Back-casting foresight exercise for feeding Strategic Research Innovation Agendas

Pier Francesco Moretti, National Research Council of Italy

12th February, 2018

INDEX	

1. The identification of priorities in Strategic Research and Innovation Agendas

1.1 CONSULTATIONS, ANALYSIS, AGENTS, DECISIONS: A COMPLEX PROCESS

The process which usually drives governmental decision-makers to adopt strategic agendas follows well established procedures and initiatives. Usually, a legitimation of the decisions as input consists of a **consultation** with those stakeholders considered relevant. Regulations, obligations, restrictions and other aspects are analysed as socio-economic-political **drivers and constraints**.
When dealing with trans-national initiatives, as JPI Oceans, the analysis of different interests and national priorities bring additional aspects which have to be taken into account to identify common agendas. In this context, a sort of agent-based interaction occurs, which involves roles, influences, interests and personal capacities of negotiators (Bonabeau E., 2002, PNAS, 7280; Abar S. et al., 2017, Computer Science Review, 24, 13).
Consensus is considered a legitimation as output of the definition of a strategic agenda.
Seas and Oceans address an enormous complexity, in terms of environmental aspects, stakeholders, economic sectors and responsibilities. This complexity usually results, at political level, in a **compromise** or in a selection of very few **priorities**, which are at the two extremes of decisions to guarantee stability or to tackle emergencies.
The content of strategic agendas reflecting this process towards consensus are usually addressing a **wishing list or enabling aspects**, as a menu or basic ingredients of a restaurant.

1.2 THE CHALLENGE OF MATCHING AGENDAS AND ACTION

The aim of a Strategic Agenda is to define what objectives have to be achieved and what aspects need to be addressed to tackle the challenges. The Strategic Agenda then guides an implementation plan of activities aimed to solve specific problems or enable the structuring of the system in a way to evolve towards the desired direction.
The feasibility and impact of actions that are defined by a Strategic Agenda have to be evaluated. In the case of trans-national cooperation and with a variable geometry approach, different stakeholders participate to what they consider relevant and contribute with their capacity.
This approach can increase the effectiveness of joint actions, but the identification of priorities for adopting decisions is usually driven by contingency or momentum triggered by a specific interest.
Since the impact of joint actions, especially at the level of trans-national research and innovation, is very difficult to predict and evaluate at larger and longer scales, it is difficult to **stimulate decision-makers to launch high risk investments or initiatives**, where the accountability of efforts has to be balanced by the probability of success. So, feasibility becomes a very strong aspect which dominates the decision.
This implies that opportunities are needed to make decision-makers and other stakeholders (including researchers) jointly reflect on what are the fundamental questions and what is really missing to tackle the challenges.

1.3 A CHANGING SCENARIO IN THE P2P: TOWARDS MISSION-ORIENTED ACTIONS

Public-Public-Partnerships (P2Ps) are usually associated with several transnational cooperation initiatives between public funding bodies, both through tools (see ERANET COFUND, EJP, article 185 TFEU) and processes / programs (JPIs , Research Alliances, FET Flagships, etc.).
The most visible and attractive aspect for the research community is usually the launch of calls to support research projects, but there are several ways in which actions can be taken (see eg http: //www.jpi- oceans.eu/types-actions). Often, the European Commission is contributing funds to these initiatives with the use of the tools at its disposal.

In view of the forthcoming Framework Program, FP9, the Commission is reviewing its strategy to support these initiatives, with some considerations:
- in principle, it is the countries that decide on the themes on which to join their efforts, even though scientific communities are those who lobby on funding bodies to launch calls;
- there is a large fragmentation between the various initiatives, often overlapping, and with considerable disparities of investments;
- it is very difficult to assess the impact of these initiatives, especially when they face major social challenges;
- there is some difficulty in participating in some of the initiatives related to the respect of the Union's rules (in the case of non-EU countries) or lack of funds to be allocated on calls.
The GPC (the board involving EU Member States and Associates Countries aiming at addressing joint programming) and many P2P are reflecting on the future of P2Ps and how to increase the coherency and effectiveness of the actions to achieve the goals they defined.
In this context, the concept of “missions” has become an inception, aiming at shifting the perspective to a more impact-driven approach.

The Joint Programming Initiative Healthy and Productive Seas and Oceans (JPI Oceans) deals with a complex system in terms of topics, participants and joint actions. Within the many strategic areas identified by JPIO, different typologies of actions can be proposed for a possible large diversity of applications. For this reason, most actions are planned and prepared on a case-by-case basis, allowing for variable geometry and promoting an inclusive and integrated approach to reach the objectives.
These diversity and complexity can be perceived as dispersive and not effective, addressing for “Seas and Oceans” the characteristics of an “environment” and not of a “challenge”.
As an example, when the GPC has reflected on possible grouping of the large European P2Ps into main challenges, JPIO has lost its identity and spread as contributor to other challenges. In addition, when dealing with the well recognized 17 Sustainable Development Goals identified by the United Nations, only one addresses a “pure” marine goal and specifically to marine bio-resources, while JPIO aims to tackle a broader range of goals.

1.4 THE CONCEPT OF "MISSIONS" AND THE ROLE OF FORESIGHT

Many definitions can be addressed for the concept of mission.
In the research policy context, a **mission** contains the following main aspects: it is a large project or a group of projects to reach a challenging goal, preferably identified by measurable intermediate deliverables. In order to impact and get the appropriate visibility, it should simultaneously address outcome, time-frame and investments.
It is also desirable that a mission would significantly enhance the acceptance of civil society and increase the visibility of the European research, implying that visibility and comprehensibility should be adequately taken into account in its identification.
A mission should fulfil some key requirements, such as (see www.fraunhofer.de/content/dam/zv/en/Institutes/international/brussels/finalpapers/Fraunhofer-FP9-missions.pdf):

- target a goal of transformative nature for European society and its economy,
- target a goal that is not yet (sufficiently) addressed on an European level,
- target a challenge that none of the Member States can tackle on its own,
- target a purpose that spurs support and enthusiasm in Europe's citizens,
- benefit, also economically, the whole of Europe,
- trigger additional funding by member states and industry ("buy in").

To better explain what is expected as a mission, an example freely elaborated from what has been debated in some meeting between JPIs can be useful, as follows:
Scenario for the Mission: CO2 Zero-emission cities, that is, a future where cities will not impact on climate change and will reduce drastically the negative impacts on human health.
Components: Materials, Artificial Intelligence, Green Energy, Urban Farms.
Deliverable: interconnected zero-emission building.
Synergies: JPI UE, JPI CH, AAL, Set Plan, EIP SSC, ESIF, ETP construction etc.
JPI Urban has broader goals, addressing the agglomeration societies, but the complexity has been first limited to a relavant aspect (CO2 impacts) and then scaled down through a "minimal cell" (the building) constituting the organism (the city), which indeed is flexible (adaptable to geography, culture etc.), comprehensible and measurable.

Foresight is usually referred as the ability to predict what will happen or be needed in the future, to support decisions and to plan actions.
There are many different approaches which can be adopted in the foresight exercises, which can address, with different relevance, four main aspects: creativity, expertise, evidence and interacton (Popper, R., 2008, Foresight Methodology, in Georghiou, L., Cassingena, J., Keenan, M., Miles, I. and Popper, R. eds., The Handbook of Technology Foresight, Edward Elgar, Cheltenham, pp. 44-88).
Two methodologies can indeed be adopted as forward looking and the back-casting, and both can use many different "tools" in their process. The first (forward) mainly starts from evidence, using models, horizon scanning, delphy, expert panels. The second (backward) can start from strategic creativity, then involving expert panels, wild cards, delphy etc.
It seems clear that, when trying to support the identification of a mission, and to match its characteristics, the backward methodology for foresight is the more appropriate.

2. A "back-casting" foresight exercise to support mission-oriented actions

2.1 THE APPROACH

In order to support the identification of long-term mission-oriented actions with a clear identity for Seas and Oceans, and feed the process for the update of the SRIA, a foresight workshop to reflect on possible options of visible, public-comprehensible and measurable missions is organized integrating "genius speeches" (intuitive visioning) and "face-to-face" (opposing visions) experts panels. "Visionary transformation scenarios" for marine and maritime challenges will be addressed, for identifying the different components, with scientific and technological paths to reach those scenarios.
The outputs of the workshops consists in the analysis and report to the Management Board of JPIO, with further eventual event for dissemination or publication.

Three scenarios have been selected for Seas and Oceans and other aspects preliminary suggested as follows. These scenarios are not independent each other and can address cross-cutting aspects.
Proteins from the Seas and Oceans, that is, a future where the nutritional protein support from seafood to a global growing population is ensured.
Components: Microbiome, Chemical Synthetic Biology, Blockchain, Ecosystem approach, Aquaculture, Overfishing, FET Photosynthesis, Nutrition and Safety.
Deliverables: zero-impact (input-output, energy, pollution etc.) cage/fish tools, labs + marine protected areas for ecosystem augmented monitoring, global monitoring of catches, blockchain for EU seafood safety.
Space-Ocean, that is, a future where the sustainable use of the marine space is enabled for automated human activities.
Components: Automation, Underwater Communication, FET Quantum Technologies, Machine learning, 4d Materials, Cabled Seafloor Technology, Security & Surveillance, Augmented Observatories, Essential Ocean Variables.
Deliverables: Underwater Internet, Long-range AUV, bio-sensors, 4D materials.
A Green-Blue Planet, that is, a future where Seas and Oceans are environmental friendly, with zero impact from human activities.
Components: Nature-based Packaging, Green Vessels, New Materials, CO2 recycling, Mining, nano-to-macro manufacturing, Energy from the Ocean, Pollution Remediation Techniques, Risk Management, Economy.
Deliverables: nature-based solution for packaging, zero-impact vessel, phagocytosis-inspired remediation tecnologies.

2.1 THE EXERCISE FOR JPI OCEANS ON MARCH 15, 2018

Three genius speakers far from the marine community are invited to provoke the discussion:
- one addressing how the conquest of space enabled activities on land, so what were the main driver and scientific/technological disruptive innovations which impacted the most,
- one addressing the nutrition and production of food in space, in particular how matching efficiency, effectiveness and wellbeing of astronauts,

- one addressing the planning of long-term infrastructures which activities at anf for the sea, as cruise ships or floating islands, where the land-sea interaction is crucial within a zero-impacts approach.
Approximately 30 experts from different aspects (named components in the description of scenarios) are also invited to debate in Brussels on the validity/feasibility of the scenarios, additional components and deliverables, addressing the main scientific/technological gaps to achieve the deliverables and the feasibility to fill the gaps. A selection of MB representatives have been asked to join in order to participate the brainstorming and transfer to the MB enlarged context.

In order to brief and bring the participants up to speed into the three scenarios, a "**back to the future newspaper**" is prepared, where news have been created for 2038 and the agenda and rationale of the event are included (see annex).

2.1 PROS OF THE IMPACTS AND CONS IN THE ORGANIZATION

The main advantage of a back-casting approach is the characteristic of **stimulating creativity and reducing the competition** between the participants. In fact, participants are asked to debate and focus on something that is unachievable at the state of the art, so without any evaluation of feasibility of actions. Indeed, it makes little sense for participants to present what they do or wish to do. The interaction between **different disciplines**, sectors and interests can make weak signals emerge and different points of view to identify the relevant aspects of the challenges. The aim is to **enable a translation from socio-economic-political missions into scientific/technological ones**. As an example, a typical backcasting exercise on a visionary scenario for manufacturing and materials has recently identified few and fundamental issues to be addressed at the research level which are rarely promoted as priorities for funding (see www.foresight.cnr.it/materials*)*.

There are many challenges in organizing a backcasting exercise.
The first is the identification of the participants and their number. They have to be **motivated** to join something new where the win-win factor is difficult to be identified at personal level. So, the preparation of **background documents, interaction and face-to-face briefings** are fundamental to make the participants aware of the objectives and roles. Usually, the opportunity to meet experts in a multidisciplinary context and the **innovative experience is a matter**, but strongly depends on the personal attitude of the invited expert and the capacity of the organizers to present the initiative.
For this reason a bouquet of experts and "plan b" has to be addressed in the organization.
Another aspect to be taken into account is the selection of questions to guide the debate. Moderators are also crucial in avoiding the debate to fly too high into philosophical aspects which can distract from reflections which can be useful and not trivial, or to make the experts respect timing and focus.

3. ANNEX 1: The “back to the future” newspaper

0.024€

The Blue Observer

Thursday 15 March 2038 - N°135 - www.jpioceans.eu

Editor: Pier Francesco Moretti - **Contributors**: Willem De Moor, John Hanus and Tom Redd

Lab Grown Fish Production Overtakes Aquaculture

ATHENS- Cultured fish overtook aquaculture production in Europe for the first time in 2037, according to the European statistics agency Eurostat. The consumption of in vitro fish has been steadily increasing over the last two decades thanks to several technological breakthroughs, consumer acceptance and affordability.

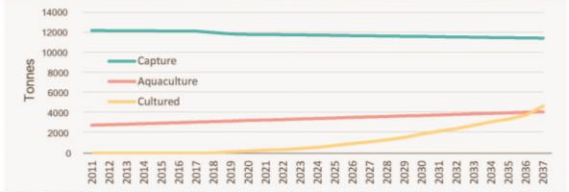
First pioneered in the mid 2010s, mainstream acceptance has steadily increasing due ethical and food safety concerns. In many respects, 2037 was a watershed year for in vitro fish products with many celebrities endorsing the CleanMeat Diet, which promotes cultured meat as a safer, more sustainable and ethical alternative to wild and farmed sources. A spokesperson for Clean Meat International Mersella Fernandes recently stated that “there has been a growing public recognition on the cognitive and emotional lives of nonhuman animals, including fish, which has led to an increasing demand for non-animal proteins”.

Prices for in vitro meat have continued to fall with 2032 marking the first time that the price of cultured filets of tuna, salmon and cod fell below that of wild and farmed alternatives. Traditionally, cultured alternatives of complex fish products such as these have been prohibitable expensive, but the introduction of FishX’s RepliFish 3000 has revolutionised production and seen costs fall dramatically.

However, the industry has recently been accused of anti-competitive practices and the concentration of food production. In response to this, the visionary founder and CEO of FishX, Tom Redd, last month announced that his company would create an open source licence for the RepliFish 3000 production unit.

While producers have traditionally focused on replicating natural species, a number of new companies have started offering products combine the qualities of different fish to produce a hybrid.

Asked if he thought if that in vitro production would one day completely replace wild and farmed fish, Mr Redd responded quoting the Nobel laureate Nils Bohr: “Prediction is very difficult, especially if it’s about the future”.



Top: Spot the difference: Cultured vs Natural Salmon fillet. Bottom: Fish production data Production data (Eurostat)

SEA-Express delays underwater deliveries

DAKAR- The increase of population of marine mammals after the controversial decision at United Nations is bringing unexpected impacts. A whale hit a pelagic-satellite with temporary damages to underwater communications in the South Atlantic. The control of the 20m depth route between Dakar and Miami is now supported by the Agulhas constellation with reduced capacity. Most of the up to 5 Kg goods from America to Africa are delayed but Sea-Express reassured clients to restore the situation within a week.

Continues page 3

AUV Circumnavigate the Globe on One Charge

LISBON- A European Autonomous Underwater Vehicle (AUV) has completed the first global ocean circumnavigation using only stored energy. The vessel was able to complete the global circumnavigation by using a highly efficient biomimetic propulsion system, which mimics the biology of migratory marine species; coupled with a newly developed bio-battery, capable of storing energy at much higher densities than traditional graphene batteries.

Prof. Lekkas, who led the European Ocean Agency project, stated that this achievement was made possible by bringing together experts from fields bi-omimetic, energy storage and underwater navigation.

Continues page 6.

WEATHER

Hurricane Kathrine dispersed the Azores offshore algae culture. Container carriers have been reprogrammed to refuel at the Atlantic-VI floating city. The intensity of hurricanes continues to pose a risk to surface transportation. Forecasting weekly extreme events remains unreliable.

SPORT

Controversy builds around the decision to allow Human-AI teams to compete in hydrosailing in the 2040 Olympics.

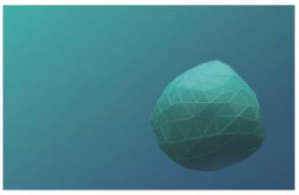
POLL

Should Human-AI teams compete in the olympics?

58% Yes

42% No

Self-assembling cages deployed in Mariana Trench



MO’OREA- Last week the Pacific Dredging Association deployed the last of the self-assembling chain of cages licensed by the Global Catching Authority. The challenge to place this advanced artifact on the 11Km deep seafloor has been successful thanks to the new generation of self-assembling anti-fouling materials. They are deployed as a 100m long wire and change their shape as a function of pressure. Last decade chances failed due to the low salinity whose dynamics was unknown and which was not taken into consideration in the modeling. This made quotations of the 5 harpoons restaurants rocketing: deep-sea unique crabs have been already booked for special recipes. Rumors say that the Mermaid Gourmet at the capital of the Polynesian Floating Federation of Cities has invited last crowned heads.

“Bluebeard” hacker’s collective captures swarm of autonomous ships

MADRID- The collective is demanding a ransom for the release of the ships which they have seized off the coast of Portugal, the European Union anti-cyberpiracy operation announced late on Tuesday. A spokesperson of the collective said the amount of ransom demanded was intended to finance marine conservation efforts.

Monday’s hacking was the first such seizure of a large swarm of commercial vessels since 2035. It came as a surprise to the global shipping industry as online cybersecurity measures of Nato countries, as well as China, India and Iran, had suppressed hackings for several years. However, the United Nations warned in October that the situation was fragile and that several collectives “possess the intent and capability to resume attacks”. One expert said some had let down their guard as the situation calmed.

Quantum technologies hacking the market of food?

ROME- The bass at the 3D-food store are bright blue and look delicious, but how do you know these tablets are actually safe for you to eat and antibiotic-free? Since blockchain being used to improve consumer confidence in food safety, you may see another label joining the growing list on your favorite blisters of proteins. The Mediterranean Aquaculture Corporation announced the certification of its products by IBM via the introduction of quantum communication in the transactions. Consumers react positively but competitors are worried: who can control the quantum communication?

Today - 15 March 2017...

JPI Oceans Backcasting Foresight Workshop

Brussels – (Kowi, CNR, Helmholtz premises) – Rue du Trône 98

RATIONALE

In recent years, the socio-economic system has faced an increasing number of pressures, challenges, and actors creating a complexity which is hard to tackle. Complex systems are characterized by the difficulty to make accurate predictions on their evolution which can result in abrupt changes, faster than the capacity to adapt and resile. In this context, a knowledge-based support is required, but the ability to foresee the future is a difficult task.

The act or ability to predict what will happen or be needed in the future is usually referred as "foresight" and despite different methodologies can be adopted, their ultimate goal is to support decisions. A Science and Technology Foresight, while driven by societal, political or economic needs, can address scenarios or solutions, eventually identifying breakthrough technologies to tackle the challenges and proposing research and innovation paths.

In the process towards the definition and launch of the Ninth Framework Program of the European Union, a reflection at European level on the role of research and innovation in support to policy is urgently needed, especially when dealing with complex systems as those addressed for Seas and Oceans.

The Joint Programming Initiative Healthy and Productive Seas and Oceans (JPI Oceans) is an intergovernmental initiative launched by the Council of the European Union in 2011. It provides a strategic policy platform for a long-term European approach to marine and maritime research and technology developments. JPI Oceans is registered as an international non-profit association under Belgian law (JPI Oceans AISBL) and its office is located in Brussels. JPI Oceans currently brings together representatives from ministries and research funding agencies of 21 European countries, covering all European sea basins. The workshop, framed in the Horizon 2020 project CSA Oceans 2 whose objective is to support JPI Oceans in its activities, aims at debating research and innovation paths needed to address marine and maritime missions. Three missions have been identified as scenarios for a back-casting approach:

Proteins from the Seas and Oceans, that is, a future where the nutritional protein support from seafood to a global growing population is ensured.
Space-Ocean, that is, a future where the sustainable use of the marine space is enabled for automated human activities.
A Green-Blue Planet, that is, a future where Seas and Oceans are environmental friendly, with zero impact (pollution, CO_2, noise etc.) from human activities.

These three missions are not independent ofeach other and can address cross-cutting aspects. Participants are invited to discuss different visions, research gaps and impacts of breakthrough innovation. The outputs of the workshop will support reflections at policy level on options and/or new ideas for tackling some global challenges for Seas and Oceans.

Experts have been identified from different sectors and initiatives, often not directly related to marine and maritime aspects. They are asked not to speak about the past or the present, but to contribute, without any prejudice or lobby, to a proactive interaction for debating the validity of the scenarios, essential components and feasible deliverables, the main scientific/technological gaps to achieve them.

AGENDA

10:00 – 10:15	The Foresight excercises to support JPI Oceans (Jan-Stefan Fritz - KDM)
10:15 – 10:30	Setting the Scene/Chair (P.F. Moretti - CNR)
10:30 – 12:00	Genius speeches for the three scenarios, addressing the state of the art, the main challenges and the EU role (TBD, 25min each)
12:00 – 12:15	What's in the afternoon (TBD - CSA Oceans 2 partner)
12:15 – 13:00	Lunch
13:00 – 13:15	Transfer to parallel sessions (Kowi 8th floor, CNR 5th floor, Helmhotz 6st floor)
13:15 – 15:45	Face-to-face experts parallel sessions on the back-casted scenarios, addressing possible components, deliverables, synergies, risks at EU level
15:45 – 16:15	Coffee break and transfer to plenary (Kowi 8th floor)
16:15 – 16:30	Wrap-up of the parallel sessions (Rapporteurs)
16:30 – 17:00	Discussion and conclusions

Last Plastic Particle in Ocean Disappeared

The World Ocean Agency (WOA) informed on Saturday that it had lost track of the last known particle of plastic in the sea. President Ricky Santos Jr. told press that the WOA's Global Ocean Observation System had last recorded the position of the nano-sized plastic particle at around 5400m depth in the Southern Ocean before it suddenly disappeared.

The WOA could not yet confirm the reason for the sudden disappearance; however, scientists believe that a rare jellyfish was the likely cause. Prof. Andy Boath, Director of the JPI Oceans OceanPlast Programme, the world's longest running research programme on plastic pollution of the seas asserted that a mutated form of the Frank Zappa jellyfish had probably ingested the particle: "The Phialella Zappaesque is one of the only organisms that feeds on plastic polymers and some of the last specimens of this endangered species are known to live in the Weddell Sea".

Plastic pollution was once one of the most damaging pressures on marine ecosystems, which decimated a number of marine animal populations. During the peak of the marine plastic pollution in the mid-2020s, the Phialella Zappesque became the first organism to develop the ability to eat plastic. In the years that followed, the jellyfish population grew to an exponential scale and became a real plague in many tourist hotspots.

Following the move to a complete global circular economy in 2029, which cut the leak of new plastics into the ocean to zero, the amount of plastic in the ocean reduced steadily. With its main nutrient source declining, the jellyfish species population also gradually declined and can nowadays only be found in certain remote areas of the ocean.

Mussels of the future: who takes the royalties?

ATHENS- Genetic engineering has always been cause for debate. While at the beginning of this century the main struggle was focused on the ethical ramification of synthetic biology and social consequences, some evolution was not predictable. In fact, the procedures for improving the cultivation of vegetables and animals for food production, resulted in a higher probability of natural mutation in some organisms. A new type of mussels appeared, which seems to be more resistant to diseases and reduces the use of antibiotics. The debate is no more ethical: is this is a spontaneous new species available on the planet, is it a product of the food industry, or is it the property of the Greek farmer, as the first who discovered? Scientists argue that in the time it will take to solve the legal issues the super-mussel might be an invasive species in the Mediterranean.

Continues page 3

Salmon skin pizza crust. Even Italians like it!

NAPLES- The increasing request of seafood for its nutritional contribution to a healthy diet has struggled to match the demand for gluten-free pizza. Salmon skin, after years of recycling for packaging, has been synthesized in a flour which can supply the new generation of 3d-food printers. Most of the customers say they do not recognize the difference, and the Italians claim that "creativity should support the ingredients to make the difference"!

Continues page 4