

MORE INTERDISCIPLINARY RESEARCH

FOR BETTER MARINE POLICIES IN PORTUGAL

Catarina Grilo



Calouste Gulbenkian Foundation

Gulbenkian Oceans Initiative

Francisca Moura, Catarina Grilo, Filipa Saldanha, Gonalo Calado

oceanos@gulbenkian.pt

+ 351 217 823 000

Author: Catarina Grilo

This policy brief was produced in the context of the research project "The Economic Valuation and Governance of Marine and Coastal Ecosystem Services", a project supported by the Gulbenkian Oceans Initiative within the Calouste Gulbenkian Foundation and developed by the NOVA School of Business and Economics and by the Centre for Environmental and Marine Studies (CESAM) at University of Aveiro. It also had the support of the International Centre for Policy Advocacy (www.icpolicyadvocacy.org).

Contacts

Catarina Grilo

Gulbenkian Oceans Initiative, Calouste Gulbenkian Foundation

cgrilo@gulbenkian.pt

+ 351 217 823 000

Acknowledgements

The author wishes to thank: FCT for providing anonymised data on its 2014 call for project proposals in all scientific areas; Carla Domingues (F3rum Oceano – Maritime Economy Association), Gonalo Carvalho (PONG-Pesca – Platform of Portuguese NGOs on Fisheries), Henrique Cabral (MARE – Marine and Environmental Sciences Centre), and Miguel Sequeira (DGRM – Directorate-General for Natural Resources and Maritime Safety and Services) for their statements; Antonieta Cunha-e-S3 (Nova School of Business and Economics) and Henrique Queiroga (CESAM/University of Aveiro) for their insights and comments.

Proofreading: Catarina Espirito Santo

Graphic design: Formas do Poss3vel, Creative Studio

Print: Jorge Fernandes, Lda.

150 copies

Lisbon, September 2017

In partnership with



Interdisciplinary research (IDR) combines knowledge from two or more disciplines and is better suited to provide solutions to complex societal problems. IDR is therefore as able to return to society the investment made by taxpayers as single-discipline research. However, IDR is not sufficiently promoted by most stakeholders in the science community: researchers, research centres and universities, and science funding agencies.

A large maritime nation such as Portugal could greatly benefit from more interdisciplinary research that informs marine policy, especially considering that the maritime areas under its jurisdiction are expected to increase from 18 to 40 times its land area.

Several recommendations are made to different stakeholders to promote IDR within their differentiated mandates and responsibilities. In particular, three courses of action are proposed that represent increasing degrees of commitment from stakeholders and can be adopted progressively:

- (1) A pilot call for IDR projects on marine issues;
- (2) A complete overhaul of the calls for projects at FCT to better accommodate IDR;
- (3) A long-term interdisciplinary research program to support marine policy.

1. Interdisciplinary research:

WHAT IS IT AND WHAT DOES IT DO?

The oceans-related challenges that Portugal faces are complex in nature – climate change caused by multiple agents at a global scale with local impacts; marine pollution generated mostly by land-based sources; conflicts arising from multiple and often incompatible uses of maritime space; use of destructive fishing gears, overfishing and illegal, unregulated and unreported fishing; the need to optimize the location of marine renewable energy infrastructures – just to name a few.

Such complex problems can only be approached from multiple, sometimes competing, perspectives,ⁱ and may have multiple possible solutions. Finding solutions to these problems requires not simply the combination, but the integration of different disciplines into something new. This approach to scientific inquiry is known as **interdisciplinary research (IDR)**.

“Interdisciplinary research is a mode of research by teams or individuals that integrates information, data, techniques, tools, perspectives, concepts, and/or theories from two or more disciplines or bodies of specialized knowledge to advance fundamental understanding or to solve problems whose solutions are beyond the scope of a single discipline or area of research practice.”ⁱ

The solutions that IDR can offer to complex problems can be evaluated according to how and when they meet their initial objectives. This contribution of IDR to solve societal problems provides further evidence of how science can improve society. At a time of intense competition for science funding, and when scientists are more aware of the need to communicate research results to a wider public, informing public policy through IDR may be a step into greater support for public funding of science from decision-makers, practitioners, and citizens.

In the context of this policy brief, interdisciplinary research refers specifically to approaches that integrate disciplines from different scientific domains (e.g., Natural Sciences vs. Social Sciences and Humanities), and therefore distinct approaches within a single discipline are excluded.

In tackling oceans-related problems, multidisciplinary research can bring together expertise on how the marine environment functions and on how people behave (collectively and individually) towards it. However, only interdisciplinary researchⁱⁱ is able to improve our collective understanding of the interplay between the two.

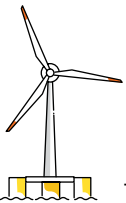
The Gulbenkian Oceans Initiative (GOI) funded the interdisciplinary research project “The Economic Valuation and Governance of Marine and Coastal Ecosystem Services”, focused on the study site of Peniche-Nazaré located in the western coast of Portugal. Over 2 years, this project produced new scientific knowledge resulting from the combination of natural sciences (biology, ecology, environmental engineering) with social sciences (economics), and made policy recommendations to decision-makers.

“Ask someone to tell you the story of the blind men and the elephant, and they’ll tell you a tale of six men, each of whom touched a different part of an elephant, unable to see what their hands were resting on. Asked to describe what they had touched, the man who felt the side of the elephant said, “I touched a wall”, and the man who felt the elephant’s tusk said, “I touched a spear”. The six men argued among themselves – was it a snake, a cow, a piece of rope? Only when they worked together, sharing their different ideas and experiences, were they able to discover the truth.”ⁱⁱⁱ



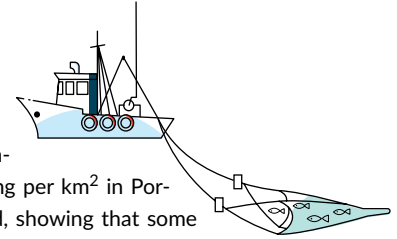
Example 1: the giant wave of Nazaré

The giant wave of Nazaré was for centuries seen as extremely dangerous for navigation and fishermen. Recent evidence from the GOI-funded research project suggests that the municipality-led media campaign had a considerable impact on the local economy, decreasing seasonality and possibly benefiting adjacent municipalities. Also highlighted is the need for neighbouring municipalities facing similar challenges to avoid wasting resources through competition. This research – combining **economics** and **local planning** – is valuable not only for Nazaré, but also to other municipalities seeking to promote their local features for tourism purposes.^{iv}



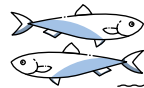
Example 2: marine renewable energies

The economic viability of marine renewable energies in Portugal was assessed from two points of view: that of the private investor (i.e., focusing on private costs and benefits), as others have done before; and that of the social planner, who also takes into account the externalities associated with marine renewable energies (emissions savings, landscape impact and artificial reef effects). The economic model developed shows that offshore wind energy may be economically viable as early as 2027 if publicly supported, while wave energy will not be viable before 2050. Yet, near-shore wind seems never to be viable due to the significant landscape costs associated with its deployment. These findings have implications both for public policies related to **energy economics** and for **maritime spatial planning**.^v



Example 3: bottom trawling

The effort of crustacean bottom trawling per km² in Portugal was estimated, showing that some areas are trawled up to five times per year. This and other evidence of the **environmental impacts** of bottom trawling was combined with **economic evidence** of the disproportional amount of subsidies allocated to this fisheries segment. The damage caused by bottom trawling would not be admissible if it would happen on land. Recommendations were made to accelerate a transition to more sustainable fisheries in Portugal, which would require abandoning bottom trawling.^{vi}



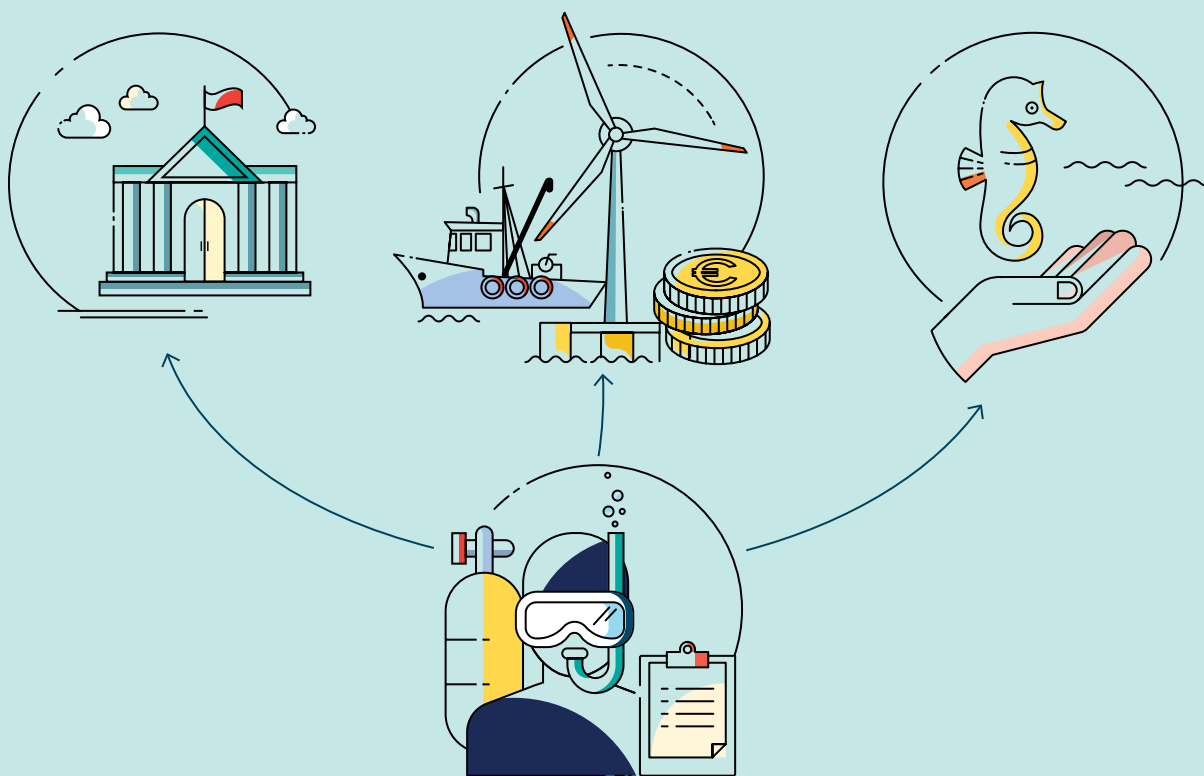
Example 4: bioeconomic model of the sardine fishery

The sardine fishery is a historically important one in Portugal, both in economic and cultural terms. Determining the optimal levels of sardine fishing exclusively from a biological point of view, i.e. focused solely on the dynamics of the fish stock, gives an incomplete picture of the issue, as it may fail to adequately account for the economic behaviour of fishermen. In contrast, doing it from a pure economic point of view, e.g., focused only on ensuring economic return to fishermen, also provides an incomplete picture as it fails to take into account fish population dynamics. With both the lenses of **biology** and **economics** combined, as in the GOI-funded project, it is possible to find a range of solutions that can ensure that the sardine stock is biologically sustainable and that fishermen have a stable revenue over time.^{vii}

These four examples – the giant wave of Nazaré, marine renewable energies, bottom trawling, and the sardine fishery – partially demonstrate the extent to which **Portugal, a large maritime nation with a marine area 18 times the size of its land area, stands to benefit from IDR**. As Portugal awaits a decision of the International Seabed Authority on the extension of its continental shelf, which could increase maritime areas under Portuguese jurisdiction to 40 times the size of its land area, the country should give more careful consideration to the potential of IDR to tackle a wide variety of marine policy issues. This has been highlighted by a wide range of marine stakeholders, namely public administration, the business community and marine environmental NGOs, showing that there is demand for IDR to inform public policies.

2. The demand for marine interdisciplinary research

IN PORTUGAL



Marine research in Portugal has grown considerably in quality and quantity in the last few decades, following the country's trend in terms of scientific and economic development. Currently, Portugal ranks 17 in a group of 40 countries in terms of ocean sciences publications.^{viii} However, its interdisciplinary character has not been sufficiently promoted, despite the evidence that greater interdisciplinarity can bring benefits to a wide range of stakeholders.

From a **public administration** point of view, IDR on marine issues can assist Portugal in meeting its obligations in a wide variety of policies under several ministries, including: the Common Fisheries Policy and the Marine Strategy Framework Directive (MSFD), both under the Ministry of the Sea; the Habitats and Birds Directives, both under the Ministry of the Environment; the National Action Plan for Renewable Energies, under the Ministry of Economy. For example, in

MSFD, Portugal needs to improve its environmental performance in relation to marine litter, so its “properties and quantities (...) do not cause harm to the coastal and marine environment”. IDR can also help inform management plans of Marine Protected Areas, by identifying levels of human activity that species and habitats can sustain, and informing the design of appropriate conservation measures.

Acting on marine litter has recently become an even more pressing matter for the country, as new research has showed very high levels of floating marine plastics on the sea surface under Portuguese jurisdiction. As over 80% of marine pollution originates on land, tackling the marine litter problem in Portugal will require IDR that combines the knowledge of what types of litter are found in the oceans, their environmental and public health impacts, their sources and how marine litter production can be reduced on land by changing both organizational and individual behaviour.

IDR can also be a tool to help **businesses** meet their knowledge needs. For example, Fórum Oceano, Portugal's maritime business association, has identified the need for greater interdisciplinary cooperation between the disciplines of Energy, Finance, Naval Engineering and Oceanography with the aim of developing technologies that harness marine renewable energies.^{ix} This is a topic that was addressed in Example 3, above.

Finally, and from the perspective of marine **environmental NGOs**, IDR can contribute to elicit the costs and benefits associated with subsidies to fisheries. These public subsidies were historically granted to help fisheries provide cheap protein to a growing population in the post-WW II years, but are today generally regarded as supporting overfishing and seafloor habitat destruction.

In addition to the interest demonstrated by several stakeholders in marine IDR, it should be noted that, according to its National Sea Strategy 2013-2020, Portugal aims to realize the potential of its marine and coastal areas “through [their] economic, social and environmental valorization (...), for the benefit of all Portuguese citizens”.^x As a large maritime nation, Portugal therefore needs IDR that combines environmental, social and economic perspectives so that the benefits provided by its marine areas can contribute to human well-being and economic development. Harnessing these benefits is only possible through the integration of multiple disciplines in the collection and analysis of evidence that is capable of informing policy decisions.

“A multidisciplinary study was conducted to inform a management and regulatory proposal for the harvesting of Japanese carpet shell (*Ruditapes phillipinarum*) in the Tagus estuary. This study provided (i) the much needed scientific knowledge on the distribution, abundance, growth and life cycle of this species, (ii) detailed information of the impacts caused by this invasive species on the estuary and by the fishing gear used to catch it, and (iii) the socioeconomic context in which clam harvesting takes place. The combination of these different insights greatly assisted my department in the definition and implementation of measures to ensure sustainable harvest levels and reduced environmental and socioeconomic impacts.”

Miguel Sequeira, Director-General for Natural Resources and Maritime Safety and Services (DGRM)
Private communication, November 2016

“We need interdisciplinary projects that can develop fish feed that is more efficient, sustainable, affordable, uses local products, meets environmental protection needs, and is adapted to national species and production systems”

Carla Domingues, Maritime Economy Association (Fórum Oceano)
Private communication, November 2016

“We need to know whether public subsidies to fisheries are providing perverse incentives to environmental destruction or not. Only by integrating expertise in fisheries business operations, public policy, and environmental impacts can taxpayers know whether their money is being put to good use or not. Interdisciplinary research has the power to do exactly that.”

Gonçalo Carvalho, coordinator of the Platform of Portuguese NGOs on Fisheries (PONG-Pesca)
Private communication, November 2016

3. The challenges

TO INTERDISCIPLINARY RESEARCH

In Portugal, as elsewhere, IDR faces several obstacles related to attitudes, communication, academic structure, funding, and career development.^{xi}



RESEARCHERS' ATTITUDE

IDR is often seen by researchers as less prestigious than single-discipline research. While many scientists recognize the need for IDR, very few are willing to cross disciplinary boundaries. Yet, there are increasingly more researchers interested in doing IDR, for several reasons. Researchers may realize that, within the boundaries of their discipline, they cannot find solutions to a problem they have been working on; or they may be enthusiastic about a new topic they believe to hold promising interactions with their own field of research, and reach out to researchers in other fields; they may also be prompted into IDR by funding opportunities to tackle problems they can contribute to solve.



COMMUNICATION

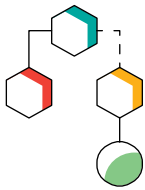
Communication is an essential feature of collaborative research such as IDR. Communication in IDR can be hindered in several ways, namely through jargon, intellectual turf, lack of team-building, and of leadership.

Jargon is important for researchers within a particular field, as it facilitates communication on specialized themes and constitutes a form of professional socialization. However, jargon can also be an obstacle to effective communication across disciplines, and thus impose a time penalty on IDR for building mutual understanding. Intellectual turf may also occur, with research-

Interdisciplinary research is difficult to implement, since often the appropriate framework is lacking (funding opportunities, research units or researchers' networks, human resources, appropriate evaluation panels, among others). Furthermore, it relies on the will of a minority of researchers to leave their core area of expertise and cooperate with others, typically with different backgrounds, in order to develop integrative research plans. Yet, most of the problems our societies face today are not easy to tackle with a (traditional) monodisciplinary scientific research. Some key issues regarding ocean sciences, such as fisheries, climate change, pollution, seabed mining, among many others, should be addressed in a more holistic perspective involving researchers from many fields of research, from natural to social and economic sciences.

*Henrique Cabral, Director and Scientific Coordinator of the Marine and Environmental Sciences Centre (MARE)
Private communication, January 2017*

ers holding strongly to their discipline and methods and distrusting the contributions of others outside of their disciplinary boundaries. Strong leadership is therefore needed to overcome communication issues, and to build effective teams. Team-building in IDR requires clear assignment of roles, an understanding of everyone's expectations, and an authority that is able to deal with issues of data and resources sharing.



ACADEMIC STRUCTURE

The organization structure of universities is in general defined according to disciplines. Such structure is necessary to distribute teaching responsibilities,

recruit, and promote faculty, as well as to establish and manage degree programs and courses. However, it also hinders collaboration among researchers from different disciplines.

There are several ways in which the impacts of academic structure on IDR can be minimized. One is by establishing interdisciplinary programs or centres that cross departments, though such programs are dependent on individual leadership and funding.^{xii} Such programs cater to the individual interest of researchers and students. This has been done in Portugal with the creation of a few interdisciplinary research centres (e.g. Institute for Interdisciplinary Research at the University of Lisbon). However, it is not clear the extent to which they have fostered IDR, or whether they simply aggregate different disconnected research groups.

Another way of minimizing the impact of academic structure on IDR is by creating internal interdisciplinary networks of researchers, such as the College on Food, Farming and Forestry of the University of Lisbon. These networks are often the result of the growing attention of academic leadership to interdisciplinarity, picking on this trend in science policy. Again, it is not clear if new collaborations are being fostered as a direct result of this college, or if researchers are conducting their research as before.

Though such initiatives reflect the growing interest in IDR, it is likely that they represent only the internalization of interdisciplinarity labels without changing the disciplinary practices. In other words, systemic implementation of interdisciplinary may be lacking.

“The public agencies in the research and innovation systems need to focus their efforts on organising research activities under larger-scale projects or platforms with more participants. The same advice applies to independent research institutes and universities and university colleges, both internally and between the institutions.”^{xiii}



FUNDING

Most public funding of science in Portugal originates from, or is channelled through, the country's science funding agency, FCT

(*Fundação para a Ciência e a Tecnologia*).

Within its wide mandate, FCT seems to have given rather incipient support to IDR. For example, an analysis of its annual activity reports revealed that only in 2004 and 2007 were there specific mechanisms to support IDR aimed at informing policy, in both cases related to HIV/AIDS.^{xiv, xv}

FCT's Scientific Council on Social Sciences and Humanities has voiced its concerns with the obstacles that FCT procedures pose to IDR.^{xvi} Among other measures, it proposed IDR projects to be evaluated simultaneously by two panels, and the creation of interdisciplinary panels. The recent report of the Reflection Group on S&T Evaluation by FCT identified progress, though limited, in the assessment of IDR units, as some were evaluated by multiple panels (in 2007) or by mixed panels (in 2013).^{xvii} Apparently, there has not been yet an assessment of IDR projects in Portugal – unlike in Finland^{xviii} – that can provide a clear indication of whether such projects face the same obstacles to funding as elsewhere, including lower success rates.^{xix}

In the field of Marine Sciences, the recent trajectory of promotion of IDR should be highlighted. In the late 1990s, the Portuguese government created a Program to Promote Ocean Sciences and Technologies (PDCTM, in Portuguese), which funded applied and fundamental research in ocean sciences and technologies with the goals of structuring, building capacity and stimulating marine research in Portugal. In particular, PDCTM sought to

stimulate an interdisciplinary approach to ocean studies by involving all scientific areas from natural sciences to social sciences and humanities. In 1999, its call for projects determined interdisciplinarity as an eligibility criteria. However, and though most proposals included extended cooperation between natural sciences and engineering, there was hardly any collaboration with the social sciences and humanities. Consequently, the promotion of interdisciplinarity in oceans research was evaluated as having the weakest level of achievement in a recent assessment of PDCTM's performance.^{xx}

In addition to PDCTM, FCT has regularly opened calls for projects in all scientific domains. The results of the 2014 call for projects shows that only one project in Marine Sciences indicated a topic in Social Sciences and Humanities as secondary area; the proposal was not approved. While analysing a single call for projects is insufficient to detect patterns, it provides a glimpse into how incipient interdisciplinarity may be in Portuguese marine scientific research. On the positive side, FCT is planning to steer its funding towards solving societal problems, as will be shown below.

The reduced funding support for IDR is further aggravated by the rules of the calls for funding of research projects in all scientific domains. Because they do not account for the specificities of IDR, these calls can constitute deterrents to IDR:

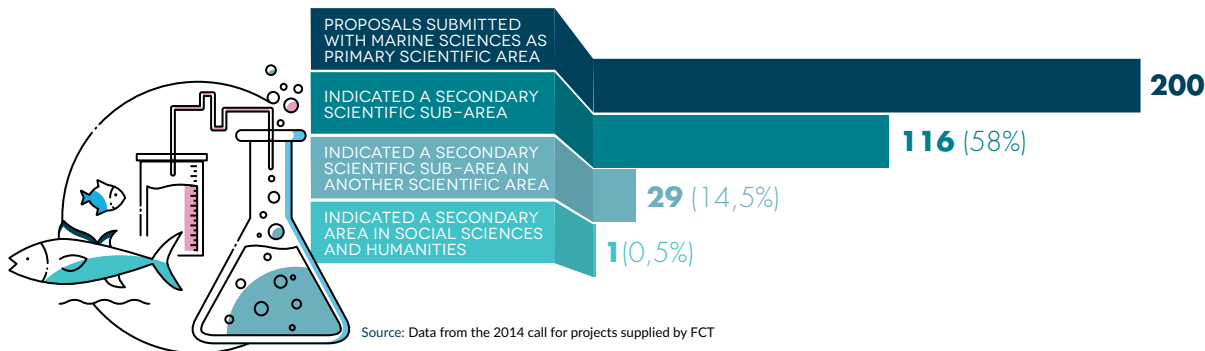
1. Preparing an IDR proposal takes more time than a single-discipline proposal, as common language has to be agreed upon, and the proposal quality is hence affected in comparison with single-discipline proposals.
2. IDR proposals may have lower scientific quality because of researchers' lack of experience or even interest in IDR.
3. It may be difficult to know under which area and sub area

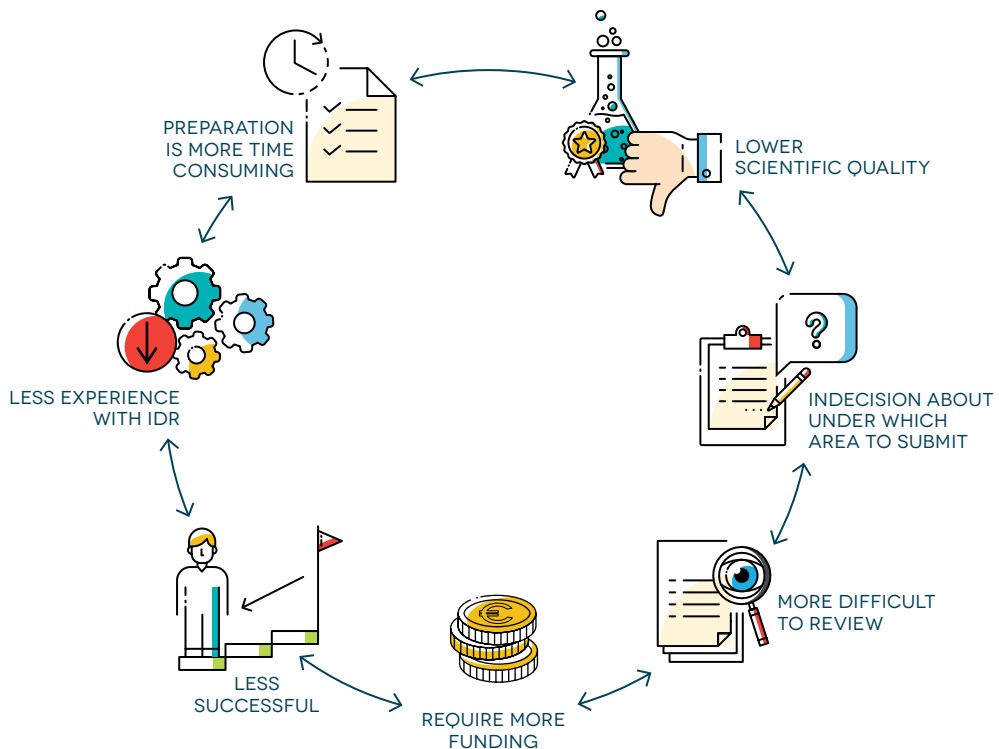
“FCT’s vision is to make Portugal an international reference in science, technology and innovation, and ensure that knowledge generated by scientific research is fully used for economic growth and the well-being of citizens.” To achieve this, FCT funds individuals, projects and research centers, “ensures the participation of Portugal in international scientific organizations, (...) [and] coordinates public policies for the Information and Knowledge Society in Portugal”.

Source: FCT’s website (www.fct.pt)

to submit an IDR, particularly if the appropriate primary and secondary area are from unrelated scientific domains (e.g., Natural Sciences and Social Sciences and Humanities).^{xxi} There is therefore the risk that a project submitted under one primary area may be considered by this panel more appropriate for submission under its secondary area, and vice-versa.

4. Once submitted, (marine) IDR proposals are more difficult and time-consuming to assess, not just because of their nature but also because science agencies often do not provide guidance to reviewers on how to deal with such proposals.
5. (Marine) IDR proposals may require more funding, as the research itself takes longer and more teams/institutions are involved. Besides, many aspects of marine research are very expensive to start with, because of the cost of building and operating experimental and observational platforms.
6. As such proposals tend to be less successful than others,





researchers may be less likely to prepare IDR proposals, bringing us back to the beginning of the cycle.

CAREER DEVELOPMENT

Progression in research careers is overwhelmingly done through specialization, which is more rewarded than mastery of interdisciplinary approaches at the frontiers of disciplines. Discipline-based departments tend to hire within their disciplines, perpetuating the single-discipline orientation of students training and of academic research. However, IDR can still be promoted in these contexts by having different departments jointly hire individuals that can bridge those disciplines and bring an interdisciplinary orientation to them. For example, the University of Birmingham was recently looking for Interdisciplinary Professorial Fellows “to further enhance the quality and impact of research” across two or more schools.^{xxii} Yet, career progression of interdisciplinary researchers also requires specific assessment criteria, just like IDR project proposals do.

The shift that is here proposed towards more (and better) IDR is part of an international trend to support the growth

in IDR observed since the 1970s,^{xxiii} with countries like the US,^{xxiv} UK,^{xxv} Canada and Australia at the forefront. In the EU, IDR gained greater attention with the 5th Framework Program funding more problem-oriented research, which was taken further with Horizon 2020. In Norway, its “R&D strategy for a marine nation of substance” was approved in 2012. It sets seven priority research areas, of which one is intrinsically interdisciplinary (“Social and legal perspectives, management and use”), and recommends that the “research community, the public administration, trade and industry, and the public agencies in the research and innovation system should seek to solve challenges using interdisciplinary and cross-sectoral projects involving science and technology”.

The European Research Council is also looking into how to improve its support of IDR. Specifically, it is considering setting up a dedicated funding scheme for IDR, while keeping the stance that funding excellent research is their priority, whether it is interdisciplinary or not.^{xxv} In addition, the independent High Level Group on maximising the impact of EU Research & Innovation Programmes has concluded that “a consistent priority [should be] attached to interdisciplinarity as a source of technological and other innovation”.^{xxvi}

4. Measures

TO ACCOMMODATE IDR ON MARINE ISSUES

Though there is no overall assessment of how the Portuguese scientific system accommodates IDR, the evidence previously presented suggests that there are several deterrents to IDR in Portugal. Several measures are proposed to enable more IDR in Portugal, and thus contribute to a greater impact of science in society.

Measure 1 Universities Promote IDR competences

Interdisciplinary research should be promoted starting at least at graduate level. Some ways of introducing IDR early in students' path are workshops, short courses, or even summer schools on interdisciplinary research methods, without the need to change a degree's structure. One such program is a recent week-long interdisciplinary PhD course on Marine Sustainability in Norway, which seeks "to support participants to better integrate knowledge from the natural and social sciences into their research".^{xxvii} In Canada, Dalhousie University has been running an well-established IDR PhD program for over 30 years.^{xxviii}

Measure 2 Universities Recognize and promote IDR competences in research careers

Job descriptions at the University level very rarely require competences in IDR. These should be part of the requirements more often, especially if a University or Research Centre needs to strengthen the societal impact of its research.

Measure 3 FCT Calls with more preparation time

There is usually insufficient time between the call announcement and the submission date to prepare robust IDR project proposals. In the 2017 FCT projects call, these two dates were only 3 months apart, and coincided with teaching duties of many researchers. Interdisciplinary project proposals typically require more preparation time, in comparison with single-discipline ones. A short period between the announcement of a call and its submission date can prevent an IDR proposal from, for example, adequately harmonizing different disciplinary languages and coordinate administratively with researchers in different institutions.

Measure 4 FCT Simplify scientific areas

Projects applying for funding from FCT need to indicate upon submission by which scientific area, and consequently evaluation panel, they wish to be assessed. An IDR proposal could be submitted under two different areas/domains. Though Principal Investigators can indicate a secondary scientific area (and associated sub-area) for their project proposal, this "does not alter the allocation to the evaluation panel, which is defined by the primary scientific area".^{xxix} Scientific panels should be simplified (i.e., fewer of them encompassing a wider range of disciplines/topics).

Measure 5
FCT
Clarify proposals'
review path and set
criteria for IDR

FCT's guide for peer reviewers does not provide any guidance on how reviewers should proceed in assessing proposals that also indicate a secondary scientific area, leaving the proposal subjected to the discretion of the panel coordinator. The panel coordinator may decide that the proposal is to be evaluated solely by the panel of the primary scientific area, or that it should also be reviewed by the panel of the secondary scientific area. Either way, there is no clear review path for IDR proposals, leaving them to be evaluated by a panel that may not fully competent to appreciate their scientific robustness, scientific impact, or potential contribution to solve societal problems. An alternative would be to form a single IDR panel, integrating researchers with expertise in IDR, and single-discipline researchers. The latter could undergo specific training in assessing IDR proposals, which could also entice their interest in doing IDR in the future. It should be noted however that the creation of interdisciplinary panels in Portugal has been met with resistance before. In addition, a set of criteria to assess IDR proposals should be created. FCT's guide for peer reviewers does not include such criteria, and consequently IDR proposals are assessed by criteria devised for single-discipline proposals only. Specific criteria for IDR would enable a more robust and fairer assessment of IDR proposals in their quality and purpose.^{xxx}

Measure 6
FCT
Increase eligible amount
without increasing
project duration

IDR projects should have a higher budget limit, without compromising the project's duration. Also, for sake of objectivity and transparency, specific criteria should be listed for what constitutes (or not) an IDR proposal, defining the eligibility of proposals for the special conditions that could be given to IDR proposals. In the 2014 call for project proposals, the maximum eligible amount that could be requested was €200,000 for a 2-year project, while in the 2017 call the eligible amount was €240,000 for a project duration of 3 years. This limit may be insufficient for more robust IDR proposals – as a comparison, the GOI-funded IDR project had a budget of €470,000 for a duration of 2 years. As discussed above, IDR proposals typically require more funding than single discipline ones, because of the level of risk involved, higher administrative burdens of collaborations between different institutions, and time consumed in fostering and maintaining fruitful collaborations between distinct academic traditions.

Measure 7
Public administration
Engage with academia

Public administration could make its need for IDR more explicit by promoting regular meetings with researchers; for example, by inviting once a year researchers from a variety of disciplinary backgrounds to discuss potential matches between academia's research agendas, the needs of the public administration department, and existing funding opportunities. Moreover, public research institutes that play an advisory role to policy-makers could provide incentives to their researchers to collaborate with other researchers in the academia working on related topics. For example, the job description of public researchers could include publishing or collaborating with other complementary research institutions. This could also allow for more in-depth analyses of official data that is collected by public departments and institutes, but often difficult for academics to use.

Measure 8
All
Create a dedicated line
of funding for IDR

One strategy science agencies often use to promote IDR is to create specific lines of funding for such projects alone. Under its call for projects in all scientific areas, FCT does not have a specific line for IDR proposals, leaving such proposals subjected to the obstacles previously presented. This may reduce the likelihood of approval for those proposals based on merit alone, and reduce societal impact of science too. Besides public funding, a line of funding for IDR could also benefit from monetary contributions from non-public organizations.

The focus on FCT as a funding agency does not reduce the responsibility of universities, research centres and public administration in fostering IDR.

5. Recommendations

In May 2017, FCT launched a consultation process to define Thematic Agendas for Research and Innovation, including one on Oceans. These Agendas seek to “mobilize different national actors, contributing to find answers based on scientific knowledge to different societal challenges”, and will shape science funding in Portugal for at least the next five years. Though IDR is not mentioned in the legislation determining the discussion and elaboration of the Thematic Agendas,^{xxxix} it seems unavoidable that it will be required to address societal challenges identified for each of the 14 themes. This presents a golden opportunity to further IDR in Portugal, and ultimately enable a greater policy impact of marine research supported by taxpayers.

The measures presented previously are stand-alone measures that individually are unlikely to enable more IDR research to further develop. We propose three alternative mechanisms to promote IDR that can contribute to systemic change towards more IDR and better societal impact of science. These mechanisms recognise the pivotal role played by science funding in shaping research, while acknowledging that other institutions can also contribute to it.

Option 1 Pilot call for IDR projects on Marine Issues

With this **pilot call**, FCT would be able to, at a minimum, (i) test improvements to its submission and reviewing processes to better accommodate IDR (measures 3-6), (ii) evaluate the results, including policy and scientific impact of IDR, and finally (iii) scale up measure 8 to other scientific areas/societal problems (see Option 2).

This IDR call for projects on marine issues would require a specific evaluation process, involving both single-discipline and interdisciplinary researchers, with the former undergoing specific training in assessing interdisciplinary proposals. This pilot call would be fully public funded. Alternatively, it could be co-funded by stakeholders that stand to benefit directly from IDR – e.g., business community. Co-funders could also be invited to specify policy problems affecting them that could benefit from an interdisciplinary approach. Public administration departments should also be invited to participate in these discussions, thus informally engaging them with Academia (measure 7). Further calls for IDR on marine issues should be preceded by an evaluation of the first call.

Option 2 Complete overhaul of FCT calls for projects

A complete overhaul of future calls for project proposals would serve the purpose of better accommodating the specificities of IDR encompassing a wider and/or more varied range of scientific areas. Such overhaul would, as in Option 1, implement measures 3-6, as well as measure 8. This option is not preferred as it does not explicitly engage other stakeholders nor does it commit them to IDR. Also, interdisciplinary panels have been met with resistance before, so this and other not yet anticipated bottlenecks may impede a radical change.

Option 3 Long-term Interdisciplinary Research Program to support Marine Policy

If there is enough institutional interest from universities, as well as interest from researchers in working in interdisciplinary contexts, and FCT has the needed funds, an interdisciplinary research program can be created to further develop interdisciplinary marine research at the service of public policy. The outlining of this program would require the participatory identification of the major challenges that Portuguese marine waters are expected to face in the next 10 years. Also, such program would most likely require interministerial coordination, as it would purport to tackle issues under the mandates of different ministries (Sea; Environment; Economy; etc.).

Any of the three options proposed would give a clear sign to the scientific community on FCT’s commitment to IDR, which could encourage universities to promote IDR competences among their students and faculty (measures 1 and 2), with long-term impacts. Of the three options presented, Option 1 is more likely to receive support from stakeholders. Unlike Options 2 and 3, the first option implies less changes to the organizational practices of all involved in calls for projects (FCT, reviewers and researchers). Option 2 would impose the burden of change almost exclusively on FCT to a greater extent than Option 1, when other actors in the scientific system also have responsibility and a role to play in promoting IDR. Option 3, on the other hand, requires a long-term commitment from both universities and FCT, not to mention high-level commitment from various ministries.

NOTES

- ⁱ Committee on Facilitating Interdisciplinary Research, National Academy of Sciences, National Academy of Engineering, Institute of Medicine "Facilitating Interdisciplinary Research" (2005). The National Academies Press. Washington, D.C. 332p. Available at: <https://www.nap.edu/catalog/11153/facilitating-interdisciplinary-research>
- ⁱⁱ We borrow the distinction between multidisciplinary and interdisciplinarity made by Editorial (2015): "multidisciplinary work [is] a collection of people tackling a problem using their specific skills (...) [while interdisciplinarity is instead] a synthesis of different approaches into something unique".
- ⁱⁱⁱ Jennifer Gardy & Fiona Brinkman (2003). "The Benefits of Interdisciplinary Research: Our Experience With Pathogen Bioinformatics". *ScienceMag*. Available at: <http://www.sciencemag.org/careers/2003/01/benefits-interdisciplinary-research-our-experience-pathogen-bioinformatics>
- ^{iv} Maria A. Cunha-e-Sá, Rita Freitas, Luís C. Nunes, Vladimir Otrachshenko (2017). "On Nature's Shoulders: Riding the Big Waves in Nazaré". Policy brief of the Gulbenkian Oceans Initiative. Calouste Gulbenkian Foundation.
- ^v Maria A. Cunha-e-Sá, Ana Faria Lopes (2017). "Marine Renewable Energy in Portugal: If and When". Policy brief of the Gulbenkian Oceans Initiative. Calouste Gulbenkian Foundation.
- ^{vi} Juan Bueno Pardo, Henrique Queiroga, Graham J. Pierce, Catarina Grilo (2017). "Trawling in Portugal: What If It Happened on Land?" Policy brief of the Gulbenkian Oceans Initiative. Calouste Gulbenkian Foundation.
- ^{vii} Renato Rosa, João Vaz, Rui Mota, Alexandra Silva (Submitted). Preferences for landings' smoothing and risk of stock collapse in optimal fishery policies: The Ibero-Atlantic sardine fishery.
- ^{viii} UNESCO (2017). *Global Ocean Science Report: The Current Status of Ocean Science around the World*. L. Valdés et al. (eds), UNESCO Publishing, Paris. Available at: <http://unesdoc.unesco.org/images/0025/002504/250428e.pdf>
- ^{ix} Oceano XXI (2015). "Desafios do Mar 2020 – Estratégias de Eficiência Coletiva", 2nd edition. Available at: http://www.forumociano.pt/files/3_Atividades/31_DesafiosDoMar2020/DesafiosDoMar2020_2Edicao_2015_revista.pdf?d=tefq
- ^x "National Sea Strategy 2013-2020". Available at: <https://www.dgpm.mm.gov.pt/enm>
- ^{xi} Terry C. Pellmar, Leon Eisenberg, Editors (2000). *Bridging Disciplines in the Brain, Behavioral, and Clinical Sciences*. Committee on Building Bridges in the Brain, Behavioral, and Clinical Sciences; Division of Neuroscience and Behavioral Health; Institute of Medicine. Available at: <https://www.nap.edu/catalog/9942/bridging-disciplines-in-the-brain-behavioral-and-clinical-sciences>
- ^{xii} Diana Rothen. *Interdisciplinary Research: Trend or Transition? Items – Insights from the Social Sciences*. Available at: <http://items.ssrc.org/interdisciplinary-research-trend-or-transition/>
- ^{xiii} The Research Council of Norway (2012). "HAV21 - An R&D strategy for a marine nation of substance". ISBN 978-82-12-03175-3. Available at: <http://hav21.no>
- ^{xiv} FCT (2005). "FCT – 2004 Activity Report". Available at: http://www.fct.pt/documentos/RA2004ultima_versao.pdf
- ^{xv} FCT (2008). "FCT – 2007 Activity Report". Available at: <http://www.fct.pt/docs/RelatorioActividades2007.zip>
- ^{xvi} CCCSH (2011). "Ciências Sociais e Humanidades: mais excelência, maior impacto - Internacionalização, pluralismo, pluridisciplinaridade, avaliação, disseminação e relação entre as políticas científicas nacional e comunitária". Statement from the Consultative Council on Social Sciences and Humanities. Available at: https://www.fct.pt/conselhos_cientificos/docs/rel_final_CCCSH_2011.pdf
- ^{xvii} Karin Wall (coord.), Carlos Bernardo, Salva Castelo-Branco, Nuno Ferrand de Almedia, Constança Providência, Claudio Sunkel (2016). Reflection Group on Science and Technology Evaluation by FCT. Available at: http://www.eshte.pt/downloads/Grupo_Reflexao_sobre_Avaliacao_Ciencia_Tecnologia_Fundacao_Ciencia_Tecnologia.pdf
- ^{xviii} Henrik Bruun, Janne Hukkinen, Katri Huutoniemi, Julie Thompson Klein (2005). Promoting Interdisciplinary Research: The Case of the Academy of Finland. Publications of the Academy of Finland 8/05. Available at: http://www.aka.fi/globalassets/awanhat/documents/tiedostot/julkaisut/8_05-promoting-interdisciplinary-research_the-case-of-the-academy-of-finland.pdf
- ^{xix} Lindell Bromham, Russell Dinnage & Xia Hua (2016). Interdisciplinary research has consistently lower funding success. *Nature* Vol. 534: 684-687. doi:10.1038/nature18315
- ^{xx} Santos, Rita Silva (2013). "Uma gota de Ciência no Oceano - O Programa Dinamizador em Ciências e Tecnologias do Mar". Master thesis, ISCTE – Instituto Universitário de Lisboa, Departamento de Sociologia.
- ^{xxi} FCT defines four scientific domains under which individual research grants and project proposals can be submitted: Life and Health Sciences (with 5 scientific areas with 19 sub-areas); Exact Sciences and Engineering (8 scientific areas with 66 sub-areas); Natural and Environmental Sciences (6 scientific areas with 26 sub-areas); Social Sciences and the Humanities (6 scientific areas with 40 sub-areas).
- ^{xxii} See <http://www.birmingham.ac.uk/staff/excellence/fellows/Interdisciplinary-Professorial-Fellows/index.aspx>
- ^{xxiii} Heidi Ledford (2015). "How to solve the world's biggest problems". *Nature News & Comment*.
- ^{xxiv} Alasdair Glead & David Marchant (2016). "Interdisciplinarity: Survey Report for the Global Research Council 2016 Annual Meeting". Global Research Council. Available at: http://www.globalresearchcouncil.org/sites/default/files/pdfs/Interdisciplinarity%20Report%20for%20GRC_DJS%20Research.pdf
- ^{xxv} Elsevier (2015). A Review of the UK's Interdisciplinary Research using a Citation-based Approach. Report to the UK Higher Education funding bodies and Medical Research Council. Available at: <https://www.elsevier.com/research-intelligence/research-initiatives/uk-interdisciplinary-research>
- ^{xxvi} Pascal Lamy, Martin Bruder Müller, Mark Ferguson, Lykke Friis, Cristina Garmendia, Iain Gray, Jan Gulliksen, Harri Kulmala, Nevenka Maher, Maya Plentz Fagundes, Lucyna A. Woźniak, Milena Žic Fuchs (2017). "LAB – FAB – APP: Investing in the European future we want". Report of the independent High Level Group on maximising the impact of EU Research & Innovation Programmes. Available at: https://ec.europa.eu/research/evaluations/pdf/archive/other_reports_studies_and_documents/hlg_2017_report.pdf
- ^{xxvii} Interdisciplinary PhD course in Marine Sustainability. Available at: <http://www.futureearth.org/norway/interdisciplinary-phd-course-marine-sustainability>
- ^{xxviii} More info: <https://www.dal.ca/faculty/gradstudies/idphd.html>
- ^{xxix} FCT (2015). "FCT Scientific Research and Technological Development Projects – 2014 - Guide for Peer Reviewers". Available at: http://www.fct.pt/apoios/projetos/concursos/2014/docs/GuidePeerReviewers_C2014.pdf
- ^{xxx} Veronica Strang & Tom McLeish (2015). *Evaluation Interdisciplinary Research: a practical guide*. Institute of Advanced Study, Durham University, UK. Available at: https://www.dur.ac.uk/resources/ias/publications/StrangandMcLeish.EvaluatingInterdisciplinaryResearch.July2015_2.pdf
- ^{xxxi} Resolution of the Council of Ministers n. 32/2016 of June 3rd.

The Calouste Gulbenkian Foundation is a Portuguese private institution of public utility, which was created in 1956 in accordance with the last will and testament of Calouste Sarkis Gulbenkian. It actively pursues its statutory aims in the fields of the arts, charity, education and science in Portugal and abroad, including through its UK Branch and Paris Delegation. The Foundation promotes a wide range of direct activities and grants supporting projects and programs.

GULBENKIAN.PT

Av. de Berna, 45A
1067-001 Lisboa