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Research And Analysis of FP6 and FP7 Projects in Waterborne Transport Within Transport Sesctor in Europe

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ABSTRACT

Waterborne transport are not main driving forces among transport modes and to increase environmental and climate change by greenhouse gas emissions and other impacts of human activities as whole. However, the waterborne transport sector should evaluate the possibilities to contribute to reduction of anthropogenic GHG emissions to emphasize navigation as an environmentally sound mode. Moreover, the waterborne transport could be observed as the GHG emitter on two ways as "high carbon" navigation and "low carbon" navigation depending on many reasons (fuel, propulsion system, ship building, etc.).

In this paper we are presenting some research results including especially waterborne transport and navigation from the European Commission project under the title "Supporting Research on Climate-Friendly Transport" (Acronym REACT) in Seventh Framework Programme (2009-2011).

1. Introduction

The review and analysis includes all FP6 projects and up-to-now approved part (first half of 2011.) of FP7 projects in relation with REACT Strategic Research Agenda (SRA) in climate-friendly transport.

An analytical classification has encompassed 374 FP6 projects and 309 FP7 projects or in total 683 projects. Five projects among these have been included in more than one main and-or specific research areas. Mainly, they have been classified in two or three main specific research areas. All projects have been considered by its SRA characteristics such as: main research area and specific research area.

Strategic Research Agenda represents an identifiable, coherent forward looking and adaptable framework for research at the beginning of the 21st Century. SRA primary focus is provide the EU with strategic roadmaps for research to achieve the future vision of a green European transport system. Basic structure of the REACT SRA presents in Figure 1.

All the information included in to the Engineering and ICT pillar (main field) derived mainly from European Technology Platforms' or ETPs' documentation. The second pillar (main field), instead, was set up assembling different sources and REACT consortium expertise (Bresciani et al., 2011, Lue et al., 2014 and www.react-transport.eu). It is in this second pillar that the research areas of policy, economy and multimodal or non-motorized means of transport (cycling, walking) are included.

The second level of classification regards sectors. For the Engineering and ICT pillar (main field), sectors correspond to the transport modes: road, rail, water and air. For the Planning Social Sciences and Economy pillar, sectors refer to different measures of governance, acting on urban space, on people's behaviour or on market: Planning and Systems, Social and behavioural measures, Industry and economy.

Two further levels of classification are provided: Main research areas and Specific research areas (as presented in Fig.2 as an extract of the structure for the Waterborne sector). The "specific research area" is the most detailed classification available within the structure of the REACT SRA.

The REACT SRA inherited from the ETP SRAs also the use

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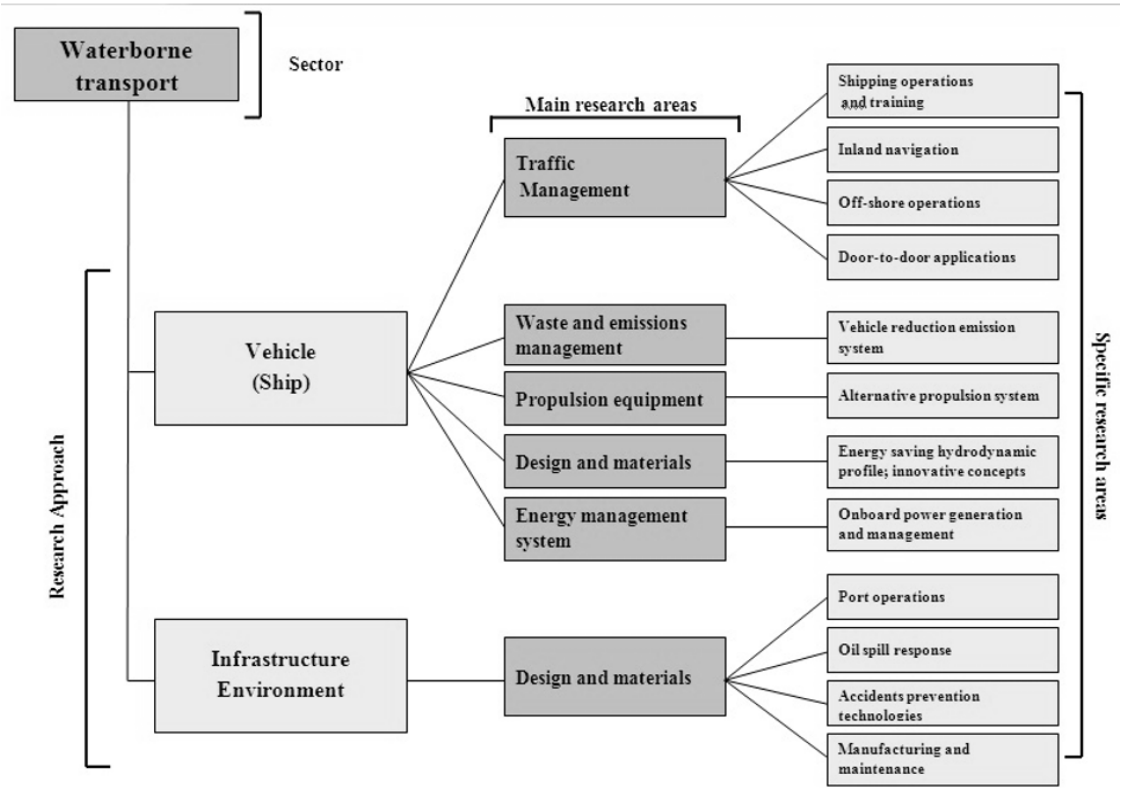
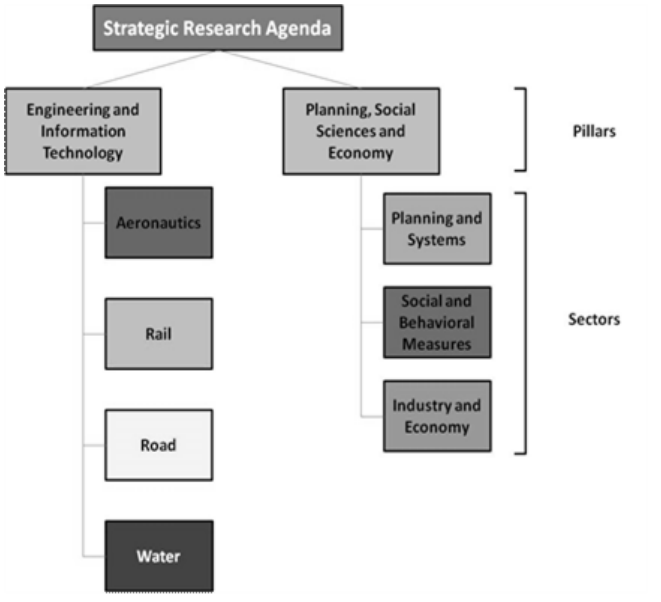
Figure 2: The structure of REACT SRA regarding the Waterborne sector



Source: Authors

of criteria and indicators to describe the research areas. They represent the means by which, through a consultation process, experts and stakeholders can express their evaluation into research areas and assign priority to them.

Figure 1: The higher levels of the hierarchical tree structure of the SRA.



Source: Authors

2. Main Fields (Pillars)

For a better review and analysis of the effects on transport and climate change, a categorization of impacts on main field has been conducted. The Main Field is divided into two categories:

Engineering and Information Technology (EIT)

Planning, Social Sciences and Economics (PSSE)

Relation between number of projects in the main fields is not proportional, as it is shown in the Figure 3.

This figure indicates that roughly more than two thirds of the projects are in the field of Engineering and Information Technology. Therefore, technological researches are much more common than researches in the field of Planning, Social Sciences and Economics. However, it is necessary to reach the balance between technological changes and behavioural aspects triggered by Planning, Social Sciences and Economics.

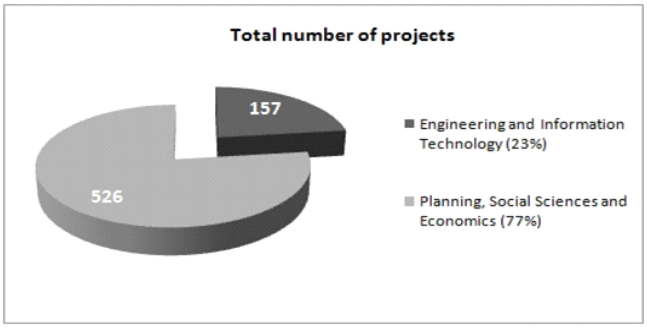
In addition, funding details relating to project cost (PC) and project funding (PF) of FP6 and FP7 projects are given in the Table 1. Projects, elaborated in this analysis, are referred to the specific research areas of the REACT SRA.

Table 1: Funding details of FP6 and FP7 projects

	FP6			FP7			Total (FP6+FP7)		
	PC (10^6 €)	PF (10^6 €)	%	PC (10^6 €)	PF (10^6 €)	%	PC (10^6 €)	PF (10^6 €)	%
EIT	2812.24	1572132	88	1337.18	863.78	79	4149.42	2435912	85
PSSE	371.92	206.06	12	354.24	243.23	21	726.16	448.29	15
Total:	3184.16	1777192	100	1691.42	1107.01	100	4875.58	2884202	100

Source: Authors

Figure 3: Relation between number of projects in the main field



Source: Authors

3. Engeineering and Information Technology

3.1. Sector - transport mode

The distribution of FP6 and FP7 projects according to the transport modes is given in the Figure 4.

Figure 4 indicates that roughly one half of the projects is in the sector / transport mode of Aeronautics. The second place belongs to the road transport with one
fourth of total number of projects. Commonly, rail and water transport as most climate-friendly transport modes participate approximately with one fourth as same as the road transport.

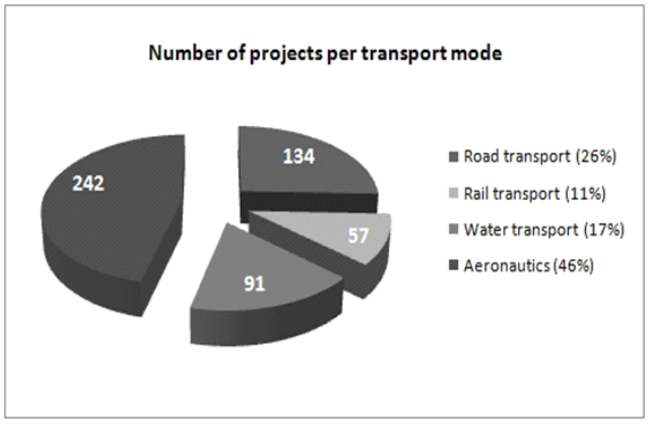
Table 2 gives an analysis of EC funding of FP6 and FP7 projects which belongs to different specific research areas of the REACT SRA within Engineering and Information Technology, as the first main research field.

Table 2: Engineering and Information Technology - funding of FP6 and FP7 projects

Transport mode	PC (FP6+FP7) (10^6 €)	%	PF (FP6+FP7) (10^6 €)	%
Road transport	1043.49	25	570372	23
Rail transport	462.02	11	264.37	11
Water transport	525.23	13	325.30	14
Aeronautics	2118.68	51	1275.87	52
TOTAL:	4149.42	100	2435912	100

Source: Authors

Figure 4: Distribution of FP6 and FP7 projects according to the transport modes (in total 524 projects)



Source: Authors

3.2. Water transport

Main research approaches in water transport are given in the Table 3.

Table 3: Main research approaches in water transport

Main research approaches	Number of projects	Percentage
Vehicle	80	88,00%
Infrastructure/environment	11	12,00%
Total:	91	100,00%

Source: Authors

In the sector of water transport, the VEHICLE is the most common research approach with the main research areas shown in the Figure 5.

Funding of FP6 and FP7 transport projects which can be allocated to specific research areas in water transport of the REACT SRA is shown in Table 4.

3.3. Road Transport

Main research areas within road transport are indicated in the Figure 6. Table 5 also contains funding details of FP6 and FP7 projects related to specific research areas of road transport in the REACT SRA.

Table 4: Water transport - funding details of FP6 and FP7 projects

Main research approach	Specific research areas	PC (10^6 €)	%	PF (10^6 €)	%
VEHICLE	Traffic Management	100.21	21	64.76	22
	Waste and emissions reduction systems	31.66	7	21.79	7
	Propulsion equipment	81.48	17	45.71	16
	Design and materials	198.15	41	123.60	42
	Energy management systems	67.31	14	38.60	13
	TOTAL:	**478.81**	**91**	**294.29**	**90**
Infrastructure/ Environment	**TOTAL:**	**46.42**	**9**	**31.01**	**10**
	GRAND TOTAL:	**525.23**	**100**	**325.30**	**100**

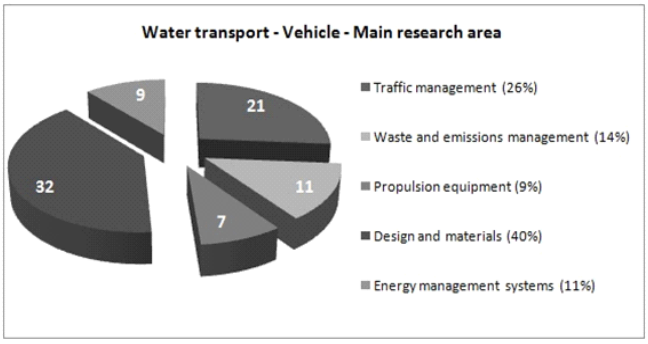
Source: Authors

Table 5: Road transport - funding details of FP6 and FP7 projects

Main research approach	Specific research areas	PC (10^6 €)	%	PF (10^6 €)	%
VEHICLE	Advanced fuels and technologies	191.26	26	101.09	26
	Design and materials	85.36	12	50.5	13
	Hybrid energy and intelligent management systems	165.75	23	99092	25
	Low emission vehicle	45.19	6	27.41	7
	Fuel cell vehicles and low carbon/hydrogen fuels	233.61	33	116.78	29
	TOTAL:	**721.17**	**69**	**394972**	**69**
Infrastructure/ Environment	Infrastructure for cell vehicles and low carbon/hydrogen fuels	100.36	57	43.24	47
	Design and materials	60.82	35	36.99	41
	Vehicle infrastructure	13.34	8	10.77	12
	TOTAL:	**175.52**	**17**	**91.00**	**16**
Driver	**TOTAL:**	**146.80**	**14**	**84.40**	**15**
	GRAND TOTAL:	**1043.49**	**100**	**570372**	**100**

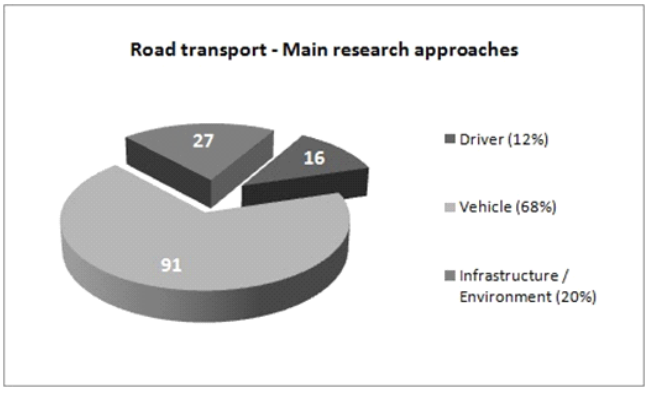
Source: Authors

Figure 5: Water transport - Vehicle - Distribution of projects (in total: 80 projects)



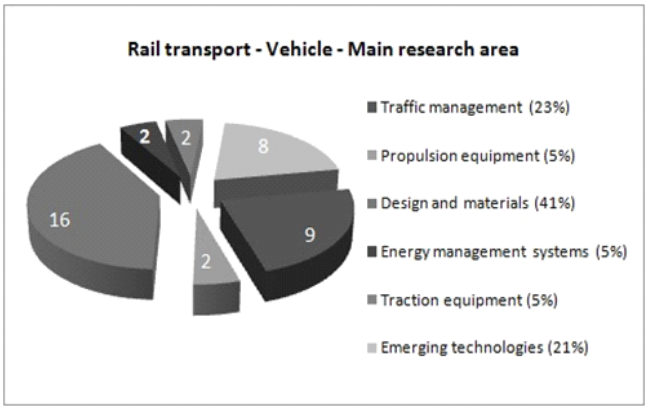
Source: Authors

Figure 6: Number of projects in Main research areas within road transport (in total: 134 projects)



Source: Authors

Figure 7: Rail transport - Vehicle - Distribution of projects (in total: 39 projects)



Source: Authors

Therefore, main research approach in road transport is VEHICLE.

INFRASTRUCTURE / ENVIRONMENT is the second ranked research approach.

3.4. Rail transport

Main research approaches in rail transport, according to the number of approved projects in FP6 and FP7 calls, are given in the Table 6.

Table 6: Main research approaches in rail transport

Main research approaches	Number of projects	Percentage
Vehicle	39	68,00%
Infrastructure/environment	18	32,00%
Total:	57	100,00%

Source: Authors

Main research approach is the VEHICLE, with main research areas given in the figure 7.

INFRASTRUCTURE / ENVIRONMENT is the second ranked research approach with the main research areas given in the Figure 7.

Funding of FP6 and FP7 rail transport projects related to corresponding specific research areas in the REACT SRA is given in Table 7.

3.5. Aeronautics

Main research approaches of the Aeronautics transport mode are given in the Table 8.

The VEHICLE is the most usual research approach in the sector of aeronautics, as well, with the main research areas indicated in the Figure 8.

Funding analysis of FP6 and FP7 projects in the aeronautics transport mode, related to the corresponding specific research area in the REACT SRA is given in Table 9.

Table 7: Rail transport - funding details of FP6 and FP7 projects

Main research approach	Specific research areas	PC (10^6 €)	%	PF (10^6 €)	%
VEHICLE	Traffic Management	75.75	23	44.63	23
	Propulsion equipment	35.14	10	19.98	10
	Design and materials	113.67	34	64.64	34
	Energy management systems	24.36	7	13.10	7
	Traction equipment	11.82	4	5.38	4
	Emerging technologies	74.47	22	42.24	22
	TOTAL:	**335.21**	**73**	**190.01**	**72**
Infrastructure/ Environment	Methods and tools	24.04	19	17.34	19
	Design and materials	102.77	81	60.02	81
	TOTAL:	**126.81**	**27**	**74.36**	**28**
	GRAND TOTAL:	**462.02**	**100**	**264.37**	**100**

Source: Authors

Table 9: Aeronautics - funding details of FP6 and FP7 projects

Main research approach	Specific research areas	PC (10^6 €)	%	PF (10^6 €)	%
VEHICLE	Traffic Management	407.99	20	245.93	20
	Methods and tools	81.79	4	52.57	4
	Flight physics	284.71	14	174.56	15
	Propulsion equipment	780.04	39	464.29	38
	Design and materials	401.53	20	240.98	20
	TOTAL:	**2038.2**	**96**	**1228.3**	**96**
Infrastructure/ Environment	**TOTAL:**	**80.48**	**4**	**47.57**	**4**
	GRAND TOTAL:	**2118.68**	**100**	**1275.87**	**100**

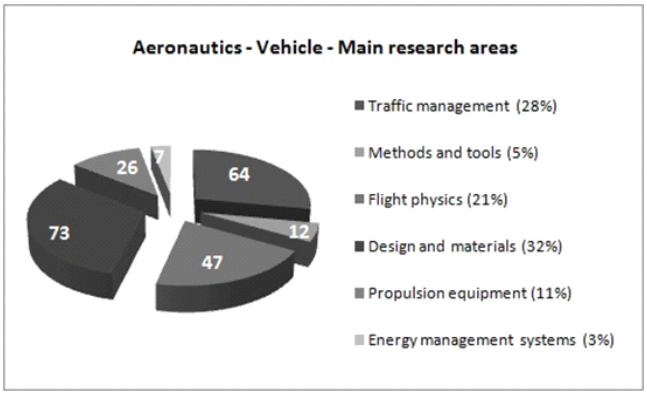
Source: Authors

Table 8: Main research approaches in aeronautics

Main research approaches	Number of projects	Percentage
Vehicle	229	95,00%
Infrastructure/environment	13	5,00%
Total:	242	100,00%

Source: Authors

Figure 8: Aeronautics - Vehicle - Distribution of projects (in total: 80 projects)



Source: Authors

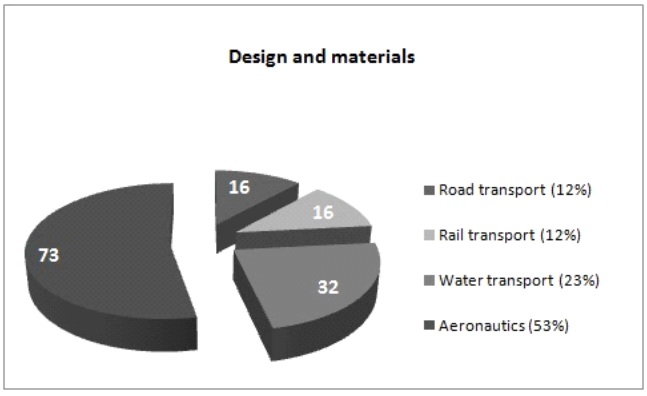
3.6. General findings

Based on an analysis of the previous results, it can be seen that the VEHICLE is the most important common research approach for all transport modes. ”Design and materials” is the common research area within the VEHICLE approach for all transport sectors. Figure 9 indicates number of FP6 and FP7 projects in the ”Design and materials” research area for road, rail, water and air transport.

”Traffic management” is common research area for rail, water and air transport.

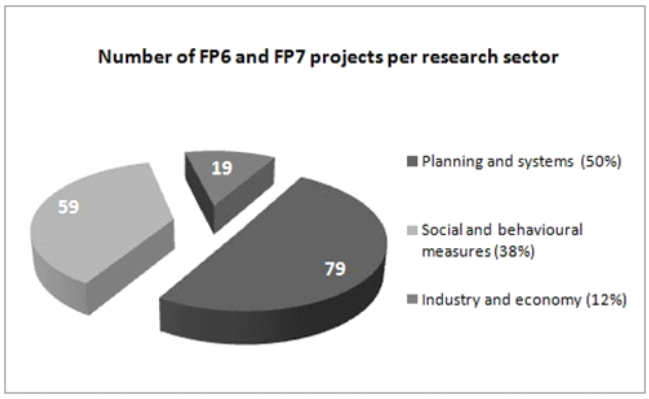
”Propulsion equipment” and ”Energy management systems” are also very important research areas in the VEHICLE research approach. They are represented in more than one transport or as given in the Figures 12 (”Propulsion equipment”) and 13 (”Energy management systems”).

Figure 9: Number of projects in ”Design and materials” for all transport modes (in total: 137 projects)



Source: Authors

Figure 10: Distribution of FP6 and FP7 projects according to the research sector Planning, Social Sciences and Economy (in total: 157 projects)



Source: Authors

4. Planning, Social Sciences and Economy

This Main research field contains 60 FP6 and 97 FP7 projects related to REACT Strategic research agenda in climate-friendly transport. Distribution of projects to research sectors is given in the Figure 10.

Table 10 shows a funding analysis of FP6 and FP7 projects which can be, by its research topics, distributed to various specific research areas of the REACT SRA within Planning, Social Sciences and Economics, as the second main research field.

Table 10: Planning, Social Sciences and Economics - funding of FP6 and FP7 projects

Sector	PC (FP6+FP7) (10^6€)	%	PF (FP6+FP7) (10^6€)	%
Planning and systems	525.49	72	304.16	68
Social and behavioural measures	170.14	24	119.03	26
Industry and economy	30.53	4	25.10	6
TOTAL:	726.16	100	448.29	100

Source: Authors

4.1. Planning and systems

Main research approaches are given in the Table 11.

The SPATIAL PLANNING is the most common research approach.

The FREIGHT TRANSPORT, as the second ranking research approach, includes the main research areas.

Table 12: Planning and systems - funding details of FP6 and FP7 projects

Main research approach	Specific research areas	PC (10^6 €)	%	PF (10^6 €)	%
Spatial planning	Integration of spatial planning, urban planning, transportation planning and economic policies	263.01	65	139.73	62
	Land use taxation	0.95	0	0.95	0
	Alternative fuels distribution infrastructure planning	62.63	16	28.69	13
	Traffic planning	11.09	3	8.22	4
	Non-motorized mobility planning	9.93	2	7.25	3
	Public transport planning	46.60	11	31.34	14
	Motorway speed limits	12.74	3	8.05	4
	TOTAL:	**406.95**	**77**	**224.23**	**74**
Freight transport	Gathering of emissions' information along supply chain	8.93	8	6.42	8
	New logistic concepts; logistic strategic agenda	79.60	67	54.91	69
	Supply chain, route planning, avoidance of empty trips	30.01	25	18.60	23
	TOTAL:	**118.54**	**23**	**79.93**	**26**
	GRAND TOTAL:	**525.49**	**100**	**304.16**	**100**

Source: Authors

Table 11: Main research approaches within "Planning and systems" sector

Main research approaches	Number of projects	Percentage
Spatial planning	53	67,00%
Freight transport	23	33,00%
Total:	79	100,00%

Source: Authors

An analysis of funding of FP6 and FP7 projects in the sector of Planning and systems is given in Table 12.

4.2. Social and behavioural measures

Main research approaches within this sector are given in the Table 13.

Therefore, main research approach within Social and behavioural transport measures is the "Education and campaigning.

The PRICING AND TAXATION as the second ranking research approach includes the main research areas.

Funding analysis of FP6 and FP7 projects in the Social and behavioural measures sector is given in Table 14.

Table 13: Main research approaches within "Social and behavioural measures" sector

Main research approaches	Number of projects	Percentage
Innovative transport systems	3	5,00%
Pricing and taxation	8	14,00%
Education and campaigning	46	78,00%
Trip avoidance	2	3,00%
Total:	59	100,00%

Source: Authors

4.3. Industry and economy

Main research approaches in the Industry and economy sector are given in Table 15.

In addition, a funding analysis of FP6 and FP7 projects in the Industry and economy sector is given in Table 16.

5. Conclusions

Work on the ship technologies in the shipping world could eventually lead to the "zero emission" vessel, as and when technologies will become available. The International Maritime Organization (IMO) is addressing the challenge to reduce emis-

Table 14: Social and behavioural measures - funding details of FP6 and FP7 projects

Main research approach	Specific research areas	PC (10^6 €)	%	PF (10^6 €)	%
Education and campaigning	Awareness campaigns	112.39	84	78.36	83
	Sustainable transport (schools)	2.74	2	2.53	3
	Initiatives for climate friendly travel to office, school, public institutions	11.17	8	8.26	8
	Eco driving	7.32	6	5.12	5
	TOTAL:	**133.62**	**78**	**94.27**	**79**
Pricing and taxation	**TOTAL:**	**21.59**	**13**	**14.96**	**12**
Innovative transport systems	**TOTAL:**	**10.73**	**6**	**6.86**	**6**
Trip avoidance	**TOTAL:**	**4.20**	**3**	**2.94**	**3**
	GRAND TOTAL:	**170.14**	**100**	**119.03**	**100**

Source: Authors

Table 16: Industry and economy - funding details of FP6 and FP7 projects

Main research approach	Specific research areas	PC (10^6 €)	%	PF (10^6 €)	%
Regulation	**TOTAL:**	**16.78**	**54**	**14.74**	**59**
Voluntary initiatives regulation	**TOTAL:**	**9.36**	**31**	**7.07**	**28**
Flexible measures	**TOTAL:**	**2.66**	**9**	**1.93**	**8**
Subsidies and incentives	**TOTAL:**	**1.73**	**6**	**1.36**	**5**
	GRAND TOTAL:	**30.53**	**100**	**25.10**	**100**

Source: Authors

Table 15: Main research approaches within "Industry and economy" sector

Main research approaches	Number of projects	Percentage
Subsidies and incentives	1	5,00%
Voluntary initiatives regulation	5	26,00%
Flexible measures	2	11,00%
Regulation	11	58,00%
Total:	19	100,00%

Source: Authors

sions now, by working on possible new regulations, using instruments such as the Energy Efficiency Design Index (EEDI). This will need to operate within a framework of future carbon trading schemes that address the real cost of carbon to the environment (Waterborne TP, 2011). Regulating ship emissions requires a comprehensive knowledge of current fuel consumption and emissions, the understanding of their impact on atmospheric composition and climate, and projections of potential future evolutions and mitigation options (Eyring et al., 2010).

In the Consultation, the highest overall priorities were given to the research area of the port operations followed by alternative propulsion systems, Innovative and hydrodynamic vessel concepts.

The first ranked is "Port operations"; This specific research area has the soonest predicted implementation phase.

The second ranked, Alternative propulsion systems is included in the main research are "Propulsion equipment".

The applied research in this specific research area will continue to 2020 with the start of predicted implementation phase. Also, this specific research area has high impact on further development on waterborne transport with great expectation in expert's opinions.

The third ranked is in the frame of main research area "Design and materials". This area has shortest of time period in applied research, round two years with the start of implementations before 2016.

Third specific research is "shipping operations and training" according to the overall priorities, GHG reduction, cost efficiency, other effects and feasibility. However, the applied research will require long time period from ten years.

The basic research requires very short time (1-2 years) for all the specific areas, except "Innovative and hydrodynamic vessel concepts" (3 years).

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