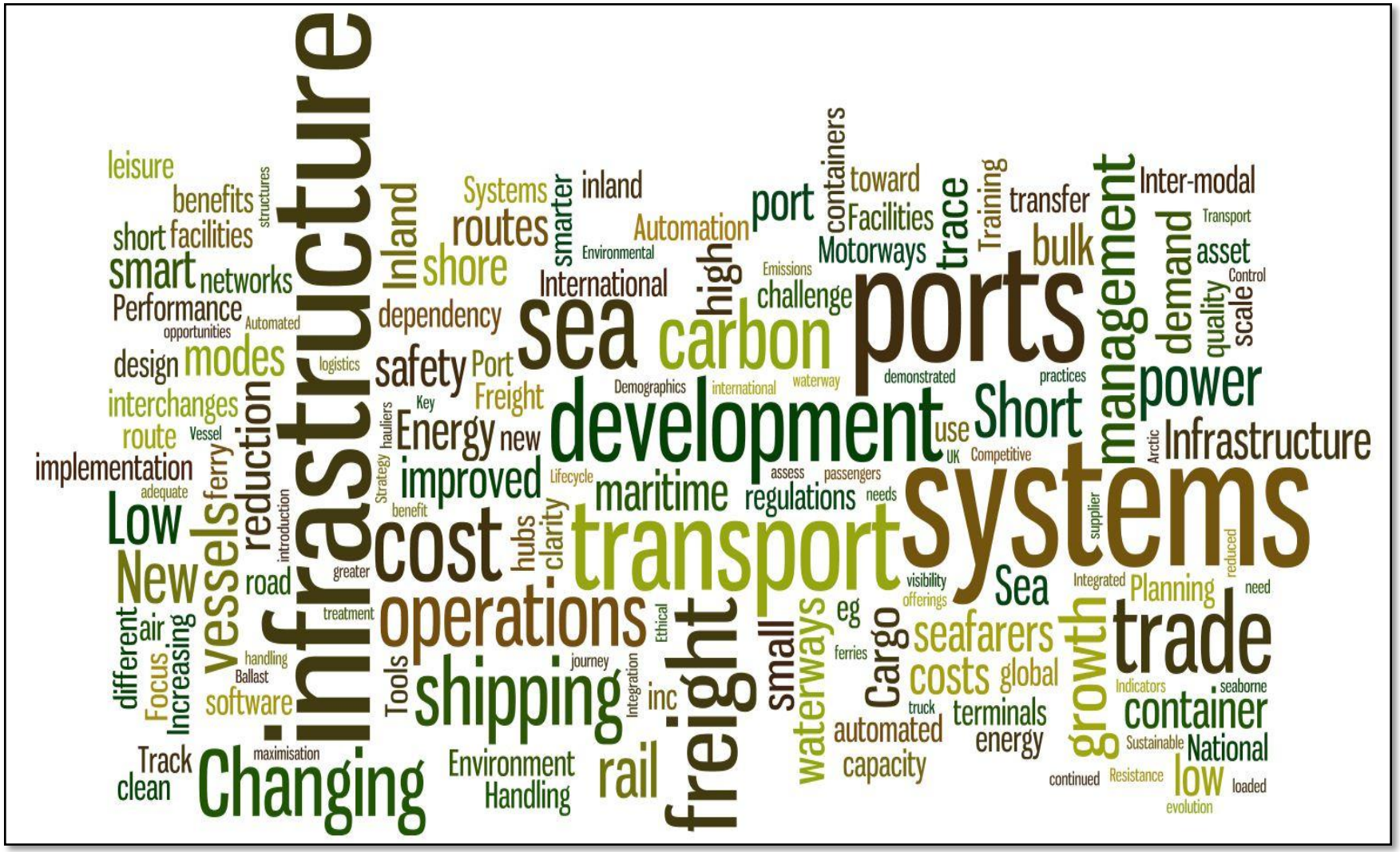
UK Marine Industries Roadmap & Capability Study

Workshop E: Ports and Infrastructure, 30 November



Executive Summary

This report results from a one-day workshop to assist the Technology Strategy Board, BIS, UK Marine Industries Alliance and the Transport KTN to develop a roadmap to identify future priority opportunities and capability needs for the UK Marine Industries. The workshop was the final one of five "Deep Dive" explorations of the sector, focussing on Ports and Infrastructure. The workshop took place in London on 30 November 2011, with input from around 20 experts drawn from across the Marine Industry, academia and other stakeholders. The workshop took a sub-set of the landscape roadmap, developed in June 2011, which was then developed further to identify priority trends & drivers and then to identify and characterise around 40 Market Opportunities in Ports and Infrastructure.

Participants contributed before the workshop by providing their perspectives in a roadmap template – identifying priority Drivers, Opportunities, Capabilities and Enablers in the Short, Medium and Long timeframes. These were consolidated ahead of the workshop to provide a start point to which further issues were added and priorities identified. The most important market opportunities were then highlighted, where UK capability could deliver against major global market needs. These assessments were based on defined criteria for Value (global & UK market, competitive strength, added value and impact on societal and environmental challenges) and Capability (in the marine industry, academia, research organisations and from adjacent industries – see Appendix C for details.)

In prioritising relevant Trends & Drivers (see section 1), there was a strong emphasis on a move towards integrated / multi-modal transport systems to support the migration of freight from road coastal shipping , driven by the changing attitudes toward different freight modes which in turn will be driven by fuel scarcity / cost and legislation to reduce CO2 and other emissions. Implementation of track & trace solutions and containerisation, as well changing consumer demand and skills shortages would necessitate more automation and integration of data. The opening of the Arctic together with expanded global trade and the move towards hub and spoke models for international freight shipping might yield a 'once in a lifetime' opportunity for UK to establish a strategic position, providing UK & International political agendas could be aligned.

Executive Summary (continued)

Priority Opportunities (see section 4) were identified across a range of areas, covering the integration of transport systems and operations in marine and between modes, re-purposing of existing ports and provision of new, and delivery of infrastructure and related services at these. The leading opportunities included systems integration (infrastructure, IT & data) from marine transport (building on strengths in this area) into other modes; new port and infrastructure facilities, particularly to serve offshore renewables support and construction; environmental services and low carbon, clean shore power for vessels in port; establishing a position as a major hub for trans-shipment (particularly in the context of new Arctic shipping routes; operation of sea “motorways" & associated short sea shipping infrastructure; bunkering (and other value-added services) associated with LNG and H2; inter-modal hubs / infrastructure & systems (eg road / rail interface to ports); end-to-end journey planning and automated cargo handling systems.

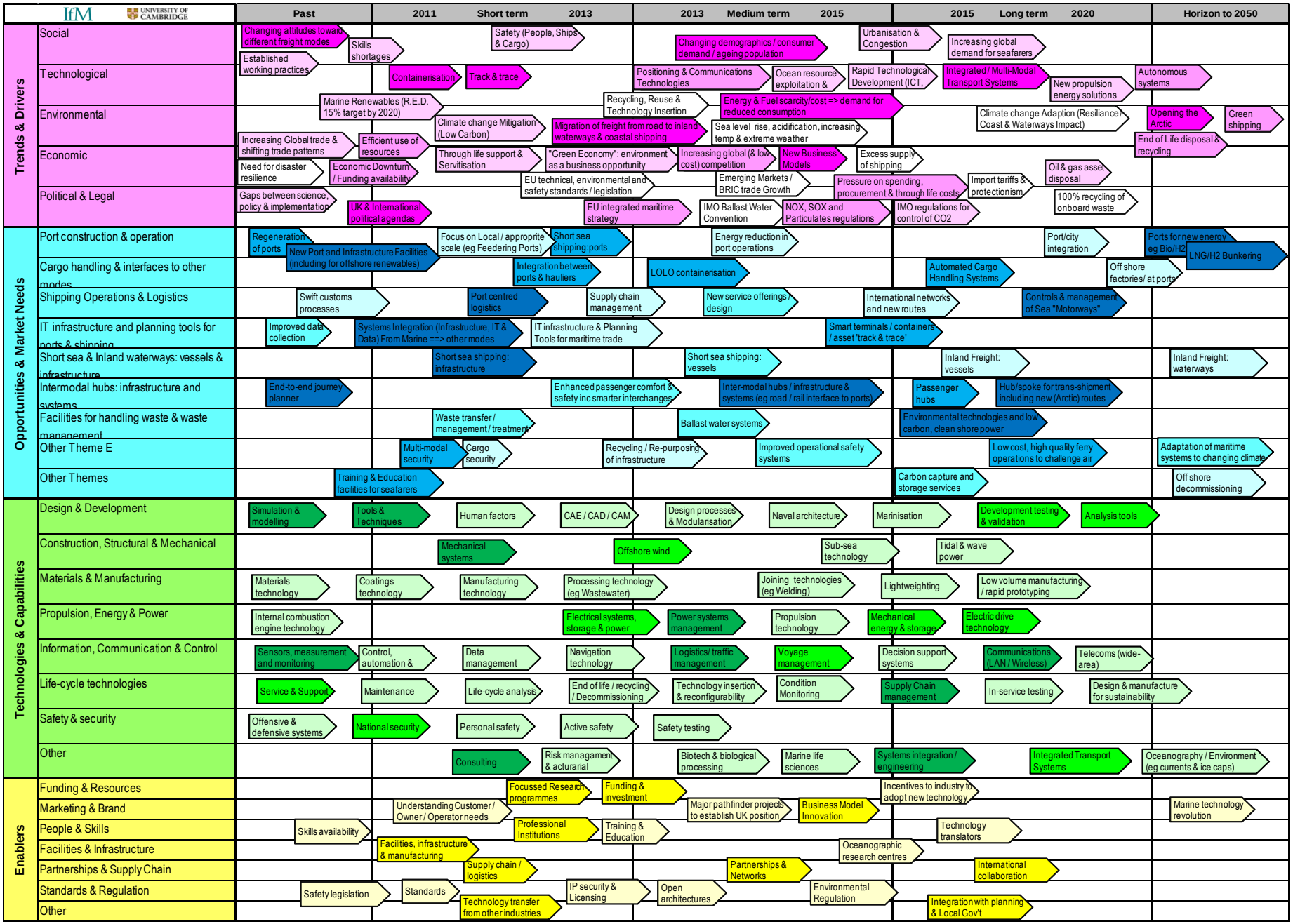
Of these opportunities, the first six were explored in more detail – to characterise the market value and identify relevant sources of UK capability for delivery (and potential gaps that will need to be filled – see section 7). It was noted that the characterisations would benefit from further validation due to the limited number of workshop participants with direct insights into port operations.

In support of these opportunities, a wide range of capabilities were identified from within the Marine Industries but also in academia and research organisations. The most relevant areas of capability to support these market opportunities were: logistics and traffic management; simulation & modelling; power systems management; sensors, measurement and monitoring technology; supply chain management; consulting; communications; systems integration; mechanical systems and integrated transport systems.

The workshop also identified other key enablers for success, underpinning these capabilities as: facilities, infrastructure & manufacturing capacity; business model innovation; funding & investment; focussed research programmes; supply chain / logistics and professional institutions.

Contents

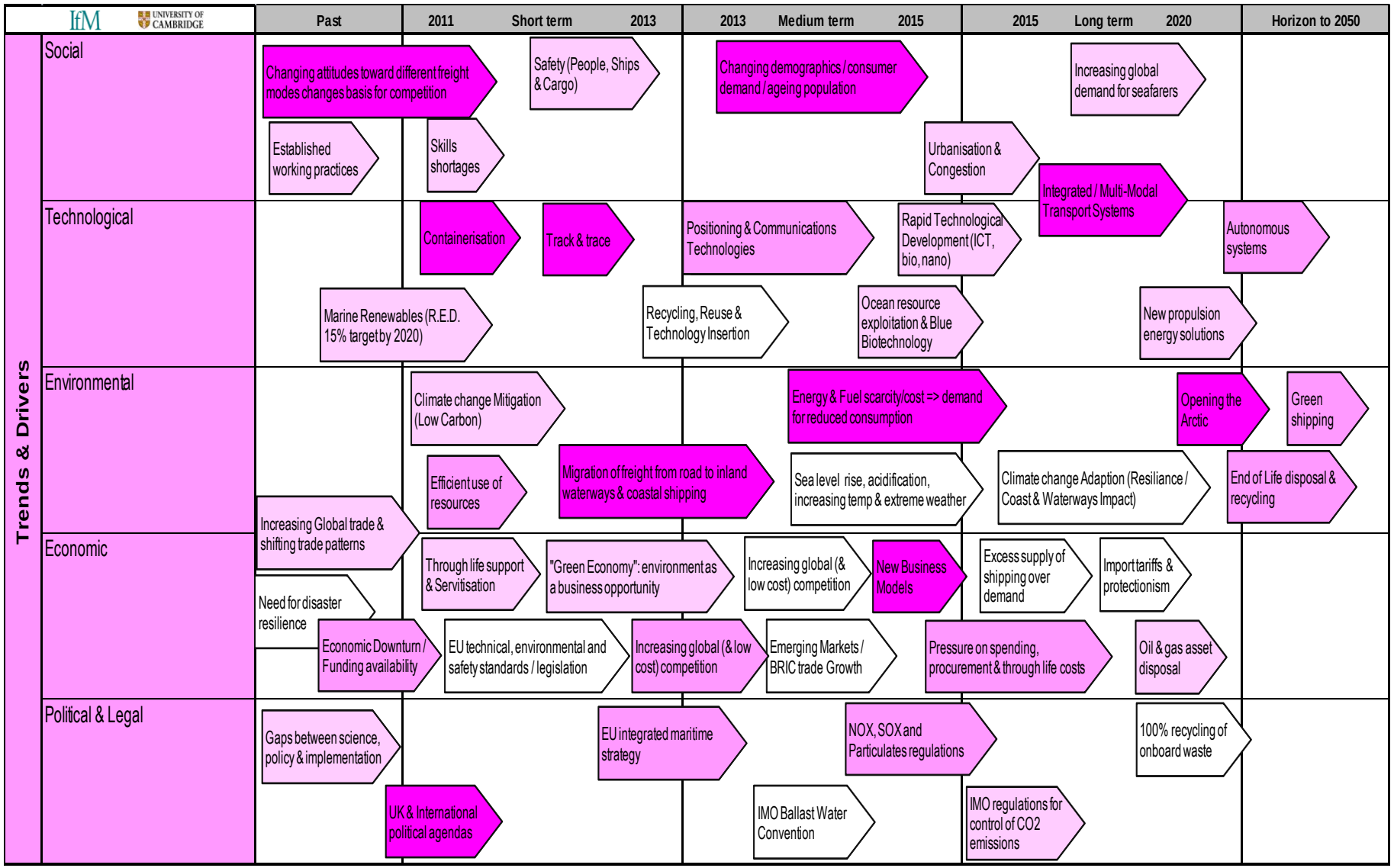
1. Roadmap Landscape



2. Landscape Linkages

Trends & Drivers													Market Opportunities			Capabilities																												Enablers												
Integrated / Multi-Modal Transport Systems	Green shipping	Efficient use of resources	Positioning & Communications Technologies	Marine Renewables (R.E.D. 15% target by 2020)	New Business Models	Ethical / Green consumers	"Green Economy": environment as a business opportunity	Climate change Mitigation (Low Carbon)	NOX, SOX and Particulates regulations	Urbanisation & Congestion	Ocean resource exploitation & Blue Biotechnology				Logistics/ traffic management	Simulation & modelling	Power systems management	Sensors, measurement and monitoring technology	Supply Chain management	Consulting	Communications (LAN / Wireless)	Systems integration / engineering	Tools & Techniques	Mechanical systems	Integrated Transport Systems	Electrical systems, storage & power infrastructure	Analysis tools	Development testing & validation	National security	Service & Support	Electric drive technology	Mechanical energy & storage technology	Voyage management	Offshore wind	Facilities, infrastructure & manufacturing capacity	Business Model Innovation	Funding & investment	Focussed Research programmes	Supply chain / logistics	Professional Institutions	Partnerships & Networks	International collaboration	Integration with planning & Local Gov't	Technology transfer from other industries	Open architectures	Understanding Customer / Owner / Operator needs	
1	2	3	4	5	6	7	8	9	10	11	12		**Market Opportunities**		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	1	2	3	4	5	6	7	8	9	10	11	12	
1	1	1	1									A	Systems Integration	4	3	3	2	3	3	3	3	3	3		3		3	3	3	3	1	2	3		1	1	1					1		1	1	1	54
		1		1	1	1	1	1			1	B	New port & infrastructure facilities	7	1	3	3	3	1	3	1	2	3	3	1	3	3	3		1		3		3	1		1	1		1		1	1				46
	1			1	1	1	1	1	1			C	Environmental Technologies	7	2	2	3	3		3		1	2		1	3					3	2	1	2		1	1	1					1				32
1		1	1		1					1		D	Hub Spoke for trans shipping	5	3	2	2	2	3		3				3	3				2				1	1			1	1	1	1	1	1			1	32
1			1						1	1		E	Sea Motorways & SSS Infrastructure	4	3	3	1		3		3	3	1	1			3	3	1	3			1		1	1			1		1			1	1		35
1	1			1		1	1				1	F	LNG/H2 Bunkering	6	2	2	2	2	2	3		3	2	3		3	3	2	2	3	2	1	1	3	1	1	1	1	1	1	1		1				49
4	3	3	3	3	3	3	3	2	2	2	2				14	15	13	13	12	12	10	12	11	10	8	9	12	11	8	10	6	8	7	8	5	4	4	4	3	3	3	3	3	3	2	2	

3.1 Trends & Drivers



3.2 Trends & Drivers (1 to 20)

Rank	Driver	%
1	Integrated / Multi-Modal Transport Systems	9%
2	Migration of freight from road to inland waterways & coastal shipping	7%
3	Track & trace	7%
4	Opening the Arctic	5%
5	UK & International political agendas	5%
6	Changing demographics / consumer demand / ageing population	4%
7	New Business Models	4%
8	Changing attitudes toward different freight modes changes basis for competition	3%
9	Containerisation	3%
10	Energy & Fuel scarcity/cost => demand for reduced consumption	3%
11	EU integrated maritime strategy	3%
12	Increasing global (& low cost) competition	3%
13	NOX, SOX and Particulates regulations	3%
14	Positioning & Communications Technologies	3%
15	Pressure on spending, procurement & through life costs	3%
16	Autonomous systems	2%
17	Economic Downturn / Funding availability	2%
18	Efficient use of resources	2%
19	End of Life disposal & recycling	2%
20	Green shipping	2%

3.2 Trends & Drivers (cont)

Rank	Driver	%
21	IMO regulations for control of CO2 emissions	2%
22	Increasing global demand for seafarers	2%
23	Increasing Global trade & shifting trade patterns	2%
24	Oil & gas asset disposal	2%
25	Safety (People, Ships & Cargo)	2%
26	Skills shortages	2%
27	Urbanisation & Congestion	2%
28	"Green Economy": environment as a business opportunity	1%
29	Climate change Mitigation (Low Carbon)	1%
30	Established working practices	1%
31	Gaps between science, policy & implementation	1%
32	Marine Renewables (R.E.D. 15% target by 2020)	1%
33	New propulsion energy solutions	1%
34	Ocean resource exploitation & Blue Biotechnology	1%
35	Rapid Technological Development (ICT, bio, nano)	1%
36	Through life support & Servitisation	1%
37	Planning	1%

3.3 Trends & Drivers Linkages

		A	B	C	D	E	F	
Rank	Driver	Systems Integration	New port & infrastructure facilities	Environmental Technologies	Hub Spoke for trans shipping	Sea Motorways & SSS Infrastructure	LNG/H2 Bunkering	Total
1	Integrated / Multi-Modal Transport Systems	1			1	1	1	4
2	Green shipping	1		1			1	3
3	Efficient use of resources	1	1		1			3
4	Positioning & Communications Technologies	1			1	1		3
5	Marine Renewables (R.E.D. 15% target by 2020)		1	1			1	3
6	New Business Models		1	1	1			3
7	Ethical / Green consumers		1	1			1	3
8	"Green Economy": environment as a business opportunity		1	1			1	3
9	Climate change Mitigation (Low Carbon)		1	1				2
10	NOX, SOX and Particulates regulations			1		1		2
11	Urbanisation & Congestion				1	1		2
12	Ocean resource exploitation & Blue Biotechnology		1				1	2
13	Energy & Fuel scarcity/cost => demand for reduced consumption			1			1	2
14	EU technical, environmental and safety standards / legislation			1		1		2
15	Increasing Global trade & shifting trade patterns	1				1		2
16	Migration of freight from road to inland waterways & coastal shipping				1	1		2
17	EU integrated maritime strategy	1				1		2
18	Risk management		1		1			2
19	IMO regulations for control of CO2 emissions			1			1	2
20	Rapid Technological Development (ICT, bio, nano)		1					1
21	Safety (People, Ships & Cargo)						1	1
22	New propulsion energy solutions						1	1
23	Autonomous systems					1		1
24	Climate change Adaption (Resilience / Coast & Waterways Impact)			1				1
25	3D CAD/CAM/CAE / simulation & modelling / rapid tooling		1					1
26	Marine ecosystem management & sustainability			1				1
27	IMO Ballast Water Convention			1				1
28	Sea level rise, acidification, increasing temp & extreme weather			1				1
29	Gaps between science, policy & implementation		1					1
30	UK/regional political		1					1
31	Carbon pricing						1	1

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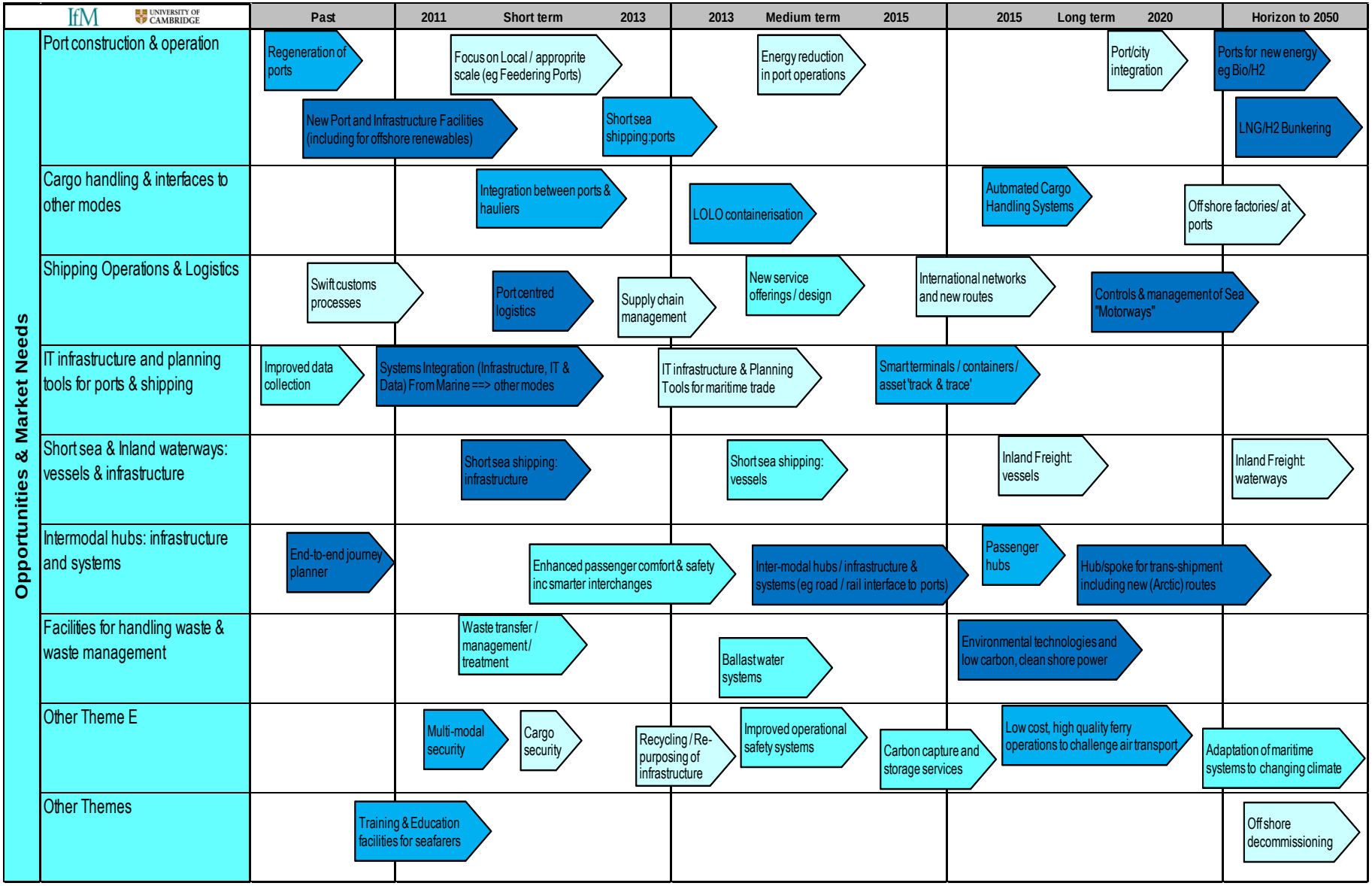
4.1 Market Opportunities



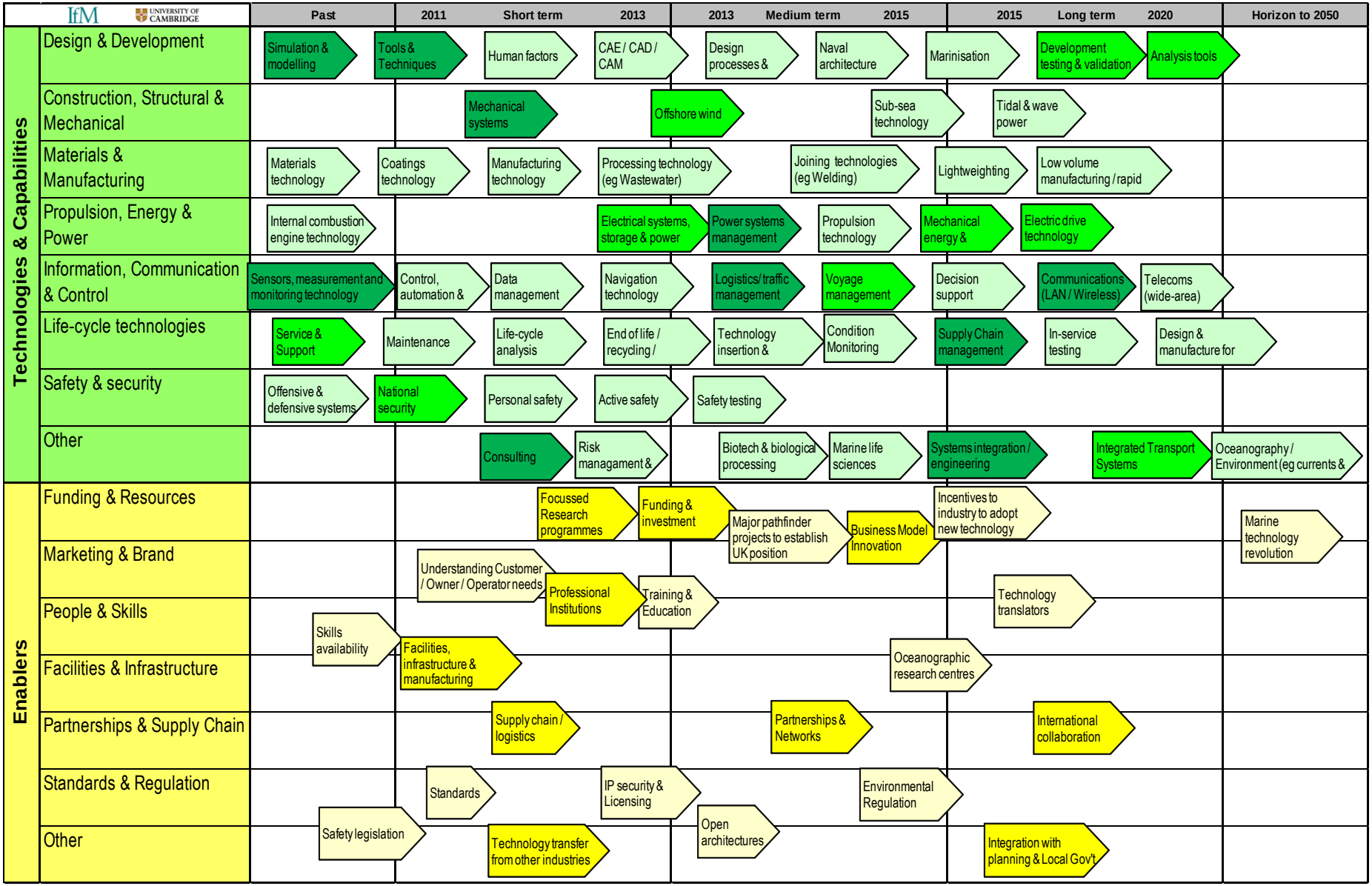
4.2 Market Opportunities (1 to 20)

	Opportunities	Market Attractiveness	Capability Fit	Total
1	Systems Integration (IT & Data) across modes			
2	New Port and Infrastructure Facilities (including for offshore renewables)			
3	Environmental technologies and low carbon, clean shore power			
4	Hub/spoke for trans-shipment including new (Arctic) routes			
5	Inter-modal hubs / infrastructure & systems (eg road / rail interface to ports)			
6	Controls & management of Sea "Motorways"			
7	End-to-end journey planner			
8	Short sea shipping: infrastructure			
9	Port centred logistics			
10	LNG/H2 Bunkering			
11	Automated Cargo Handling Systems			
12	Integration between ports & hauliers			
13	Short sea shipping:ports			
14	Training & Education facilities for seafarers			
15	Regeneration of ports			
16	LOLO containerisation			
17	Multi-modal security			
18	Low cost, high quality ferry operations to challenge air transport			
19	Smart terminals / containers / asset 'track & trace'			
20	Passenger hubs			

4.2 Market Opportunities (cont)

	Opportunities	Market Attractiveness	Capability Fit	Total
21	Carbon capture and storage services			
22	Ballast water systems			
23	New service offerings / design			
24	Ports for new energy eg Bio/H2			
25	Enhanced passenger comfort & safety inc smarter interchanges			
26	Improved operational safety systems			
27	Waste transfer / management / treatment			
28	Improved data collection			
29	Adaptation of maritime systems to changing climate			
30	Short sea shipping: vessels			
31	Supply chain management			
32	Off shore decommissioning			
33	Cargo security			
34	Energy reduction in port operations			
35	Focus on Local / approprite scale (eg Feedering Ports)			
36	Inland Freight: vessels			
37	Inland Freight: waterways			
38	International networks and new routes			
39	Recycling / Re-purposing of infrastructure			
40	Off shore factories/ at ports			
41	Port/city integration			
42	Swift customs processes			

5.1 Capabilities & Enablers



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5.2 Capabilities

		A	B	C	D	E	F	
		Systems Integration	New port & infrastructure facilities	Environmental Technologies	Hub Spoke for trans shipping	Sea Motorways & SSS Infrastructure	LNG/H2 Bunkering	
A	**Design & Development**							
A1	Simulation & modelling	**3**	**3**	2	2	**3**	2	
A2	Tools & Techniques	**3**	**3**	2	0	1	2	
A3	Human factors	**3**	**3**	0	0	1	0	
A4	CAE / CAD / CAM	1	**3**	0	0	0	2	
A5	Design processes & Modularisation	**3**	**3**	0	0	0	0	
A6	Naval architecture	1	**3**	0	0	0	**3**	
A7	Marinisation	1	**3**	0	0	0	**3**	
A8	Development testing & validation	**3**	**3**	0	0	**3**	2	
A9	Analysis tools	**3**	**3**	0	0	**3**	**3**	
A Total	**Design & Development**	**21**	**27**	4	2	**11**	**17**	
C	**Construction, Structural & Mechanical**							
C1	Mechanical systems	0	**3**	0	**3**	1	**3**	
C2	Offshore wind	0	**3**	2	0	0	**3**	
C3	Tidal & wave power	0	**3**	2	0	0	**3**	
C4	Sub-sea technology	0	**3**	0	0	0	**3**	
C5	Naval & Civilian platforms					0		
C Total	**Construction, Structural & Mechanical**	0	**12**	4	3	1	**12**	
M	**Materials & Manufacturing**							
M1	Materials technology	0	**3**	2	0	0	**3**	
M2	Coatings technology	0	**3**	1	0	0	2	
M3	Manufacturing technology	0	**3**	0	0	0	1	
M4	Processing technology (eg Wastewater)	0	0	**3**	0	0	2	
M5	Joining technologies (eg Welding)	0	**3**	0	0	0	2	
M6	Lightweighting	0	**3**	0	0	0	0	
M7	Low volume manufacturing / rapid prototyping	0	1	0	0	0	0	
M8	Command & Control							
M Total	**Materials & Manufacturing**	0	**16**	6	0	0	**10**	
P	**Propulsion, Energy & Power**							
P1	Internal combustion engine technology	0	0	2	0	1	2	
P2	Electric drive technology	1	0	**3**	0	0	2	
P3	Mechanical energy & storage technology	2	**3**	2	0	0	1	
P4	Electrical systems, storage & power infrastructure	0	**3**	**3**	0	0	**3**	
P5	Power systems management	2	**3**	**3**	2	1	2	
P6	Propulsion technology	0	1	0	0	1	2	
P Total	**Propulsion, Energy & Power**	5	**10**	**13**	2	3	**12**	

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5.2 Capabilities (cont)

		A	B	C	D	E	F	
		Systems Integration	New port & infrastructure facilities	Environmental Technologies	Hub Spoke for trans shipping	Sea Motorways & SSS Infrastructure	LNG/H2 Bunkering	
A	**Design & Development**							
I	**Information, Communication & Control**							
I1	Sensors, measurement and monitoring technology	3	3	3	2	0	2	
I2	Control, automation & autonomy	3	3	0	2	0	0	
I3	Data management	3	3	0	0	3	0	
I4	Navigation technology	3	2	0	0	3	0	
I5	Logistics/ traffic management	3	1	2	3	3	2	
I6	Voyage management	3	0	1	1	1	1	
I7	Decision support systems	3	1	0	0	0	0	
I8	Communications (LAN / Wireless)	3	1	0	3	3	0	
I9	Telecoms (wide-area)	3	1	0	0	3	0	
I Total	**Information, Communication & Control**	**27**	**15**	6	**11**	**16**	5	
L	**Life-cycle technologies**							
L1	Service & Support	3	1	0	0	3	3	
L2	Maintenance	2	1	0	0	3	3	
L3	Life-cycle analysis	2	1	0	0	3	3	
L4	End of life / recycling / Decommissioning	1	1	0	0	3	0	
L5	Technology insertion & reconfigurability	2	1	0	0	0	2	
L6	Condition Monitoring	3	1	0	0	3	2	
L7	Supply Chain management	3	1	0	3	3	2	
L8	In-service testing	3	1	0	0	0	1	
L9	Design & manufacture for sustainability	1	1	0	0	0	3	
L Total	**Life-cycle technologies**	**20**	**9**	0	3	**18**	**19**	
S	**Safety & security**							
S1	Offensive & defensive systems	3	1	0	0	0	0	
S2	National security	3	0	0	2	1	2	
S3	Personal safety	3	2	0	0	0	3	
S4	Active safety	2	2	0	0	0	3	
S5	Safety testing	3	2	0	0	0	3	
S Total	**Safety & security**	**14**	**7**	0	5	1	**11**	
O	**Other**							
O1	Biotech & biological processing	0	0	3	0	0	2	
O2	Marine life sciences	0	2	1	0	0	0	
O3	Consulting	3	3	3	0	0	3	
O4	Risk managament & acturarial	3	1	0	0	0	1	
O5	Integrated Transport Systems	3	1	1	3	0	0	
O6	Oceanography / Environment (eg currents & ice caps)	0	3	0	0	0	0	
O7	Systems integration / engineering	3	2	1	0	3	3	
O Total	**Other**	**12**	**12**	**9**	3	3	**9**	

5.3 Capability - Ranked

Capabilities		A	B	C	D	E	F	
		Systems Integration	New port & infrastructure facilities	Environmental Technologies	Hub Spoke for trans shipping	Sea Motorways & SSS Infrastructure	LNG/H2 Bunkering	Total
Ranked capabilities (top-level grouping)								
I Total	Information, Communication & Control							
A Total	Design & Development							
L Total	Life-cycle technologies							
P Total	Propulsion, Energy & Power							
O Total	Other							
S Total	Safety & security							
C Total	Construction, Structural & Mechanical							
M Total	Materials & Manufacturing							
Ranked capabilities (detail)								
I5	Logistics/ traffic management	3	1	2	3	3	2	
A1	Simulation & modelling	3	3	2	2	3	2	
P5	Power systems management	2	3	3	2	1	2	
I1	Sensors, measurement and monitoring technology	3	3	3	2	0	2	
L7	Supply Chain management	3	1	0	3	3	2	
O3	Consulting	3	3	3	0	0	3	
I8	Communications (LAN / Wireless)	3	1	0	3	3	0	
O7	Systems integration / engineering	3	2	1	0	3	3	
A2	Tools & Techniques	3	3	2	0	1	2	
C1	Mechanical systems	0	3	0	3	1	3	
O5	Integrated Transport Systems	3	1	1	3	0	0	
P4	Electrical systems, storage & power infrastructure	0	3	3	0	0	3	
A9	Analysis tools	3	3	0	0	3	3	
A8	Development testing & validation	3	3	0	0	3	2	
S2	National security	3	0	0	2	1	2	
L1	Service & Support	3	1	0	0	3	3	
P2	Electric drive technology	1	0	3	0	0	2	
P3	Mechanical energy & storage technology	2	3	2	0	0	1	
I6	Voyage management	3	0	1	1	1	1	
C2	Offshore wind	0	3	2	0	0	3	

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6.1 Enablers

		A	B	C	D	E	F	
Rank	Enablers	Systems Integration	New port & infrastructure facilities	Environmental Technologies	Hub Spoke for trans shipping	Sea Motorways & SSS Infrastructure	LNG/H2 Bunkering	Total
1	Facilities, infrastructure & manufacturing capacity	1	1		1	1	1	5
2	Business Model Innovation	1		1		1	1	4
3	Funding & investment	1	1	1			1	4
4	Focussed Research programmes		1	1	1		1	4
5	Supply chain / logistics				1	1	1	3
6	Professional Institutions		1		1		1	3
7	Partnerships & Networks				1	1	1	3
8	International collaboration	1	1		1			3
9	Integration with planning & Local Gov't		1		1		1	3
10	Technology transfer from other industries	1		1		1		3
11	Open architectures	1				1		2
12	Understanding Customer / Owner / Operator needs	1			1			2
13	Skills availability		1				1	2
14	Environmental Regulation					1	1	2
15	Standards	1					1	2
16	Major pathfinder projects to establish UK position		1		1			2
17	Incentives to industry to adopt new technology	1		1				2
18	Marine technology revolution		1				1	2
19	IP security & Licensing	1						1
20	Oceanographic research centres		1					1
21	Technology translators	1						1

7. Priority Market Opportunities (explored in breakout groups)

Opportunities	Breakout Group
Systems Integration (Infrastructure, IT & Data) From Marine ==> other modes	**A**
New Port and Infrastructure Facilities (including for offshore renewables)	**B**
Environmental technologies and low carbon, clean shore power	**C**
Hub/spoke for trans-shipment including new (Arctic) routes	**D**
Sea "Motorways" & Short Sea Shipping Infrastructure	**E**
LNG/H2 Bunkering	**F**
Inter-modal hubs / infrastructure & systems (eg road / rail interface to ports)	inc in A
End-to-end journey planner	related to A
Short sea shipping: infrastructure	inc in E
Port centred logistics	
Automated Cargo Handling Systems	
Integration between ports & hauliers	
Short sea shipping:ports	inc in E
Training & Education facilities for seafarers	See Theme A
Regeneration of ports	
LO-LO containerisation	
Multi-modal security	
Low cost, high quality ferry operations to challenge air transport	
Smart terminals / containers / asset 'track & trace'	
Passenger hubs	

See over for outputs from breakout group exploration of Priority Market Opportunities.

Key: **Black text – original team input**

Red text – carousel group comments

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7. Priority Market Opportunities (summary)

Opportunities		Market Attractiveness:					Triple bottom-line		Value	Fit with UK Capability						Fit	Total
Topic	Opportunity	Global Market Size	Home (UK) market size	Strength of competition	Added Value / Margin	Cross-sector opportunity	Planet / Environmental	People / Societal	Weighted Value	Marine Industry	University / Academic	RTO / Design Services	Other Industry	Other UK resources	Timeliness	Weighted Capability	Combined Value & Fit
A	Systems Integration	3	2	2	3	4	3	3		3	3	2	3	4	3		
B	New port & infrastructure facilities	3	2	1	2	2	2	2		2	3	3	3	3	2		
C	Environmental Technologies	4	3	2	4	3	3	1		3	4	2	3	3	2		
D	Hub Spoke for trans shipping	4	3	0	1.5	3	2	2		1.5	2	2	2		1		
E	Sea Motorways & SSS Infrastructure	1	1	3	3	2	2	2		2	4	2	1	3	1		
F	LNG/H2 Bunkering	4	2	2	1	4	4	2		2	2	4	3	4	1		

See over for outputs from breakout group exploration of Priority Market Opportunities.

Key: **Black text – original team input**

Red text – carousel group comments

Opportunity A		Systems Integration		Team	ML JJB SH
Infrastructure, IT & Data. Marine & other modes				Score	2.9
Value		Basis for Characterisation & Evidence		Score	This opportunity is attractive because:
Market Attractiveness: Global Market Growth Opportunity	Large > £2bn	Mature aviation data integration (ticketing). Marin well developed in military & at sea - type 42 integration of 26+ system & sub system though IT based/data integration. Proven capability of cross equipment & application.		3.0	Necessary expertise already exists. Proven application in sector & globally. Opportunity is substantial. Challenges to integration are not insurmountable and within a reasonable timeframe. New business opportunities. Converging technology - now! IT, WWW, Apps. UK has experience & references
Market Attractiveness: Home (UK) Market Growth Opportunity	Modest > £100m	IP - creativity - UK innovation- communication, IT, data management expertise. Market leaders in the UK - MOD & aviation 25%		2.0	
Market Attractiveness: Strength of competition (Global)	Strong / Established	No evidence of global rest practices - local practices - no full logistics chain		2.0	
Market Attractiveness: Added Value in UK	70%	Emerging markets. New services & products - new platforms - such as Facebook pop-up		3.0	
Market Attractiveness: Cross-sector opportunity	**V. Large > £2bn**	Transfer of systems interface into other sectors - aviation/road		4.0	
Triple bottom-line: Planet / Environmental	Major	Less waste - greater efficiencies. Reduce ed capita cost. Infrastructure stay major		3.0	Knowledge Gaps (in team): Intermodal: understanding the handshake. Handshake technology for distributed systems. Rich handshake technology
Triple bottom-line: People / Societal	Major	Business & people benefits - visibility accountability		3.0	
Capability		Where is the capability?	What are the Gaps?	Score	UK has the capability to deliver...
Fit with UK Capability: Marine Industry	World-Leading OR significant scale	BAE systems - MOD. NIMROD. Rolls Royce. Marine industry - star alliance. Aviation	Integration between intermodal touch points. Web based service integration	3.0	Integration: everything in place available. Going to happen on it's own. No action needed? Gap is handshaking? Critical to an integrated ports policy
Fit with UK Capability: University / Academic	World-Leading OR significant scale	Best in class - Coastal. Bristol - system of system	No lineage across University research to market	3.0	
Fit with UK Capability: R&T Org. / Design	Moderate / Emerging / Dispersed	Isolation	Getting it together, schematic networks	2.0	
Fit with UK Capability: Non-Marine / Other	World-Leading OR significant scale	Aviation, space, FedEx, UPS. Transfer into marine	cross transport integrator. Single portal of expertise. Trains	3.0	
Fit with UK Capability: Other UK resources	**World-Leading & significant scale**	Insurance, Finance, NHS		4.0	Knowledge Gaps (in team): Handshake technology. (interface between modes. Data/physical interface)
Timeliness: UK Capability matches market need	Pace setting	Research base - yes	Cross sector - academia into industry	3.0	

Opportunity	B	New port & infrastructure facilities		Team	GR, AR, PJ
(e.g. To support offshore renewables)				Score	2.4
Value		Basis for Characterisation & Evidence		Score	This opportunity is attractive because:
Market Attractiveness:	Global Market Growth Opportunity	Large > £2bn	Massive opportunities worldwide. Huge market. Diverse	3.0	Desperation! UK has excellent location. Atttractive near term & medium term opportunity but entirely at whim of gov. Policy & therefore vey high risk investment
	Home (UK) Market Growth Opportunity	Modest > £100m	Investment in parts in NI, Northwest, Humberside & SE England	2.0	
	Strength of competition (Global)	Dominant / Entrenched	Uk doing OK, but strong competition from Europe. UK leader in wave/tidal	1.0	
	Added Value in UK	30%	Set up plants for assembly & preferably manufacture at UK ports	2.0	
	Cross-sector opportunity	Modest > £100m	Create cluster of activities & businesses around renewable HUB spin-offs as export opportunities. High tech-R&D hubs. Knowledge based industry & manufacture & training. Desire but lacks opportunity. Needs clarity of policy & direction for investment certainty	2.0	
Triple bottom-line	Planet / Environmental	Modest	Support for fundamental renewable energy source. New industry focussed on renewable - attracts sustainable communities, model environmental city etc	2.0	Knowledge Gaps (in team):
	People / Societal	Modest	Cool place to work! Regeneration. Migration of high-earning workers	2.0	
Capability			Where is the capability? / What are the Gaps?	Score	UK has the capability to deliver...
Fit with UK Capability	Marine Industry	Moderate / Emerging / Dispersed	SMI members. Renewables UK / Resistance to change. 'Anchor' organisation to enable the process. Potential interport competition. If supply is from Europe, why UK support? Need to encourage supply chain	2.0	Most of it but needs a leader or firm direction. Role for government to build collaborative support for new 'shared' facility?
	University / Academic	World-Leading OR significant scale	Coastal universities. Southampton, Liverpool, Glasgow, Plymouth, Cardiff / DELIVERY of brilliant ideas	3.0	
	R&T Org. / Design	World-Leading OR significant scale	Small companies. Large overseas companies as inward invests / Market leader required	3.0	
	Non-Marine / Other	World-Leading OR significant scale	Construction companies. Support infrastructure / Skilled labour?	3.0	
	Other UK resources	World-Leading OR significant scale	Stable society / Governmental focus on manufacturing & long-term thinking	3.0	Knowledge Gaps (in team):
Timeliness	UK Capability matches market need	Lagging but could recover	A bit slow / Planning hold ups	2.0	

Opportunity	C	Environmental Technologies		Team	IJ MP JM
e.g. Waste & ballast & clean energy @ BRTS				Score	2.9
Value		Basis for Characterisation & Evidence		Score	This opportunity is attractive because:
Market Attractiveness: Global Market Growth Opportunity	**V. Large > £5bn**	IMO regs. Energy cost. What proportion of energy cons in total shipping process is port-based? Low?		4.0	
Market Attractiveness: Home (UK) Market Growth Opportunity	Large > £1bn	Large or modest?		3.0	
Market Attractiveness: Strength of competition (Global)	Strong / Established			2.0	
Market Attractiveness: Added Value in UK	**90%**			4.0	
Market Attractiveness: Cross-sector opportunity	Large > £1bn			3.0	
Triple bottom-line: Planet / Environmental	Major	Opportunity game changing in reducing port emissions		3.0	Knowledge Gaps (in team):
Triple bottom-line: People / Societal	None	cleaner beaches, estuaries		1.0	
Capability		Where is the capability?	What are the Gaps?	Score	UK has the capability to deliver...
Fit with UK Capability: Marine Industry	World-Leading OR significant scale	e.g. Hamworthy, BMT		3.0	
Fit with UK Capability: University / Academic	**World-Leading & significant scale**	Across UK. Not land locked to UK		4.0	
Fit with UK Capability: R&T Org. / Design	Moderate / Emerging / Dispersed	QinetiQ		2.0	
Fit with UK Capability: Non-Marine / Other	World-Leading OR significant scale	It systems industries. Civil engineering consultancy, Ricardo, utilities sector, EATechnology, environmental industries	Technology transfer to port sector	3.0	
Fit with UK Capability: Other UK resources	World-Leading OR significant scale	Natural resources, brand UK		3.0	Knowledge Gaps (in team):
Timeliness: UK Capability matches market need	Lagging but could recover			2.0	

Opportunity	D	Hub Spoke for trans shipping		Team	AB VP JI
Inc. New arctic routes (bonus!)				Score	1.9

Value			Basis for Characterisation & Evidence	Score	This opportunity is attractive because:
Market Attractiveness:	Global Market Growth Opportunity	**V. Large > £5bn**	Ship > ship & ship > land hub. Increased global trade	4.0	Draws 'trade' through UK. Brings distribution hub. Develops technology to provide high-efficiency cargo transport transfer (port services - bunkering waste etc)
	Home (UK) Market Growth Opportunity	Large > £1bn	Exploitation of liner route shortening (single European input) * cruise ship hubs - aviation, island links. Plus even larger potential for freight? True, but realise UK cruise ship positions	3.0	
	Strength of competition (Global)	Dominant / Entrenched	Rotterdam established with growth in capacity. International ownership. Link to inland shipping routes	0.0	
	Added Value in UK	30%	Employment, although advantage eroded by automation	1.5	
	Cross-sector opportunity	Large > £1bn	knock on to short sea feeders & land transport (limit capacity of rail links for freight)	3.0	
Triple bottom-line	Planet / Environmental	Modest	Reduction of CO2 - shorter transport miles	2.0	Knowledge Gaps (in team): scale Global vs. local optimal hub size evaluation. Network design. Who knows? Global trade assumption
	People / Societal	Modest	Reduction of road transport - congestion. Employment?	2.0	

Capability			Where is the capability?	What are the Gaps?	Score	UK has the capability to deliver...
Fit with UK Capability	Marine Industry	Moderate / Emerging / Dispersed	Manor UK ports?	Join up to road/rail networks. Connectivity to Europe. Short sea TX routes (round UK to Europe) small UK ports with handling capacity. Port engineering. Industry involvement	1.5	Space? Planning? Ability to 'persuade' global port company to invest to beat existing capability. Collaborative transport planning systems integration capability
	University / Academic	Moderate / Emerging / Dispersed	Logistics (management & modelling) LJMU, Soton, Plymouth, Leeds, H-W, Cranfield		2.0	
	R&T Org. / Design	Moderate / Emerging / Dispersed	Consultants	Equipment design & supply	2.0	
	Non-Marine / Other	Moderate / Emerging / Dispersed	Rail/road networks	Rail capacity & links or geared ships. Investment	2.0	
	Other UK resources	None		Use infrastructure more effectively		Knowledge Gaps (in team): Business constraints. Freedom of data
Timeliness	UK Capability matches market need	Already "missed the boat"	Inefficient	Modest capacity - handles UK inwards & outwards only at key ports - h/o short sea links. SSS not req'd for trans shipping? IS for effective links to Europe	1.0	

Opportunity	E	Sea Motorways & SSS Infrastructure		Team	JF DR
				Score	2.0

Value		Basis for Characterisation & Evidence		Score	This opportunity is attractive because:
Market Attractiveness: Global Market Growth Opportunity	Small <£200m	Global ops= export potential of system. Could be used in gulf states, Indonesia/Phil/US/Med. Small value. Small value due to saturation of areas software/system. Need analysis to develop business/energy case to support SSS?		1.0	Significant % of imports through Dover/Calais with related issue in congestion. Safety/security environmental & fuel consumption. Supports UK slip motorway concept. Idea that has been discussed for many years & needs doing! Without Govt subsidies can SSS beat haulage? Short sea S coastal services - who will pay for infrastructure? Govt? Private? Explore alternative port designs - small port design - simulation
Market Attractiveness: Home (UK) Market Growth Opportunity	Small < £100m	Benefits to local economies & quality cost reduction. Small ports of which x 50. savings on road maintenance, safety, congestion, time. Cost - potential infra expansion to small port environments. Medium based on 10% traffic reduction. Small port growth. jobs. Reduction of congestion, time saving		1.0	
Market Attractiveness: Strength of competition (Global)	Weak / Emerging	Software undeveloped. Technology is new.		3.0	
Market Attractiveness: Added Value in UK	70%	Quality life, jobs, environment		3.0	
Market Attractiveness: Cross-sector opportunity	Modest > £100m	IT market, road infrastructure - road & rail. SE congestion, jobs. New industries to port areas. Boat building inland water - waterways		2.0	
Triple bottom-line: Planet / Environmental	Modest	Increase as approach adopted around the world. CO2 fuel reduction 10% decrease of lorries. Even spread.		2.0	Knowledge Gaps (in team): Data lost load size. Technology advancement & capability. Multiple markets goes well with emerging! China, Russia
Triple bottom-line: People / Societal	Modest	New jobs. Better life quality esp. SE. Less disruption, time saving		2.0	
Capability		Where is the capability?	What are the Gaps?	Score	UK has the capability to deliver...
Fit with UK Capability: Marine Industry	Moderate / Emerging / Dispersed	Have capability. Need the will & opportunity. Mechanical systems - cheaper & more efficient loading & unloading in small ports.	Engine technology. Crane manufacture	2.0	Everything! Historically it worked well, goes well with gas economy
Fit with UK Capability: University / Academic	**World-Leading & significant scale**	Economic benefits cost/benefit	Life cycle technology needs research	4.0	
Fit with UK Capability: R&T Org. / Design	Moderate / Emerging / Dispersed			2.0	
Fit with UK Capability: Non-Marine / Other	None	Opp for port environment development i.e. New business, IP		1.0	
Fit with UK Capability: Other UK resources	World-Leading OR significant scale	Need for investment		3.0	Knowledge Gaps (in team): Donald Rumsfeld
Timeliness: UK Capability matches market need	Already "missed the boat"			1.0	

Opportunity	F	LNG/H2 Bunkering		Team	RKH BH SW
				Score	2.7

Value			Basis for Characterisation & Evidence	Score	This opportunity is attractive because:
Market Attractiveness:	Global Market Growth Opportunity	**V. Large > £5bn**	Regulation Co2, SO2 Nox. Fuel efficiency. Nat gas market globally expanding e.g. Shale gas	4.0	Large world market & domestic need for fuel. UK well-placed with all major req'd elements. Spill over opps beyond marine (e.g. Logistics, energy) Enabler for low CO2 economy. Great job creation. Advanced ship design/manufacture support industries.
	Home (UK) Market Growth Opportunity	Modest > £100m	Trade in gas. Services in bunkering, Producer etc of LNG x H2. Location. Increased trade vs. spill over. Servicing emerging markets Note on scores: Short term LNG only - 2. Long term total energy network - 4	2.0	
	Strength of competition (Global)	Strong / Established	Scandinavia but not so good location or capabilities	2.0	
	Added Value in UK	10%	High for services. Not all LNG sourced UK. Increased trade adding value. UK is net importer of gas Note on scores: As proportion of fuel itself -1. Of services & spill over - 4	1.0	
	Cross-sector opportunity	**V. Large > £2bn**	Enabler for energy tech e.g. AD/renewables. Logistics benefits. Transport fuels	4.0	
Triple bottom-line	Planet / Environmental	**Game-Changing**	part of low CO2 economy	4.0	Knowledge Gaps (in team): Specific orgs for capability. Is anyone already doing holistic planning for this?
	People / Societal	Modest	Job creation. Facilitates sustainable low CO2 economy. Energy security	2.0	

Capability			Where is the capability?	What are the Gaps?	Score	UK has the capability to deliver...
Fit with UK Capability	Marine Industry	Moderate / Emerging / Dispersed	Ports, gas supply, renewables, infrastructure, location, H2 tech, waste management? Would attract investment	Engines manufacture for commercial ships, tech for biogas	2.0	All component elements > but needs integration and leadership. Great spring off benefits
	University / Academic	Moderate / Emerging / Dispersed	Strong in individual focus areas, renewable energy, process eng (bio fuels emerging)	Joined-up research on this topic appl. To marine. Hydrogen handling & storage is real high-tech challenge	2.0	
	R&T Org. / Design	**World-Leading & significant scale**	Consultancies in energy, renewables, design, analysis		4.0	
	Non-Marine / Other	World-Leading OR significant scale	Fuels companies, renewables, utilities,		3.0	
	Other UK resources	**World-Leading & significant scale**	Deregulated power market. Marine/shipping infrastructure. Location! Clean water for electrolysis		4.0	Knowledge Gaps (in team):
Timeliness	UK Capability matches market need	Already "missed the boat"	Big opportunity, good capability - need to start!		1.0	

Appendices

A. Participants
B. Workshop Feedback
C. Workshop Process
D. Market Opportunities Detail
E. Participant pre-work

Appendix A: Workshop Participants

First	Surname	Organisation
Alan	Bury	Liverpool John Moores University
John	Fannon	Sollerta Ltd
Stephen	Hart	Technology Strategy Board
Bob	Hockham	BMT
John	Ingram	Transport KTN
Ian	Jenkinson	Liverpool John Moore's University
Julian	Johanson-Brown	Halcrow Maritime
Peter	Joyce	BIS
Richard	Kemp-Harper	Technology Strategy Board
Michel	Leseure	University of Chichester
John	Murray	Society of Maritime Industries
Vaughan	Pomeroy	University of Southampton
Michael	Priestnall	Cambridge Carbon Capture Ltd
Gordon	Rankine	Beckett Rankine
Alex	Robertson	4d-dynamics
Dawn	Robins	University of Chichester
Simon	Wrigley	Ricardo
Dominic	Oughton	IfM
Jim	Trueman	IfM