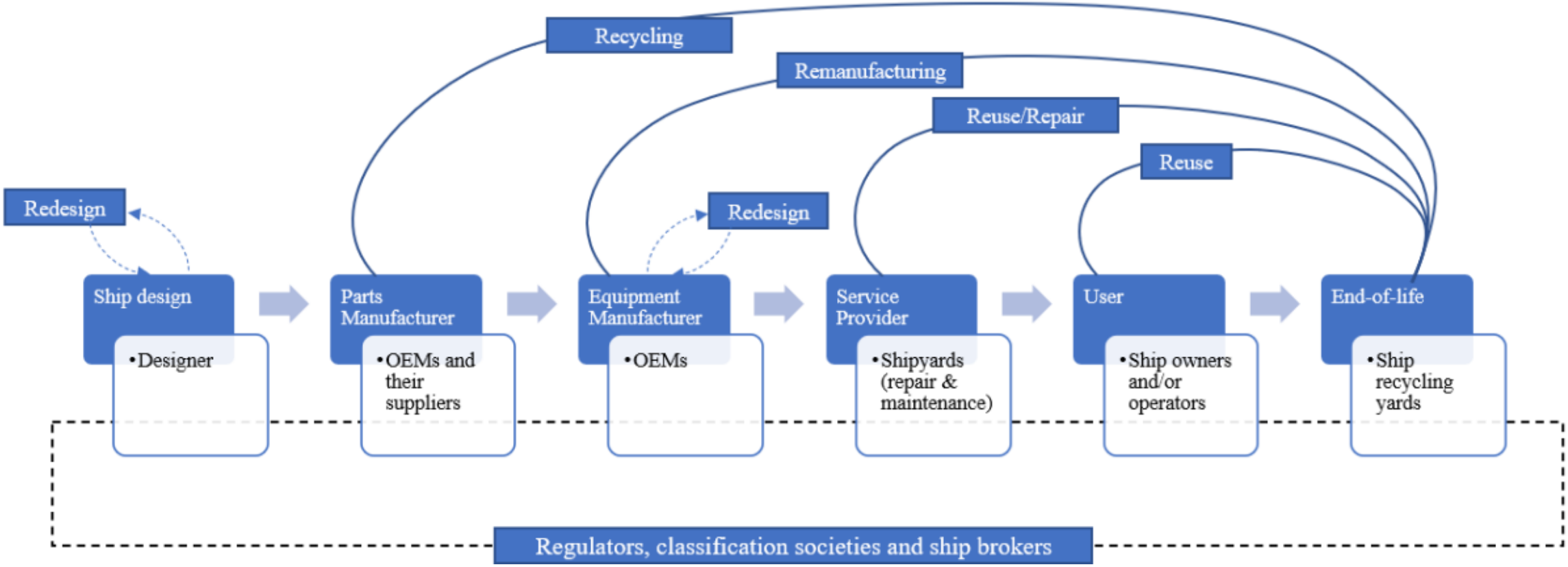


Fig 2. Maritime stakeholders and CE practices

Maritime Industry

Sectors	Turnover (€bn)	Firms	Employment ('000)	Cores ('000)	Intensity
Aerospace	12.4	1,000	71	5,160	11.5%
Automotive	7.4	2,363	43	27,286	1.1%
EEE	3.1	2,502	28	87,925	1.1%
Furniture	0.3	147	4	2,173	0.4%
DOR	4.1	581	31	7,390	2.9%
Machinery	1.0	513	6	1,010	0.7%
Marine	0.1	7	1	83	0.3%
Medical Equipment	1.0	60	7	1,005	2.8%
Rail	0.3	30	3	374	1.1%

Introduction



Cents
Circular Economy Network+ in Transportation Systems

- **Aim and objectives**

GOAL

Creating a CE framework for the maritime industry.

TASKS

- Identifying barriers for the successful implementation
- Mapping high value equipment on board vessels
- Identifying the current and potential reuse-remanufacture-recycle rates
- Identifying strategy and technology solutions
- Developing an overall structure to support end-of-life strategies for high value items on board.

Barriers in the maritime

Conflict of interest between the stakeholders,

Working conditions of the ships (long life, change of technology, impact of sea and cargo),

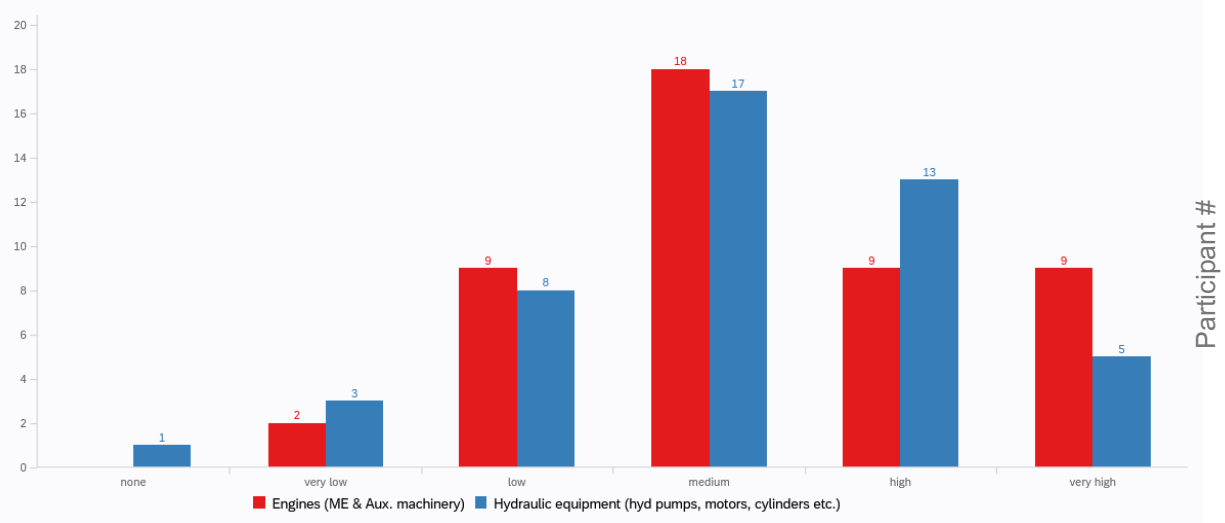
Lack of logistics for the circularity,

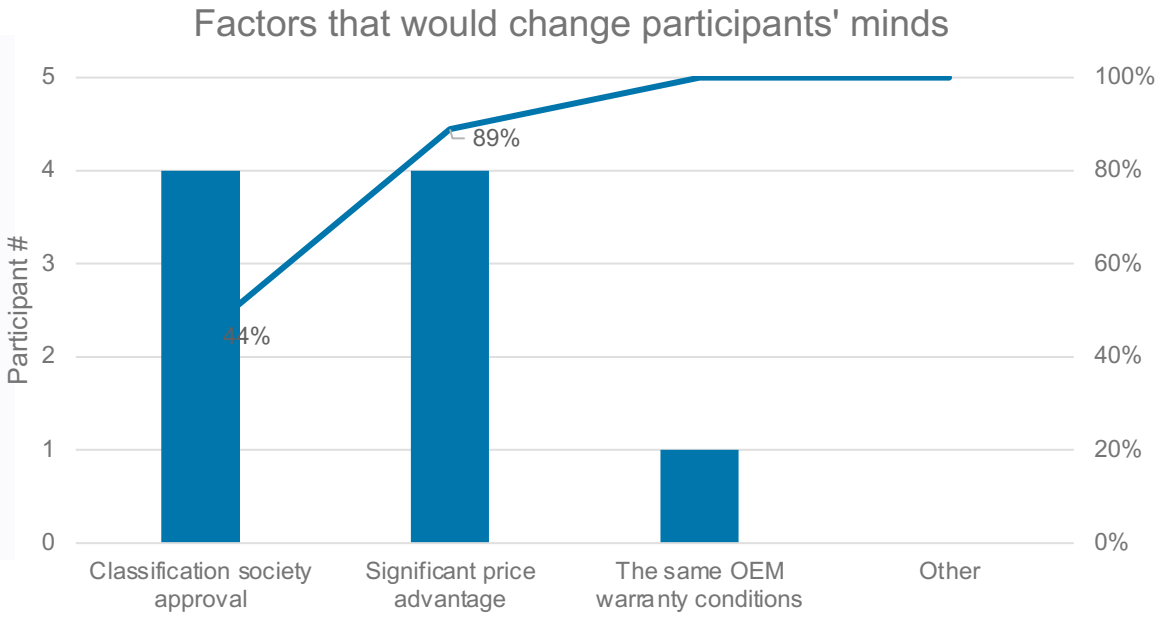
Regulatory barriers (changing rules, rules preventing reuse/reman, import bans in some countries),

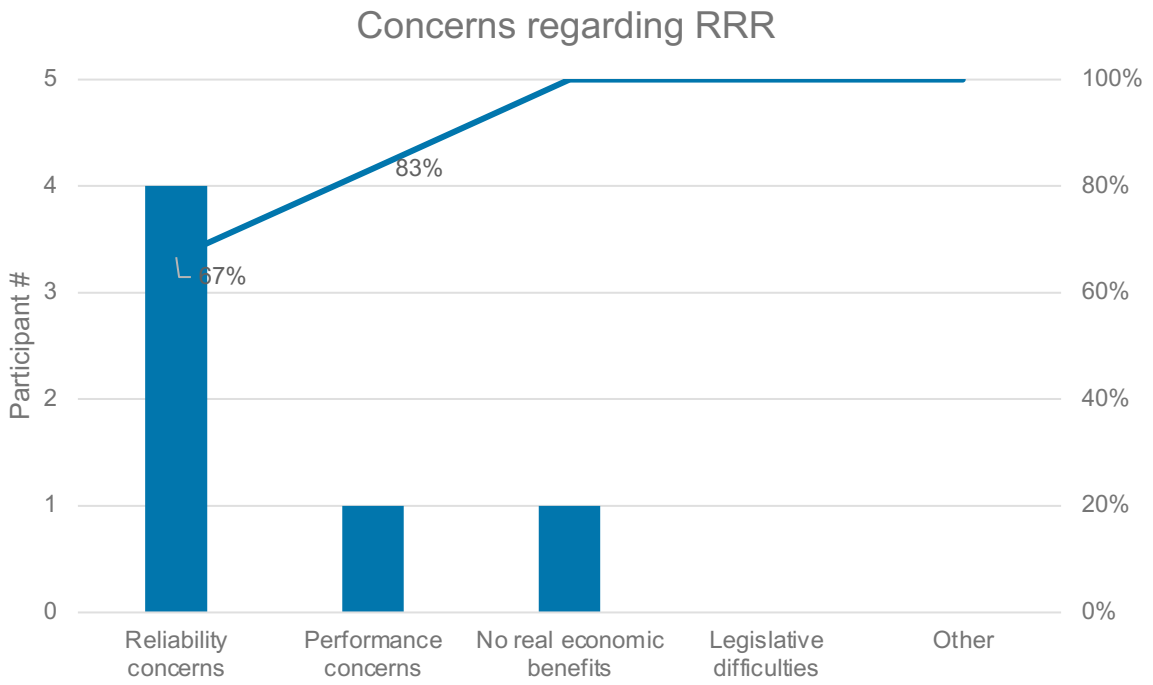
Perception of the industry members (owners/yards do not favour used equipment,

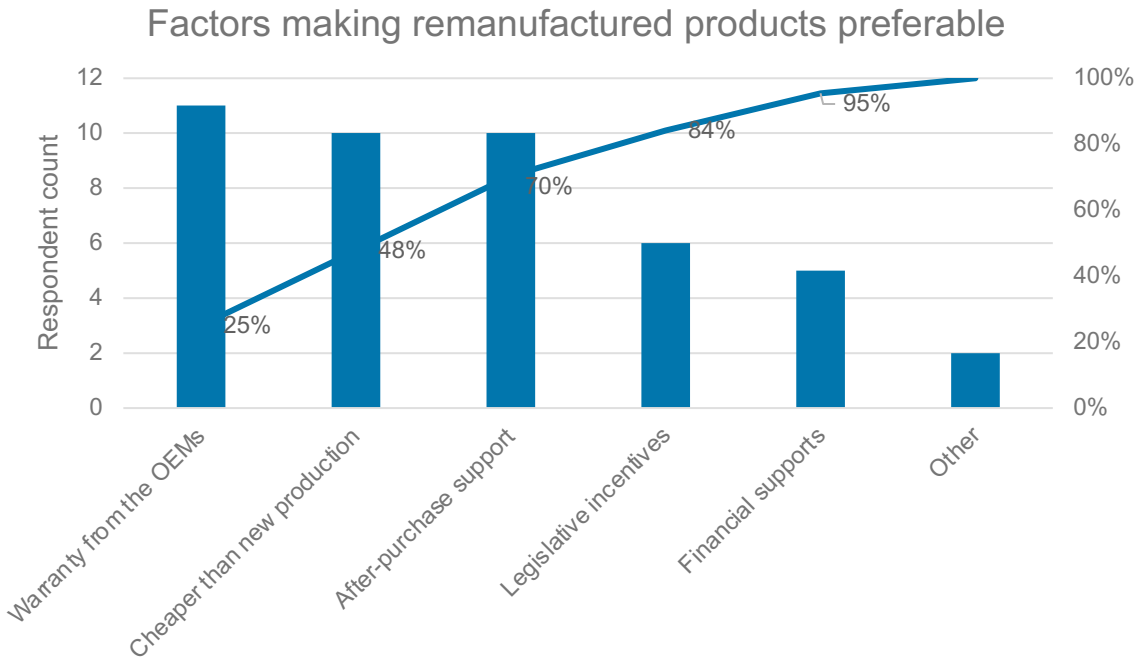
The lack of transparency (equipment lists etc. are not known),

Lack of understanding of the maritime industry (as above, recycling is understood as circularity or "net-zero" efforts mainly focus on the operation stage).

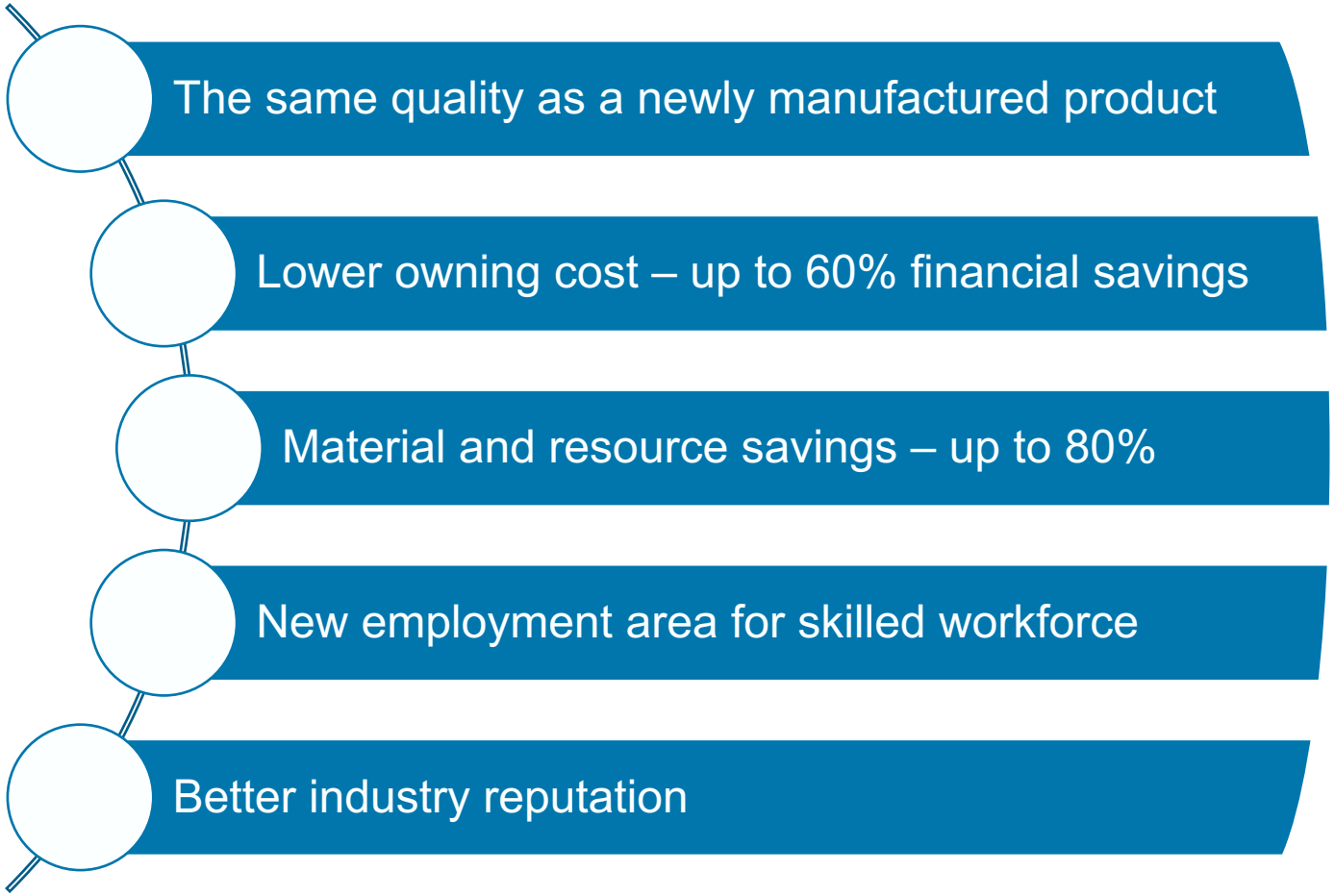

20
18
16
14
12
10
8
6
4
2
0
1
2
3
9
8
18
17
9
13
9
5
none
very low
low
medium
high
very high
Engines (ME & Aux. machinery)
Hydraulic equipment (hyd pumps, motors, cylinders etc.)


Factors that would change participants' minds
Participant #
5
4
3
2
1
0
100%
80%
60%
40%
20%
0%
44%
89%
Classification society approval
Significant price advantage
The same OEM warranty conditions
Other

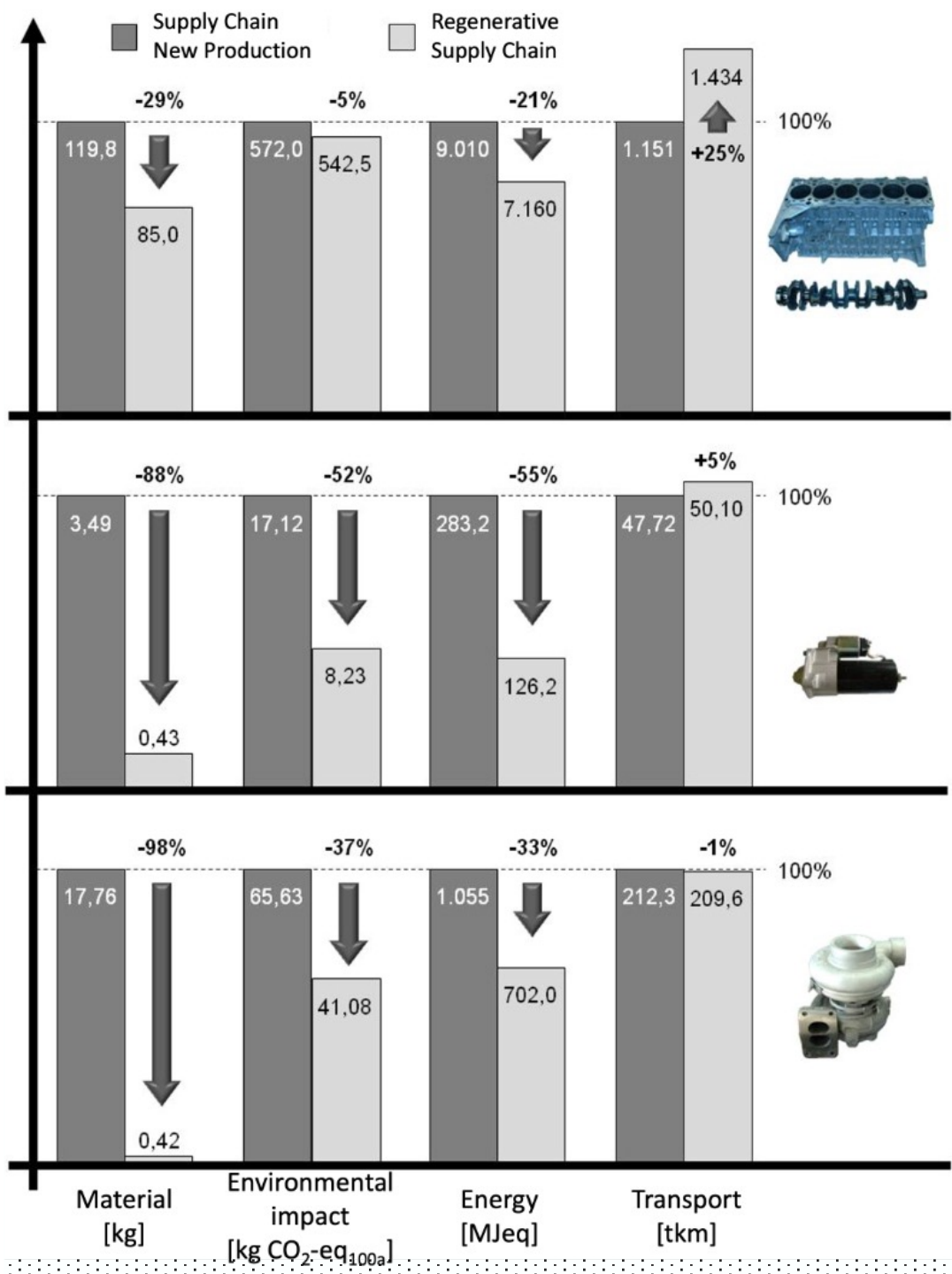

Concerns regarding RRR
Participant #
5
4
3
2
1
0
100%
80%
60%
40%
20%
0%
67%
83%
Reliability concerns
Performance concerns
No real economic benefits
Legislative difficulties
Other


Factors making remanufactured products preferable
Respondent count
12
10
8
6
4
2
0
100%
80%
60%
40%
20%
0%
25%
48%
70%
84%
95%
Warranty from the OEMs
Cheaper than new production
After-purchase support
Legislative incentives
Financial supports
Other

Opportunities



Potential for Material Environmental Impact Energy saving



Energy, material, emissions and transport savings in remanufacturing (vs new product) of automotive parts (engine, starter and turbocharger) (Koehler, 2021).

Which industries would benefit from remanufactured/repurposed components on marine vessels?				
Main Engine	**Aux Machinery / Gensets**	**Hydraulic pumps & motors**	**Cylinders and other hyd components**	**Other (please specify)**
Heavy industries-construction and mining	Electric power / Energy generation industry	Heavy industries-construction and mining	Cranes	Batteries in near future could be reused between industries
Shipping industry in LRC	People in small villages with limited access to electricity in developing countries	Factories	Factories	Tanks and electric motors can also be reused
Electric power generation	Automotive	Ship repair	Shipping	
Offshore renewable energy	Floating and Land based Powerplants, Production Facilities	Fishing	Engine manufacturing	
Floating and land based power plants	Shipyards	Agriculture	Automobile	
Landbased energy plants: cogen-trigen or landfill plants	Landbased energy plants , cogens , trigens , landfill plants	Aviation	Aviation	
Low cost vessels	Various electrical site, substations, facilities as back UP power source	Automobile	Manufacturing industry	
		Manufacturing industry	Energy plants	
		Energy plants		
		Shipyards		

Solutions



Strategy

- Closed loop supply chains
- Seeding
- Take-back strategies
  a. Trade-in
  b. Leasing
- Product service systems
- Remanufacturing hubs



Software

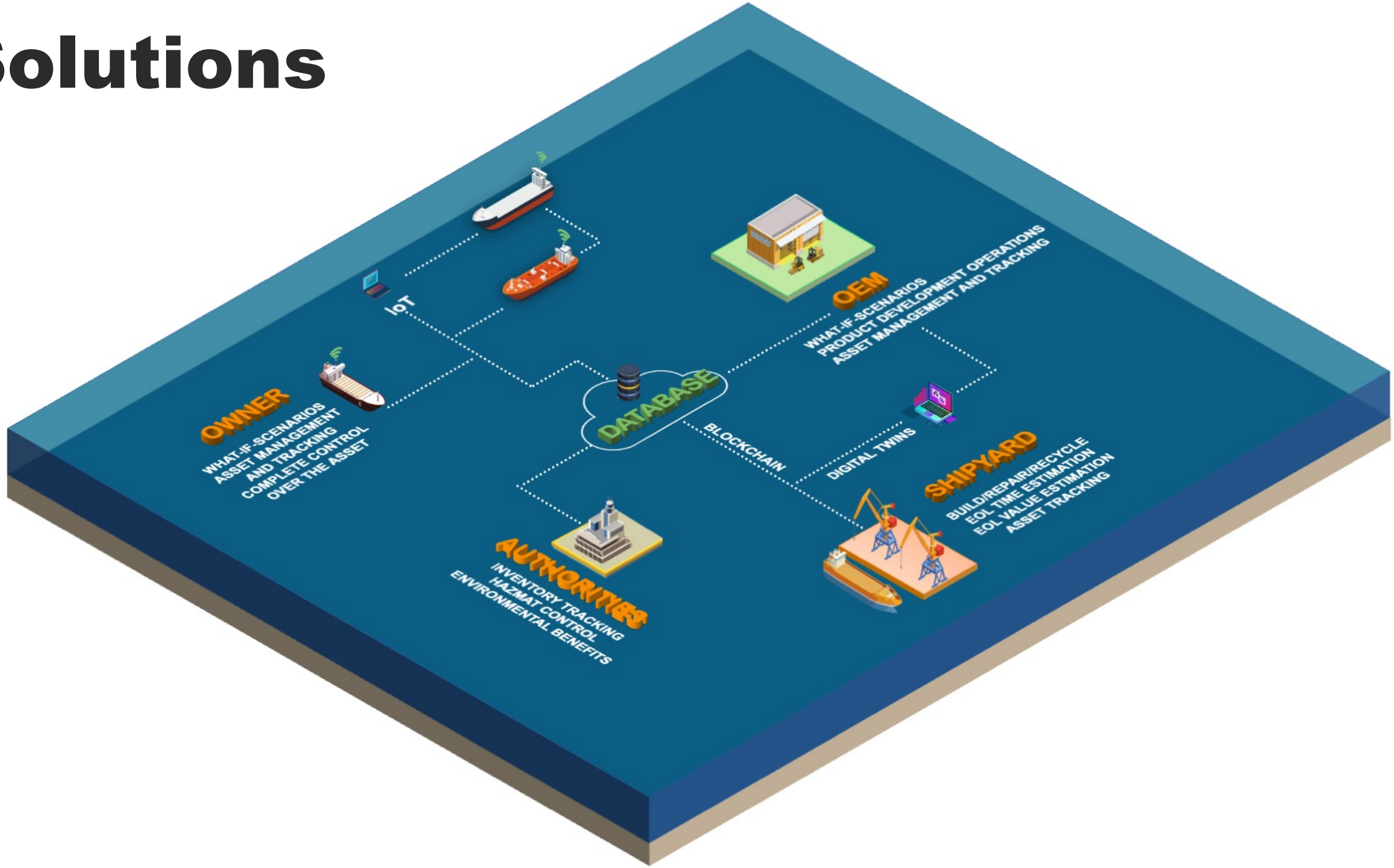
- Industry 4.0
- IoT
- Big data analytics and AI
- Digital twins
- Database solutions and blockchain
- Smart recovery decision making



Hardware

- Sensors
- Radio frequency identification (RFID)
- QR codes

Solutions


IoT
OWNER
WHAT-IF-SCENARIOS
ASSET MANAGEMENT
AND TRACKING
COMPLETE CONTROL
OVER THE ASSET
DATABASE
BLOCKCHAIN
OEM
WHAT-IF-SCENARIOS
PRODUCT DEVELOPMENT OPERATIONS
ASSET MANAGEMENT AND TRACKING
DIGITAL TWINS
SHIPYARD
BUILD/REPAIR/RECYCLE
EOL TIME ESTIMATION
EOL VALUE ESTIMATION
ASSET TRACKING
AUTHORITIES
INVENTORY TRACKING
HAZMAT CONTROL
ENVIRONMENTAL BENEFITS

Conclusions

1) Significant RRR potential exists.

2) There is also demand for used equipment.

3) Circular economy awareness is low within the maritime industry.

4) Industry has an appetite for further advancements regarding circular economy principles.

5) Nearly nine tenth of the decision-makers consider remanufactured products preferable, provided they have the same reliability and quality as newly manufactured alternatives

6) The industry needs certification and regulation clarifications to progress forward.

7) Production methods need to be re-evaluated

Individual stakeholders can not achieve circularity on their own

Holistic and inclusive solutions might trigger the change in the maritime industry

Increasing awareness is the key

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