European Fisheries Technology Platform

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SUMMARY REPORT AND RECOMMENDATIONS OBTAINED FROM THE WORKSHOP:

FISHING VESSEL TECHNOLOGIES. CHALLENGES FOR A SUSTAINABLE EUROPEAN FISHING FLEET

ICM-CNR, CAPO GRANÍTOLA, SICILY, 6TH-7TH JUNE 2012.

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FISHING VESSEL TECHNOLOGIES. CHALLENGES FOR A SUSTAINABLE EUROPEAN FISHING FLEET

1. BACKGROUND

The European Fisheries Technology Platform aims to identify the key challenges for the future of fisheries and fishing research, technology and innovation and to formulate, based on them, the sector's strategy and action plan that will strengthen its capacity to grow smart, sustainable and inclusive in the forthcoming years, thus, keeping a prominent role within the European Marine Economy.

The EFTP, through its Board of Directors and Secretariat, is promoting a number of workshops aimed to discus and reach agreement on a series of issues that are or paramount relevance to the above mentioned process:

1. Fishing Vessel Technologies
2. Energy Efficiency.
3. Discards.

The aim of the **Fishing Vessel Technologies workshop has been to make progress on the EFTP's RTDI strategy by compiling the inputs from a panel of stakeholders and experts** from different European regions, developing diverse activities and representing different particular interests. Discussion has been lead to reach a consensus on the key challenges and on how efforts should be oriented in the forthcoming years with regards to those.

The workshop took place from 6th to 7th June 2012 at the premises of the *Institute for Coastal Marine Environment (IAMC), Italian National Research Council (CNR).* A total of 28 participants from different countries and with different background disciplines and professional profiles, attended.

2. METHODOLOGY

The workshop started with a set of wellcome and introductory presentations, aiming to give attendants a broad overview of the current marine context scenario regarding strategic multi-stakeholder collaboration, public funding integration perspectives and forthcoming changes in policy and regulatory framework.

In this context, Dr. Salvattore Mazzola presented an overview of the Italian fishing industry and on the general situation of the mediterranean fisheries. He remarked a number of key areas where research and innovation yields possitive outcomes for the industry to develop and grow sustainably, going from a biology and ecology perspectives to the equally relevant economics and governance issues. He also expressed the interest of ICM-CNR to integrate and contribute to EFTP working groups and discussion fora.

Dr. Kathrine Angell-Hansen provided a wide overview of the JPI Oceans initiative. She explained its background, its aim and scope, its current status and forthcomming expectancies. She specially remarked JPI Oceans capacity to integrate outcomes from different stakeholders and initiatives related to European Marine and Maritime Research and Innovation. She remarked the crossutting approach of JPI and emphasized the common areas of interest with EFTP.

A video from Dr. Mogens Schou, advisor of the Danish Ministry of Fisheries, was played and shared with the audience. Dr. Schou focused his presentation mainly on the Reform of the Common Fisheries Policy and on one of its main objectives: the discard ban and its consequencies, making special emphasis on the transfer of responsibility to the fishermen. He presented this scenario as a great challenge but also as a great opportunnity for the fishing industry to demonstrate its capacity to tackle the issue in collaboration with the research bodies.

Finally, Dr. Adolfo Uriarte, made an overview on how funding instruments and policies relevant for the EFTP are evolving. Current prospects regarding some of the most relevant funding instruments for future of fisheries related research and innovation action were addessed. The process for the definition of Horizon2020 and the European Atlantic Ocean Strategy, was introduced as an opportunnity for the EFTP to provide inputs that can influence the orientation of priorities towards European Fishing Industry's interests.

Most specific and research and innovation related contents of the workshop were addressed in a total of four sessions focusing each of the following aspects:

1. **Multipurpose fishing vessels.**
2. **Vessel security technology and onboard ergonomics.**
3. **Effective fish handling systems.**
4. **Fuel efficiency and footprint.**

For the accomplishment of each session a key note speech was provided by a short selection of experts who provided to the audience their perspectives on future challenges, key technologies illustrating this with examples of relevant results and lessons from the past. Thus, those presentations served as starting point for further discussion.

All the attendants were invited and encouraged to a proactive and interactive discussion process that, after key note presentations comprised:

a) Group/roundtable discussions
b) Plenary discussions
c) Voting to establish final priority scores.

Group - Round table discussion was developed allowing the attendants to interact with the all the others by rotating the group members in each of the four sessions. All attendants had the opportunity to share within the group their particular views and a group rapporteur was appointed to wrap up and share the group's conclusions for plenary discussion.

Group and plenary discussion is aimed to complete, refine or point out the speaker's perspective, and to reach also a common perspective on the following aspects:

- **Necessary activities or mix of activities** to address each challenge.
- Geographic **scope** (national, regional, sea-basin…) of the activities to address to cope with each challenge.
- Most relevant **drivers** influencing the process.
- **Priority** action and **term horizon** (time for the challenges to be achieved).

A summary table used in the process to compile information on these key questions addressed is annexed.

The last stage of the process consisted in a voting process where attendants had to select from a total of 20 issues, a maximum of 9 of major priority, and using a colour code (green=5 points, blue=3 points and red 2 points), they could even score among the priorities chosen by each.

3. CONCLUSIONS ACHIEVED

The text below consists of an introduction and a summary of the round table discussion that was organised in four groups as above mentioned.

3.1. Multipurpose fishing vessel technologies

Dr. Vegar Johansen, from SINTEF, introduced his presentation with an overview on the current status of the European fishing fleet. Factors such as the limited fishing opportunities, the overcapacity and large activity outside EU waters were remarked.

From a technical perspective, one of the most relevant matters of the European fishing fleet is the diversity of technical standards. It should be deeply considered in implementing future innovations; establishing strong standards contributes to guarantee the existence of a market offering attractive opportunities for innovation uptake.

Multipurpose fishing vessels provide an opportunity to increase profitability for the sector and even to diversify the activity towards other complementary ones. One of the issues that in nowadays context gains more and more prominence has to do with the opportunity currently available technologies offer to have detailed real time information on the fishing activity. This technical context will probably open new possibilities for more flexibility in regulating the activity, making it possible that vessels use multiple gears (i.e. to cope with seasonal variations of some target catches) and even that they open time slots to accomplish different complementary activities such as marine observation, marine litter collection and sea cleaning, spills' contingency cooperation, tourism, maintenance and transport activities related to aquaculture, support to development of marine energy platforms, etc. Thus, in this context, flexible technology becomes the challenge. Multipurpose vessels should be capable to serve many of the above mentioned purposes.

There are also some specific challenges regarding the incorporation of some of these activities, for example, the involvement of fishing fleet in data collection for stock assessment and in other marine observation activities would benefit from the improvement of systems to automate the data capture and facilitate transmission.

Involving fishing crews in other activities different from fishing and fish handling, will require relevant efforts in training and skilling the crews for multipurpose work. Security requirements

must also be considered in this scenario. EU and national regulations should also encompass this process to make it feasible.

On-going experiences of multipurpose activities should be identified and benchmarked. In Norway for example it is being successfully accomplished a collaboration between fishing fleet and oil companies to involve them in transport and support to maintenance activities.

Dr. Bernardo Patti, from CNR_IAMC remarked the relevance that the broad adoption of VMS should have in the application of the ecosystem approach making feasible the purpose to integrate data from commercial fisheries in stock assessment. Enhanced VMS is considered a key technology at the present. This technology is evolving to interactive VMS and current work show how feasible it is to integrate the VMS information in complex geo-referenced decision support systems. The speaker referred two on-going projects: SSD-PESCA "Decision support system for sustainable management of fisheries in the southern regions in Italy" and the Italian flagship programme RITTMARE.

Interactive VMS integrates logbook with touch screen, GPS antenna and software tools for different purposes and geo-referenced data analysis. The project has integrated technologies to become a fisheries observation platform serving to different stakeholders and purposes (environmental and at the same time helping fishermen to operate more efficiently). CPUE estimates, for example, can be obtained and in fact the platform designed is already providing forecast maps that help collaborating skippers in their decision processes.

System includes different means to catch relevant data, a system for transmission and a land platform to process the information gathered. The pilot system has been installed in a number of bottom trawlers operating in the southern Adriatic Sea basin.

Future improvements should base on a new generation of sensors and radar technologies capable to measure and detect different environmental parameters and events (with relevance in fishing under safe conditions, i.e. surface currents, waves… and in efficiency) with high resolution, and new systems for device switching and data real time data transmission.

Discussion among participants in the workshop remarked a number of challenges that were before the end of the workshop prioritised through the voting process carried out.

Outstanding challenges:

- Implementing the ecosystem approach by using the vessel to capture data.
- Integrating the sustainability concept and multipurpose activities for the global ship design.
- Catering the ship for complementary activities like tourism, energy transport and support to maintenance activities, surveillance and support to contingency plans, litter gathering, etc.
- Develop technologies (gears and management systems for multi-gear vessels) to make feasible and efficient a multispecies catching to cope with seasonal variations.

Foreseeable changes in fishing discards regulation, the discards ban and the obligation to land all the capture, were suggested to be tackled through improvements in gear selectivity, and improvements in vessel design and adaptation of equipment to optimize storage capacity. These aspects will be addressed more deeply within the specific workshop on fishing discards. With regard to the discards' problem, Dr. Fabio Fiorentino defended with his presentation that in some areas, gear technology and selectivity measures might not be sufficiently to reduce discards and restore the ecosystems' health. He suggests that selectivity should be combined with management measures such as temporary bans in recruitment areas. He suggests that changing the exploitation patterns to more sustainable ones, is one of the most relevant aspects to recover Mediterranean fisheries.

In general, to attain the above mentioned challenges there is a good knowledge base available regarding several relevant disciplines. An integrative and applicable approach recommends enhancing and promoting works that combine available knowledge in marine ecology, oceanography and biology with advances in computer aided design, mathematic modelling, information and communication technologies, etc.

With few exceptions **there is a clear consensus that future efforts in this field should mostly concentrate in demonstration of available technologies under commercial conditions operation, and in further steps towards innovation and technology transfer.**

Most of the challenges identified would also require a support from policy action to facilitate not just the demonstration activities but mainly a feasible uptake of technologies by the industry.

Such support would require in some cases, for example to cater tourism on board, adaptations in the European, national and regional regulatory frameworks, that facilitate at the same time the assumption of risks by assurance companies… Support in other cases could comprise incentives for the fleet to facilitate investment, training incentives for crews to perform alternative activities, etc.

With regard to the scope for action implementation, most of the issues can be considered of EU and even international relevance, however regionalisation of actions would also be recommended to select possible multipurpose alternatives in coherence with the area context.

The maximum framework considered to achieve these challenges is 2020, however, and given the current available knowledge and technologies, relevant results could be available within a mid term, by 2016.

The fishing industry has clear a niche of opportunity in implementing the concept of business hybridization. Growing smart under this new business model, would definitely benefit from integrating knowledge and technology in adapting the production means, from multipurpose vessel to multipurpose business, to operate under optimal conditions and take the most from this adaptation process.

3.2. Vessel security technology and ergonomic work on board

Dr. Emilio Campana, from CMR-INSEAN, focused his presentation on vessel safety aspects and energy efficiency. Although energy aspects will be summarised at 3.4 section in this report, it was developed the idea that future vessel technologies will mainly focus on improvements of design tools and experiments for safety purposes and on greening the vessel to reduce fuel consumption for efficiency and sustainability purposes .

Navigation and manoeuvring conditions are frequently dangerous at the open sea; violent water-vessel interaction can damage the vessel structure and equipment, seriously alter the vessel dynamic stability and put the crew under extremely risky situations. The more precisely interactions can be measured and consequences predicted, the more efficient vessel designs and decision support systems will be.

Research tools to make progress in this area comprise numeric modelling, model testing and full scale trials. One of the key challenges for the future research in this area is to integrate more information about the fluid-structure interactions and its consequences, to make the models more

complex and to combine the results obtained with data from model and full scale tests. This will make it possible to improve models' prediction capacity to the possibility to introduce real operation conditions in design and predict ship behaviour and optimal manoeuvring. And further, allow a complete physical understanding on what happens to the boat in different situations. CFD-EFD integration: may help filling the gaps and improve the knowledge significantly in this area.

Key technologies to concentrate future efforts should mainly consider hydrodynamics (for simulation of stochastic environmental phenomena, to develop models capable to predict instability and capsizing risk during real operation under bad weather conditions); electroelasticity (to optimize the elasticity of the hull design) and electromagnetism (improving x-band radar systems to provide spatio-temporal information on wave fields and surface currents). The integration of research improvements in these areas, together with high computational capacity possibilities, and an approach based on design possibilities plus model testing and full scale trials, would allow significant improvements in design efficiency for safety purposes. New materials and surface treatment technologies should also be considered in addressing new and safer vessel designs.

Dr. Xabier Aboitiz, from Azti Tecnalia focused his presentation on challenges regarding safety of on board activities, not only dependant on vessel behaviour in different navigation and manoeuvring conditions, but also dealing with the special conditions of labour onboard. As far as fishing vessels are not just transport units but catching, handling, processing and storage units the relevant regulatory framework comprises not just maritime safety regulations, but also labour safety conventions and Directives. One of the key aspects to gain efficacy in developing new safety and ergonomic devices, or in introducing safety and ergonomics in on-board technologies (gears, deck equipment…) is to have a reliable base of information on accidents that allows the identification and assessment of risks. There are available risk assessment methods, but they have been developed for land conditions, considering standard tasks and labour journeys. Working at the sea is significantly different from land standards and thus, specific risk-assessment tools should be defined.

Again, having more, long term and good quality information and adequate tools to analyse it, is essential to support the decision making process on board. Software tools should be developed for this purpose, and again specific characteristics of the fleet and of the work on-board should be

considered: easy to understand and use tools, quickly processing information and providing outputs for the skipper, automatic feed of data through sensors', sensors' networks and other devices, are just some of the requirements for future development to achieve such challenge.

Outstanding challenges:

- Improving vessel stability by means of new designs based on complex modelling, model testing and full scale trials.
- Continuous monitoring of different parameters affecting ship safety, improvements in radar technologies.
- Freak wave detection and improvement of information on severe weather conditions and its interaction with the vessel's structure and devices.
- Improving the design for noise and vibration reduction and thermal control inside the vessel.
- Development of new protocols for risk assessment adapted to onboard real operation conditions.
- Monitoring dangerous aspects of on-board operations, such as gear handling.

Some of the above mentioned challenges still require significant research and development efforts to related core technologies. Namely improvements in numerical simulation and modelling, EFD-CFD integration, X-band radar and design optimisation would benefit from oriented research efforts aiming to address more complex and affordable solutions.

Available technologies should also be applied for demonstration purposes in existing vessels (i.e.: decision support systems, monitoring systems, etc.) given this should provide relevant data to speed up related research activities and better adaptation to market and real operation requirements.

On-board risk assessment and development of ergonomic workstations would also require the acquisition of some new knowledge through good quality and long term data. Risk assessment can benefit from tools developed for on land operations however specific development and major

efforts in technology transfer for implementation should be made, to yield preventive measures and decisions.

Dangerous operations, and particularly gear handling, should probably require specific research and development and innovation to provide tools that detect precisely the risks and support real time decision taking.

All the challenges are of international relevance, although the approach to the problem should consider specificities of the fleets and operation areas.

One of the key drivers constraining the improvements in this field is the lack of incentives for investment in new vessels. Thus, short and mid term possibilities would benefit from development and innovation efforts that can provide partial step-by-step improvements, nonetheless necessary to make progress towards better and safer working conditions on board.

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Research-based improvements in vessel safety and on-board security would be expected to become available technologies in the long term (10-15 years). However significant improvements in monitoring safety and ergonomic parameters, in developing decision support systems and in introducing improvements for a more comfortable life at the sea, should be feasible within a shorter term.

3.3. Fish handling and processing

Dr. Hanne Digre, from SINTEF, described the processes and factors that influence the effectiveness of on-board handling and processing and which are critical in keeping the product's quality and safety. She suggests than one of the critical changes expected for the fishing activity is to concentrate in quality rather than in quantity, contributing also in this way to sustainability.

Possible improvements in this context should branch the whole process from gear technologies, transfer fish from the sea, from the gear to the vessel, slaughtering and packaging, freezing, storage, etc. Damages caused to fish during these processes can normally be easily detected and cause serious losses to the industry.

One of the technological options suggested consists in making catching systems more gentle and keeping fish alive in tanks and then stunning before killing. Furthermore, automation of processes to obtain effective flexible processing, increased product quality and EHS (environment, health

and safety) for the fishermen is considered crucial. Flexibility should also mean possibility to process efficiently different species.

One of the promising goals is to bring the fish on board alive and keep it alive until bled and gutted. Stunning of alive catch will allow more rapid bleeding, gutting and rinsing of the fish. Electrical stunning has been identified as a fast and efficient method to render fish unconscious and insensible, this also facilitates the handling of fish by fishermen making less heavy the manual work.

Introducing these new techniques and automating the sorting and processing may demand space on board for good quality processing. A derived challenge would be to optimize processing capacity accordingly to the dimension of the vessel and the target catches. Introducing automatic processing does always yield in better product's quality. This could even be enhanced by considering the ergonomics of the processing labour-post to adapt the corresponding equipment to a safer and more comfortable design of means and processes.

There is enough evidence on the importance of keeping the fish at low temperatures along all the process, and when the aim is to freeze it, to achieve a fast freezing. Cooling and cool control technologies are determinant in some cases to estimate and prolongue, through best conservation and storage practices, the product's shelf life. Recent experiences evidence possible improvements derived from the use of slurry-ice, ozone, and others. But not all past experiences have been successful, the specie's requirements have to be studied individually, however, advantage should be taken from all the work that has been carried out in the last years. SINTEF Fisheries and Aquaculture is involved in several projects focusing on developing novel on board catch handling systems safeguarding the initial fish quality as well as the fishermen's HSE. Results from these projects will be presented to the public.

Outstanding challenges:

- Improve fishing gears for a more gentle catch.
- Gentle handling of alive fish until processing.
- Development of automatic multi-species handling systems.
- Automatic continuous processing and storage systems.

- Utilization of organic waste from processing.
- Improvements in cooling chain control and effectiveness, shelf life increase and logistics.

In general terms, in this area technologies and handling strategies are so close related that good part of the challenges could be comprised in a more generic one: “Development of efficient onboard fish handling, processing and storage systems”.

Among the key technologies determining future progress in this field automation, electronics, sensors, food processing and packaging technologies, computer aided vision, etc.

In this area there is a wide margin for improvements derived from the intensification of innovation efforts. Such could consist in activities that go from demonstration of adapted technologies to proof of concept activities, end-user validation, etc. Technologies that have been widely developed for land processing plants could yield significant improvements from their onboard adaptation.

Applied research challenges are more significant in achieving completely automatic and multi-species processing plants on board.

Making handling, processing and storage more efficient is a common need for EU fish and seafood products aiming to reach most demanding markets. Market is indeed the main key driver for the achievement of the above mentioned challenges. It is needed also to encompass technology development with market and consumer awareness actions to help consumers appreciate the benefits of the product and of the production process. Labelling is considered another important support element to differentiate the product and the fishing activity itself. Available technologies nowadays allow prospecting significant improvements no later than 2015.

Although most of the above described can be considered to be applicable to fish and disposal products (organic waste from gutting), and although a large amount of projects has been carried out in the last years, to get value from organic waste products in fisheries, there is still effort to do in stages more near to market uptake.

3.4. Fuel efficiency. Fisheries' carbon footprint reduction.

Contributions to this topic were provided with regard to four main aspects: efficient vessel design and equipment, gear technologies, analysis of energy use through energy audits and decision support systems.

Dr. Antonello Sala, from ISMAR-CNR, remarked the current relevance of fuel costs for the catching sector, representing, in average, 55% of the total running costs. Improving profitability ratio depends strongly on the possibility to reduce energy consumption as far as increasing the amount of catch is not a presumable scenario and fishermen's possibilities to influence the prices is kept low.

Energy audits can help establishing the baseline to implement measures for fuel consumption reduction, as far as they consist in systematically approach the evaluation of energy consumption in fisheries. Many factors influence the energy consumption in a vessel and the variety of fleets and technical standards makes this analysis a complex process.

One of the key aspects to consider is the selection of instruments that should be used to measure energy consumptions in a vessel. Current work has been performed at ISMAR to determine what the main energy consumers are in a fishing vessel, which are the best instruments for measuring, and how far consumption patterns differ among different kinds of vessels. This has provided some evidence on the adequacy of the instrumentation used (acoustic fuel meters, torque meters, oil flow and pressure meters, Ammeter claws, strain gauges, GPS and gear monitoring systems) and on the measurements taken. One of the challenges was to integrate these elements in a common system to systematically record consumptions and facilitate the post-processing of information.

Results also recommend to use a series of indicators for comparison such as power delivered, fuel consumption, total towing force and vessel speed.

The research carried out suggests that some inefficiency come from obsolescence of designs and devices. Some improvements can be achieved from retrofitting, however, in the future, energy efficiency will have to be better considered in fishing vessel's design. It can even be expected that Energy Efficiency Design Index is also applied to fishing vessels.

The work also evidenced that audits are crucial to determine an energy efficiency strategy and to identify the areas for improvement.

In general, it can be said that relevant savings can be obtained from using navigation with controllable pitch propeller, from optimizing the routes (if weather and environmental information is also considered) and from strategically reducing speed.

Development of fishing gear technologies can also play a key role in energy efficiency. Gear design and improvements in otterboard can also yield significant improvements. Again, it is crucial to use different measuring technologies (distance, tension, pitch and roll sensors…) and the analysis strategy should consist in comparing traditional designs with new ones operating under full scale commercial conditions. Computational simulation could also benefit from exhaustive data from experimental field trials, making a good alternative for future estimates if models can be optimized, thanks to current efforts in field trials.

Dr. Zigor Uriondo from AZTI, emphasised the idea that currently available vessels were built when fuel prices where significantly lower than today, and that far, energy efficiency was not given enough relevance.

Energy consumption reductions can be expected from technical improvements but also from operational changes. Technical improvements are restricted by the low expectancies on a short term fleet renewal. Consumptions profiles are different for different kinds of ships and it is not evident the optimal-feasible solution in each case. Derived from this variety of fleet it is also that new sources for energy could be considered but it has to be considered the different needs; propulsion, generation vs. consumption. Then improvements should be addressed differently, one issue is new generation systems and propulsion and another is reducing consumptions.

Specialised and independent energy audits can recommend feasible improvements.

Optimal results could only be expected by stressing the need to improve new vessel designs to integrate in it a proper approach to energy efficiency.

Improvements in generation and propulsion will come from alternative prime-movers, heat recovery systems, alternative energies and fuels. Small changes in equipment and onboard devices including efficient fishing gears are the key areas for improving the carbon print through lowering fuel consumption of the current fleet.

Dr. Karl Johan Reite, from SINTEF, points out that the amount of information to be considered in taking decisions to optimise the efficiency of the activity, and in particular the energy efficiency of the fishing ship, is great and complex. A more systematic approach to the decision making process is required. He divides the types of decisions into operational and design decisions. He further establishes three operational decision levels: strategic, tactical and immediate. The

operational decisions will affect the vessels's energy efficiecy within the constraints given by the design decisions. Decision support systems can be developed to help both, design and the three levels of operational decision. In its most simple form a decision support system may provide the operator with better information. The second step would be to make the operator able to perform 'what if' analysis, and the third step to give the operator direct advice with respect to what to do. For the second and third step, simulation of the process to optimize would be needed, making simulation of the fishing process a necessary goal.It would be of great benefit to all if there is a strong commitment to exchange experiences and information and to open access to experimental data, to enforce and fasten technological development and its impact.

Outstanding challenges:

- Standardise fishing vessel energy efficiency measurements and measuring devices for energy monitoring and decision support systems.
- Develop energy monitoring and decision support systems
- Develop tools to aid the design of more energy efficient vessels.
- Development of alternative energy propulsion and generation systems.

Research within future fishing vessels design, should specially focus on energy efficiency with respect to design, building materials, equipment, etc. The lack of knowledge about vessel behaviour during operational conditions is also an important issue that should be addressed.

Development can be achieved to register data of different nature that influences the energy performance of the vessel and integrate this data in a decision support system. Computing techniques should be considered in this to let the system learn from past and predict future scenarios.

Energy efficiency and reducing fisheries' carbon footprint is a global problem, so solutions should come from a Pan-European scope of actions. Apart from the facilitating and speeding effect that incentives derived from policy action could have, it is a key driver to work with fishermen in training them to understand and manage the energetic aspects of the work onboard. Decision support systems which are easy to use can be of much to their users for reducing energy consumption.

4. RESULTS OF THE VOTING PROCESS

From all the above explained, workshop attendants had the chance to vote among a total of 20 issues (key expressions referring to the outstanding challenges). From the total list of issues, the following nine aspects concentrate 71% of the total votes (450 of 636):

Challenge descriptor for the voting process	N0. of votes
Implementing the ecosystem approach by using the vessel to capture data	69
Integrate sustainability and multipurpose activities in the global ship design concept	68
Improve energy efficiecy of fishing vessels	47
Managemet systems for real-time energy optimization	47
Modify vessels to catter for tourists on board	46
Improving the design for noise and vibration reduction and thermal control	45
Fishing gear technologies (for energy efficiency)	45
Development of efficient fish processing and handling systems	45
Improving gear selectivity	38

ANNEX 1

Participants

Name	Surname	Organization
Xabier	Aboitiz Goitia	AZTI TECNALIA
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Angelo	Bonanno	IAMC-CNR
Guiseppa	Buscaino	IAMC-CNR CAPO GRANITOLA
Emilio Fortunato	Campana	CNR-INSEAN
Angela	Cuttitta	IAMC-CNR USO DI CAPO GRANITOLA
Hanne	Digre	SINTEF FISHERIES AND AQUACULTURE
Torgeir	Edvardsen	SINTEF
Rosa	Fernandez	FUNDACIÓN CETMAR
Francesco	Filiciotto	IAMC-CNR
Fabio	Fiorentino	IAMC-CNR
V. Maximiliano	Giacalone	CNR-IAMC
Vegar	Johansen	SINTEF
De Boer	Louwe	EKOFISHGROUP
Salvatore	Mazzola	IAMC-CNR
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