Acronym: COLUMBUS

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Report on current metrics for research performance

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RE Restricted to a group specified by the consortium (including the Commission Services)	
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CONTENT

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Executive Summary

COLUMBUS is a BG11-H2020 project, that aims to ensure that applicable knowledge generated through EU- science and technology research is accessible and effectively transferred to end-users: policy, industry, science and wider society. The project's activities are to capture, organize, assess and transfer knowledge, skills and competence from those who generate them to those who will utilize them.

The Legacy Work Package (WP8) within the COLUMBUS project aims to examine the barriers affecting efficient Knowledge Transfer (KT) and improve the research system by supporting the value creation from research investments and developing a methodology to encourage funding agencies to prioritise Knowledge Transfer systems in their funding mechanisms.

The Task 8.1 within WP8 contains a review of traditional and current metrics of success for researchers and research performing organisations to understand the current landscape. It also contains interviews of representatives from progressive organisations responding to the broader role of science in society. The identification of roles and responsibilities of researchers in carrying out KT has been explored as well as any incentives and recognition for effective KT work.

This situation reveals strong some constraints in the development of KT activities in the scientific community that is not restricted to the marine science community. As shown in the report, Researchers seem not to consider KT as a real added value for a researcher's career and according to the consultation are not seen as a priority in both research performing organisations and funding agencies and remain a useful and rewarding activity but still undervalued and thus not of main concern for researchers. There is a paradox between what is expected from researchers, in terms of outreach and KT activities, and the evaluation criteria that are applied for their professional assessment and their research projects appraisal. Re-examining research performance metrics and/or promoting the development and implementation of new jobs (and careers), dedicated to KT and popularisation of research activities and outcomes (inside research performing organisations) would be options to overcome this paradox.

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Introduction

1. Background

Europe is lagging behind other continents in its ability to convert research knowledge into innovation and growth. At the same time, the research community is seen as a potential enabling community to achieve Europe 2020[1]. COLUMBUS ensures measurable value creation from research investments contributing to the long term European Strategy for Blue Growth[2] to support long term economic growth in the marine and maritime sectors

To achieve measurable benefits, COLUMBUS believes the research system needs to be examined to identify potential improvements and efficiencies that would allow it to respond to the demand set by the policy makers. Additionally, researchers and funding agencies alike need the tools and resources to effectively improve their ability to carry out Responsible Research and Innovation.

The Legacy Work Package (WP8) within the COLUMBUS project is tasked to examine the barriers affecting efficient KT and improve the value creation from research investments and developing a methodology to encourage funding agencies to prioritise Knowledge Transfer systems in their funding mechanisms.

2. Aims and Objectives

The goals of Task 8.1 within WP8 are to review traditional and current metrics of success for researchers and research performing organisations, to understand the current landscape and to identify case studies of progressive organisations responding to the broader role of science in society. Identification of roles and responsibilities of researchers and support staff in carrying out KT will be explored as well as any incentives and recognition for effective KT work.

3. Structure of report

The first section, Introduction, includes the principal aims of this report, as well as definitions of a few terms that will be used throughout.

Section Methodology will provide the set of procedures of consultation activities used to collect information for analysis.

Section Results and Discussion, will provide the main results, supporting graphs and main discussion. This section is separated into five subtopics: the first will showcase demographics of the participants contacted by email; then subtopics 2 and 3 will include comparative analysis between the two types of participants. The subtopic 4 will show participants' suggestions of metrics that not appeared in the

[1] http://ec.europa.eu/europe2020/europe-2020-in-a-nutshell/priorities/index_en.htm

[2] http://ec.europa.eu/maritimeaffairs/policy/blue_growth/index_en.htm

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questionnaire and finally in 5, there will be portrait interviews of people performing knowledge transfer.

Conclusion and reflections will provide the main conclusions drawn from the entire analysis and will discuss possible solutions to enhance research assessment and better promotion of knowledge transfer activities.

Last section, the Annex, will provide raw answers of participants to the open questions.

4. Definitions

Knowledge Transfer (KT), according to COLUMBUS
A term used to describe the overall process of moving knowledge from its source(s) to potential user(s) of knowledge which results in eventual impact. KT consists of a range of activities which aim to capture, organise, assess and transmit knowledge, skills and competence from those who generate them to those who will utilise them, the end user.

Knowledge Transfer, according to the University of Cambridge
A term used to encompass a very broad range of activities to support mutually beneficial collaborations between universities, businesses and the public sector.

Knowledge Transfer (between research institutions and industry) according to the European Commission[3]

KT involves the processes for capturing, collecting and sharing explicit and tacit knowledge, including skills and competence. It includes both commercial and non-commercial activities such as research collaborations, consultancy, licensing, spin-off creation, researcher mobility, publication, etc. While the emphasis is on scientific and technological knowledge other forms such as technology-enabled business processes are also concerned.

H-index
An author-level metric that attempts to measure both the productivity and citation impact of the publications of a scientist or scholar. The index is based on the set of the scientist's most cited papers and the number of citations that they have received in other publications.

5. An important background element

In 2007, DG Research of the European Commission established an Expert Group for “Knowledge Transfer Metrics” to improve coherence and convergence between existing surveys of knowledge transfer from public research organisations (PROs) to business and other sectors in society. The outcomes of the Expert Group were i) the identification and review of existing indicators used by national and international KT surveys, ii) the development of a set of strategic orientations regarding the directions in which the European knowledge transfer benchmarking systems should be

[3] http://ec.europa.eu/invest-in-research/pdf/download_en/knowledge_transfe_07.pdf

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encouraged and, iii) plans for concrete operational arrangements, regarding actions to be undertaken to promote and facilitate cooperation between the various data collection activities.

The Expert Group produced in 2009 a comprehensive report[4] entitled “Metrics for Knowledge Transfer from Public Research Organisations in Europe” that comprises surveys of KT across European countries, comparison between various KTO surveys and recommendations and guidelines related to KT core indicators.

In order not to overlap with such a broad analysis that took about 2 years and involved more than 12 experts, we focused our study on the perception of current metrics of success by researchers and research performing organisations. We completed the study by testimonies of professionals involved in KT either as part of their academic activities or in full-time.

Methodology

The methodology of Task 8.1 was carried out in two ways:
- Email interviews
- Selected one-to-one interviews

Metrics analysis

Scientists are often requested for completing questionnaires and surveys of all sorts and therefore potentially reluctant to answer. Our strategy here was thus not to carry out an exhaustive and statistical analysis but rather to target relevant people in research performing organisations from different European countries in order to get a general perception of the recognition of KT activities in marine scientists’ career. These people have been previously contacted and asked for consent. We thought it was also appropriate to probe research funding agencies to estimate the added value of researchers’ KT activities when applying for project funding. The objective here was to see whether significant discrepancies exist between the two sectors.

Based on our professional networks in marine science, researchers and funding agency assessors were identified in order to represent a wide range of European countries (France, Norway, Germany, Ireland, Portugal, Sweden, UK, Italy, Denmark, Netherlands and Poland), institutions, career advancement and male-female parity.

Researchers were personally contacted by email on the 17 May 2016, and research assessors in funding agencies on 19 July 2016.

The academics were asked for specific information:
- Position (junior, senior)
- Mission (research, teaching, outreach/communication)
- Type of organisation (university, industry, research institution)

[4] http://ec.europa.eu/invest-in-research/pdf/download_en/knowledge_transfer_web.pdf

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- Country of work
- Gender

The assessors were asked for:
- Their institution
- Country of work
- Gender

They all had to rate a list of metrics currently used to evaluate research performance, according to their own experience. The rating was on a scale from 1 to 5:
- 1 being very important
- 2 important
- 3 no opinion
- 4 not important
- 5 not important at all

These metrics were related to scientific production and relations with society, industry and policy. They could add additional metrics to the list and were also asked to give examples of knowledge transfers and their opinion on current research performance metrics.

The items to rate were the following:

Scientific Production
1. Publication in a peer-reviewed International or National Journal, listed in international databases (PubMed, ISI Web of knowledge)
2. Publication in a peer-reviewed International or National Journal, NOT listed in international databases
3. Publication in a NON peer-reviewed Journal
4. Publication of a patent
5. Invitation to be a speaker in an International or National congress
6. Oral communication with proceedings in an International or National congress
7. Oral communication WITHOUT proceedings in a national or international congress
8. Poster in a national or international congress
9. Editor of a book or journal
10. Author of a book or a book chapter
11. Other publications (translations, position papers,…)
12. Other scientific productions (database, software, exhibition catalog, project report,…)
13. H-index

Teaching & supervision
14. Number of master and/or PhD student supervised
15. Number of teaching hours of undergraduate students
16. Number of teaching hours of graduate students
17. (Other)

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Research & development contracts
18. Involvement in National projects
19. Involvement in European Commission projects (FP7, H2020, etc.)
20. Involvement in International Projects (human frontier, bilateral projects)
21. (Other)

Science for Society
22. Participation to workshops for school students or in popularization events
23. Oral presentations in popularisation conferences (TED talks, université du temps libre)
24. Participation to science for society exhibitions (Science Fest, Sea festivals, Biodiversity day, Lab Open doors day,…)
25. Author of an article for a popularization magazine (NewScientist, Biofutur, Science news)
26. Interview for TV or radio shows
27. (Other)

Science and Industry
28. Number of partnerships or subcontracting with industry
29. Number of co-supervised PhD students with industrial partners
30. Number of maturation funding projects you've been involved in
31. Number of hours of lectures in trainings or workshops for industry audiences
32. (Other)

Science for Policy
33. Development/contribution to Position or white papers
34. Involvement in Science to Policy interfaces
35. Involvement in Science to Policy events
36. (Other)

Interviews

In order to provide case studies of Knowledge Transfer, interviews were conducted by Skype teleconferences and in person. The following questions were asked to a selection of professionals who perform important Knowledge Transfer activities:
- What is your definition of KT?
- Please describe your KT activities
- What kind of audience where you targeting?
- How much time do you spend on KT activities?
- What was the impact of your KT activities for the concerned field? On your career?
- What do you think of the current need for justifying the money spent for research and the race for publication?

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Results and Discussion

1. Interviewees demographics

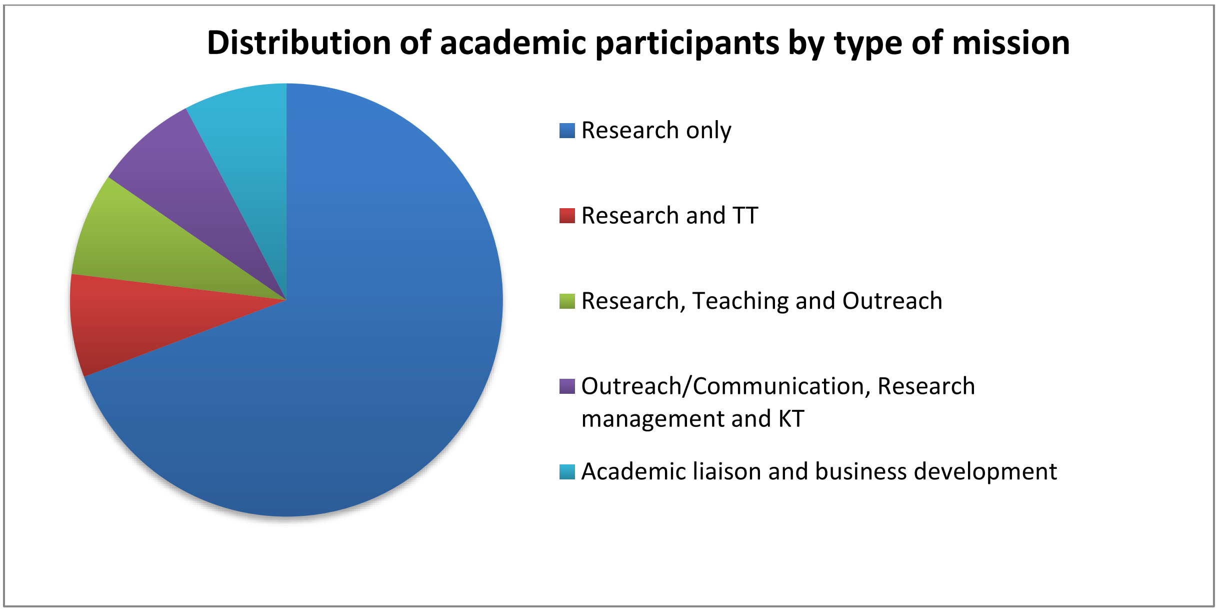

Figure 1. Distribution of participants to the Task 8.1 Interview by type of mission. Nearly three quarters only performed research activities. TT: technology transfer, KT: knowledge transfer.

The aim of the questionnaire was not a statistical study but a more focused approach with selected people where it was possible to compare between countries or genders.

A panel of 17 academics were contacted, amongst them 13 answered to the email interviews: 7 of them were women, 6 were men. It was also sent to a selection of 16 research assessors in funding agencies. Nine of them answered: 4 women and 5 men.

Most of the academic participants (see Figure 1) were having research activities, of which two had additional activities: technology transfer for one, teaching and outreach for the other. Two academic participants did not perform any research, instead one was performing academic liaison and business development activities, the other one was doing outreach, research management and KT.

The academic participants were mostly performing their activities in research institutions (Figure 2), however their place of work was not linked to their main occupation.

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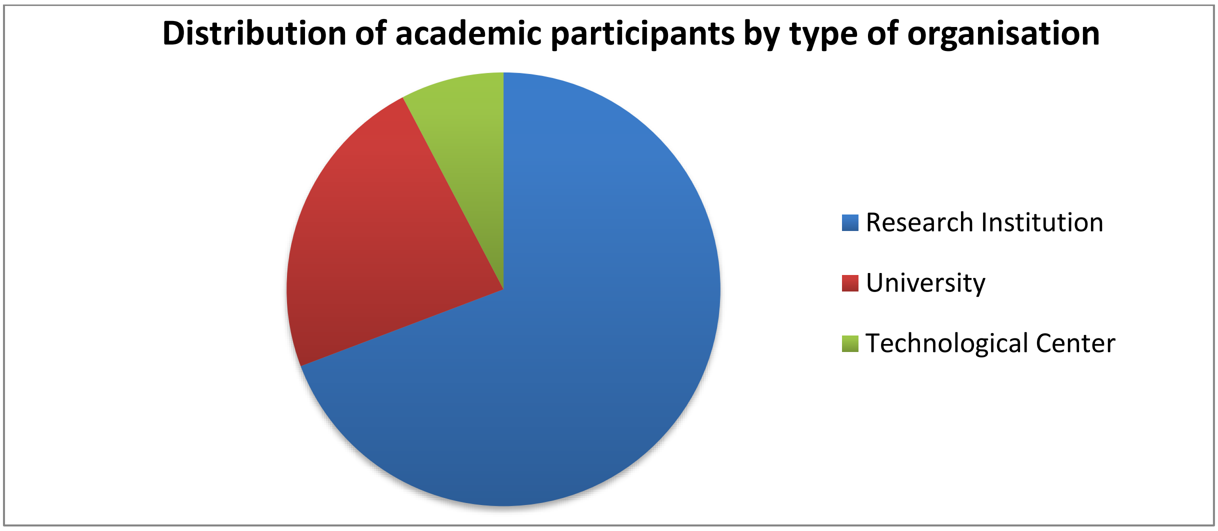

Figure 2. Distribution of participants to the Task 8.1 Interview by type of institution. More than two thirds work in a research institution.

2. Metrics for research performance seen by academics

Research performance of individual scientist is assessed mainly on publication and patents whereas success of RPOs depends on its international ranking (Universities) and different factors.

Top 10 research performance metrics for academics

Table 1 represents research performance metrics ranked according to interviewees, in order from the most important to the least important. The key scientific production appeared to be the **publication in a peer-reviewed journal**, listed in international databases, such as PubMed or ISI Web of Knowledge. This was true for all people who performed research, with or without additional activities such as teaching, technology transfer and outreach or communication. It was only considered of low importance for people involved in academic liaison and business development activities.

This top criterion was closely followed by the **involvement in research and development contracts**, such as European, international or national projects.

For other Science related metrics, in the top 10 metrics, there was also the number of congress-invited speaker (5th position) and H-index (9th position).

Supervision of students was also important or very important for 70% of the participants (all performing research as main activity).

The Science for Policy category was considered important, as 2 out of 3 metrics were in the top 10: contribution to position or white papers and involvement in science-policy interfaces.

Science for Society metrics

Most of the participants had rather a neutral opinion about **science for society activities** and only a third saw it as important for their career, those were participants from Southern European countries

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(France, Italy, Spain and Portugal).
Participation to popularization **events** was generally seen as not important at all.

Other metrics

Teaching seemed less important, but was still seen as positive in the case of graduate students. However, for the one participant not performing research, **teaching or supervision** was considered not important at all.
Interestingly, no evident opinion was expressed for the **publication of a patent**. When looking in detail in the results, half of the academics considered it as rather important and the other half not important.
Finally, publications in non-peer-reviewed journals were ranked very low, none of the participants considered that it has any value in a CV.

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Table 1. Average ranking of research performance metrics for academics.
Av Sr: average score, 1 is most important, 5 is not important at all.
Sc: scientific production, RD: research and development contracts, T: teaching and supervision, P: science for policy, So: science for society, I: science for industry.

	Research Performance metrics	Av Sr	Category
1	01. Publication in a peer-reviewed Journal, listed in international db	1.3	Sc
2	19. Involvement in European Commission funded projects	1.3	RD
3	20. Involvement in International projects	1.5	RD
4	18. Involvement in National projects	1.6	RD
5	05. Invited speaker in a national or international congress	1.8	Sc
6	14. Supervision of master and/or PhD students	1.8	T
7	33. Development/contribution to Position or white papers	1.9	P
8	28. Partnerships or subcontracting with industry	2.0	I
9	13. H-index	2.1	Sc
10	34. Involvement in Science to Policy interfaces	2.1	P
11	06. Oral communication in a congress with proceedings	2.2	Sc
12	09. Editor of a book or journal	2.4	Sc
13	31. Participation in lectures or workshops for industry audiences	2.4	I
14	30. Participation in maturation funding projects	2.5	I
15	07. Oral communication in a congress WITHOUT proceedings	2.5	Sc
16	16. Teaching of graduate students	2.6	T
17	25. Author of an article for a popularization magazine	2.6	So
18	35. Involvement in Science to Policy events	2.6	P
19	10. Author of a book or a book chapter	2.7	Sc
20	29. Co-supervision of PhD students with industrial partners	2.7	I
21	12. Other scientific productions	2.8	Sc
22	26. Interview for a TV or Radio show	2.8	So
23	11. Other publications (translations, positions papers, ...)	2.9	Sc
24	15. Teaching of undergraduate students	3.0	T
25	22. Organisation/participation in popularisation events	3.0	So
26	23. Oral presentations in popularisation conferences	3.0	So
27	04. Publication of a patent	3.2	Sc
28	24. Participation in science for society events	3.2	So
29	08. Poster in a national or international congress	3.4	Sc
30	02. Publication in a peer-reviewed Journal, NOT listed in international db	3.5	Sc
31	03. Publication in a NON peer-reviewed Journal	4.5	Sc

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3. Synthesis with metrics seen by funding agency assessors

Table 2. Average ranking of research performance metrics for funding agency assessors.
Av Sr: average score, 1 is most important, 5 is not important at all.
Sc: scientific production, RD: research and development contracts, T: teaching and supervision, P: science for policy, So: science for society, I: science for industry.

	Research Performance metrics	Av Sr	Category
1	01. Publication in a peer-reviewed Journal, listed in international db	1.3	Sc
2	18. Involvement in National projects	1.4	RD
3	19. Involvement in European Commission funded projects	1.6	RD
4	14. Supervision of master and/or PhD students	1.6	T
5	20. Involvement in International projects	1.7	RD
6	10. Author of a book or a book chapter	1.7	Sc
7	28. Partnerships or subcontracting with industry	1.8	I
8	33. Development/contribution to Position or white papers	1.9	P
9	16. Teaching of graduate students	1.9	T
10	05. Invited speaker in a national or international congress	1.9	Sc
11	29. Co-supervision of PhD students with industrial partners	2.0	I
12	34. Involvement in Science to Policy interfaces	2.1	P
13	25. Author of an article for a popularisation magazine	2.1	So
14	09. Editor of a book or journal	2.1	Sc
15	04. Publication of a patent	2.1	Sc
16	30. Participation in maturation funding projects	2.2	I
17	02. Publication in a peer-reviewed Journal, NOT listed in international db	2.3	Sc
18	31. Participation in lectures or workshops for industry audiences	2.4	I
19	06. Oral communication in a congress with proceedings	2.4	Sc
20	15. Teaching of undergraduate students	2.6	T
21	11. Other publications (translations, positions papers, ...)	2.6	Sc
22	35. Involvement in Science to Policy events	2.7	P
23	22. Organisation/participation in popularisation events	2.7	So
24	23. Oral presentations in popularisation conferences	2.8	So
25	13. H-index	2.8	Sc
26	26. Interview for a TV or Radio show	2.9	So
27	24. Participation in science for society events	2.9	So
28	12. Other scientific productions	2.9	Sc
29	08. Poster in a national or international congress	3.0	Sc
30	07. Oral communication in a congress WITHOUT proceedings	3.0	Sc
31	03. Publication in a NON peer-reviewed Journal	3.9	Sc

In general, academic participants and funding agency assessors had a similar ranking of metrics for research performance (see Annexe 1), and there was no obvious difference between the country of participants, their experience, nor their gender.
They all agreed that the most important metric was the **publication in a peer-reviewed journal**, listed in international databases, such as PubMed or ISI Web of Knowledge. They also agreed on the major value of the **involvement in European, international and national projects**.

The same neutral opinion was expressed for: science for society items, poster communications, other scientific publications (position papers, translations) or other scientific productions (softwares, databases, reports).

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The opinions for a few items were not concordant between the two categories of participants:

- writing a book or book chapter and patent publication were both underestimated activities by academics (average rank 3) compared to assessors that ranked them higher than 2.
- teaching grad students and supervising PhD student had also a rank lower than 3 for academics and closer to 2 for funding agency assessors.
- interestingly, funding agency assessors considered rather important the publication in peer-reviewed journal, not listed in international databases, when academics considered rather unimportant
- on the opposite, the **H-index** was also considered as an important criterion for 80% of the academic participants, when assessors had a neutral opinion about it.

The result for **Patent publication** showed that interviewees did see the importance of this scientific production, **whereas it is commonly highly valued by their organisations** and those who assess research academics did not agree on the importance of this scientific production.

4. Towards efficient metrics for research performance

The participants were asked to express their opinion on current research performance metrics and to describe what would be their ideal metrics. Raw results are showed in Annexe 1.
The most obvious trend was that researchers wish to have more criteria for assessing their work. They consider that the race for publication and bibliometric is over-estimated and is not sufficient to judge of a researcher's work.

Scientific fields are quite difficult to compare. Interviewees would like that assessment take into consideration the diversity of their activities, which, they agree, is time consuming, but it would be the only way for a fair evaluation.

5. Interviews

Professionals were chosen and interviewed for their outstanding participation in Knowledge Transfer activities, according to the broader meaning embracing both definitions (see the definitions section). The following portraits are the synthesis of their interviews. First are displayed the portraits of two scientists performing KT in addition to research activities, then three portraits of former scientists that perform or were performing KT as a main activity.

Sam DUPONT, Researcher in the Department of Biological and Environmental Sciences at the University of Gothenburg.

Sam Dupont has been highly involved in KT activities for eight years, in parallel to his research on ocean acidification. He became aware that very little data is available on the impact of ocean acidification on the African continent, where environmental changes will hit the hardest and strongly affect the local populations.
He thus decided to develop and contribute to a capacity building initiative by organizing three courses in South Africa (2015), Mozambique (2016) and Mauritius (2016). They had participants from

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20 African countries. The first workshop was aimed at a large audience: policy makers, researchers and professors. The goal was to raise awareness about ocean acidification in Africa. The other workshops were more technical, for an audience of young scientists, and focusing on biology (Mozambique) and monitoring (Mauritius). One workshop demonstrated that it was possible to build a laboratory from scratch for less than 10kUSD. He has also contributed to the development of school curriculum and educational tools (e.g. http://i2sea.stanford.edu/).

Impactful KT needs significant resources in time and money. Sam's involvement in these activities is very important, as he estimates that more than 25% of his time is dedicated to KT. This is possible since it does not interfere with his scientific production (e.g. enough publications per year). Most of the time Sam allocates to KT activities is spent in identifying key stakeholders, establishing direct contact and use the optimal message and communication strategies. He noticed that targeted KT is much more impactful that random dissemination. This requires upstream investigation on the societal needs and values. From a career perspective, he admits that on a CV, scientific production is the most important, but his high level of participation to KT activities allowed him to be identified as an internationally recognized communicator, which is a strong vector for new collaborations and more invitations to public events and conferences.

From a personal point of view, he considers his KT activities very rewarding. He appreciates the social and interpersonal side of this work, and finds it useful in a more tangible way than just performing pure research.

He thinks that being a communicator is not intuitive and researchers are often not trained to carry out KT activities, which leads to setting those aside. He has been attending communication training workshops and works with social science professionals who elaborate communication and education tools.

Philippe POTIN, Researcher in the Station Biologique de Roscoff at the French National Centre for Scientific Research (CNRS).

Philippe Potin is the leader and scientific coordinator of IDEALG, a 18-partner long-term project that aims to develop algal biotechnologies. He is deeply involved in KT activities, which are the essence of one of the workpackages (WP) of the project. He designed this WP like a platform for collaborative projects where impactful KT is carried out in many ways, to various audiences.

He supported successful KT aimed at industrial stakeholders such as new enzymes production, metabolomic and genomic technologies as well as algae cultivation techniques. He is involved in popularization events for schools (students and teachers), local policy makers and professional associations. He participates in supervision of students and training of new support staff, which allows him to stay connected to pure research. He is also involved in competitiveness clusters and

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biotechnology networks that link research and industry. He also performs worldwide dissemination of the project.

These KT activities helped raising awareness of the place of seaweed in the local economy, on environmental issues and also promoted the creation of new academic-industry projects (e.g. ALGOLIFE), PhD thesis and two EU-H2020 funded projects: ALFF and GENIALG.

Philippe has been involved in KT activities since he started out in science and today it takes most of his time. However, he admits that he built his career on a strong basic research dynamic, knowing that KT is more considered like the "icing on the cake". Publishing enough and at high level still remains required to be well assessed in his institute.
From a personal point of view, he considers popularization as the most rewarding. He would like to participate to activities that would help creating jobs in local companies, promote scientific culture with artists and ecomuseums. He appreciates working in a research institution such as CNRS that is more focused on publishing quality science than patents.

He believes that KT activities have to be fed directly by science, and should be communicated by the researchers themselves, not communicators and consultants from transfer centers, who are too disconnected from upstream research and thus lack creativity.

He believes that citizens expect scientists to make them dream and they are happy with it. However, he regrets that policy makers and entrepreneurs misunderstand research thinking that public money has to create an artificial economy generating benefits rather that support research, education, creativity and culture which are the last resources that are not yet outsourced.

Damien Guiffant, manager of Oceanomics, a project coordinated by Colomban de Vargas, funded by the French program "Invest for the Futur".

During his PhD, Damien did KT mostly in the form of Science for Society. He was organizing conferences for school students about anticancer research, and the use of sea Urchin and yeast as models in anticancer research. He also wanted to raise awareness on the distance in the value chain between basic research and pharmaceutical industry.

He also worked as the project manager of MG4U (Marine Genomics for Users), a FP7 project that aimed at transferring knowledge around a specific yet broad field: Marine Genomics. The goal was enhancing contact between researchers and three audiences: science, industry and policy makers. Some key effective KT of MG4U were:

- summer courses and workshops for students and researchers,

- factsheets for industry displayed in several symposia positioned in the industry fields, such as Biomarine convention in 2011 and 2012,

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- a publication, a policy brief and a workshop aimed at policy makers to raise their awareness on marine genomics' applications,

Agnès Pouliquen, director of Systema Environnement, a company dedicated to Knoweldge Transfer between science, stakeholders and policy makers.

Agnès is specialised in KT related to coastal and marine biodiversity. She regrets that decisions can be made without sufficient background scientific knowledge. This results from a difficulty in finding a shared communication channel between research, professionals of the maritime world and policy makers. Her work fits into this obvious need of translators of science: her role being to enhance links and create a continuous interaction between scientists and end-users.

The vision of KT at Systema Environnement is the capacity to synthesize and translate science into a targeted and practical message. It is creating a solid bond between the two communities and it requires:
- a deep understanding of the knowledge source and trust from the scientists, who are often not used to intermediary,
- an excellent knowledge of the target's needs and background,
- an extensive network in both communities.

She has a PhD in ecology, being thus a specialist in this field. She is also a generalist, able to analyse the needs of her various audiences and to adapt to their level of knowledge, making sure that the transferred knowledge has been well understood and impactful.
She insists that efficient KT cannot be done just as a side project, but needs a dedicated and trained person and is thus a fully-fledged job.

Pierre Colas, Head of the Technology Transfer (TT) office at the Station Biologique in Roscoff.

Pierre is an INSERM researcher (INSERM is the French national Institute for health and medical research). Over the past 20 years, he has been performing research on target proteins and molecules with therapeutic interest and he has created a biotechnology company to add value and exploit his results. This knowledge of both basic research and industry allowed him to develop the TT office in Roscoff marine station. Part of his activities focus on the design of Blue Valley, a scientific park dedicated to marine biotechnologies in Roscoff. He is also involved in Blue Train, a multi partner (including 15 companies) training program for students and professionals, whose goal is to foster the development of marine biotechnology in Brittany.

Pierre's vision of KT is circulating the scientific knowledge to an audience than does not have necessarily access to it or the background for understanding it, by adapting the message, the channel and the aims. It can be targeted but also disseminated. For him it is quite different from what he

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performs when doing TT. Most of the industrial stakeholders he interacts with are well aware of the science behind a patent. However, KT can contribute to TT in an indirect way, by preparing the background and raising awareness about new scientific methods in companies with little or no R&D activities, (e.g. traditional fields such as mussel or oyster-farming).

In the context of the EMBRIC H2020 project (http://www.embric.eu/), a study performed by the workpackage 5 led by Pierre, highlighted that the social and economic impact of TT originated from the Roscoff marine station is mostly local. He assumes it is probably linked to the geographical dependence to the marine environment and resources, and that such territoriality may not be observed in other sectors (e.g. pharma, where TT probably occurs on a more global scale). This territorial anchoring prompts Pierre to build a network and a broad knowledge of the regional industrial base and its needs, as well as relations with local policy makers.

He believes that researchers should be interested in KT and TT, and at least be aware of the opportunities offered by the French ecosystem that supports innovation and TT. He regrets that the evaluation of researchers focuses almost only on publications and does not take into account KT and TT activities.

Conclusions/ Reflections

It is noticeable that nowadays researchers are more and more asked to justify their activities (even fundamental science) with regard to the added value that these activities contribute to society, i.e. Social and economic impact. Most research programs (and therefore funding opportunities) are now addressing societal challenges. Scientists are increasingly aware of the need and sought to communicate and transfer the outcomes and challenges of their research to the different actors in society (citizens, schools, policy makers, industrials…). As a matter of fact, many of them are pleased and see the benefit in doing so although it requires time and specific expertise or even training. At the present time, researchers are expected to publish in high ranked international journals, to teach, to supervise graduate students, to attract funding, to publish patents (and license these patents), to attend and organise international conferences or workshops, to contribute to position papers for policy makers and to develop popularization activities. All these diverse activities are essential, stimulating and most of the time rewarding. But at the end of the day, and this is clearly shown by the results of the analysis, what truly matters today to researchers' activity and career development is still the race for publishing in peer-reviewed journals combined with the ability to raise funds preferentially from international programs.

This situation results in constraints for the development of knowledge transfer activities in the scientific community which is not restricted to the marine science community. As seen in the results of this report (questionnaire and live interviews), knowledge transfer activities are not a real added value for a researcher's career. As long as this situation persists, KT activities will never be a priority both in research performing organisations and funding agencies and will remain a useful and rewarding activity but still undervalued and thus not of main concern for researchers. To make a long

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story short, KT activities are more “a cherry on the cake” than a top priority in a researcher track record.

There is currently a clear paradox between what is expected from researchers, (including an emphasis on KT activities) and the evaluation criteria that are applied for their professional assessment and their research project’s appraisal.

One option to overcome this paradox would be to acknowledge Knowledge Transfer as a significant part of a research profiles, by re-examining research performance metrics. However, these metrics are grounded on a long and robust scientific academic culture and heritage and they will not evolve rapidly.

Another option would be to promote the development and implementation of new jobs (and careers), dedicated to knowledge transfer and popularisation of research activities and outcomes. Ideally this new kind of activity would have to be performed inside research performing organisations, as it has to be constantly fed by research and kept up to date. Within research institutions scientists would have to be informed of KT officers role, understand their work and trust them.

To be efficient, there is a clear need to be a specialist in a restricted scientific field, have a broad network and targeting an audience that has been deeply studied to be aware of its specific needs. Each target community being different, the type of KT is also different. The channels of KT for society - like popularisation and citizen science - are not the same than KT for industry, which is closer to Technology transfer and requires understanding of business needs.

More and more early career scientists are attracted by this new type of activities, they truly see the value of it and are strongly motivated (for instance by the importance to educate the general public and stakeholders on the environmental issues the ocean is facing). Provided that they get an appropriate training in outreach and communication tools and methodologies, and that the research community is prepared to welcome their work, these young scientists (or others) would perfectly fill the gap. Obviously, there is a need and an opportunity.

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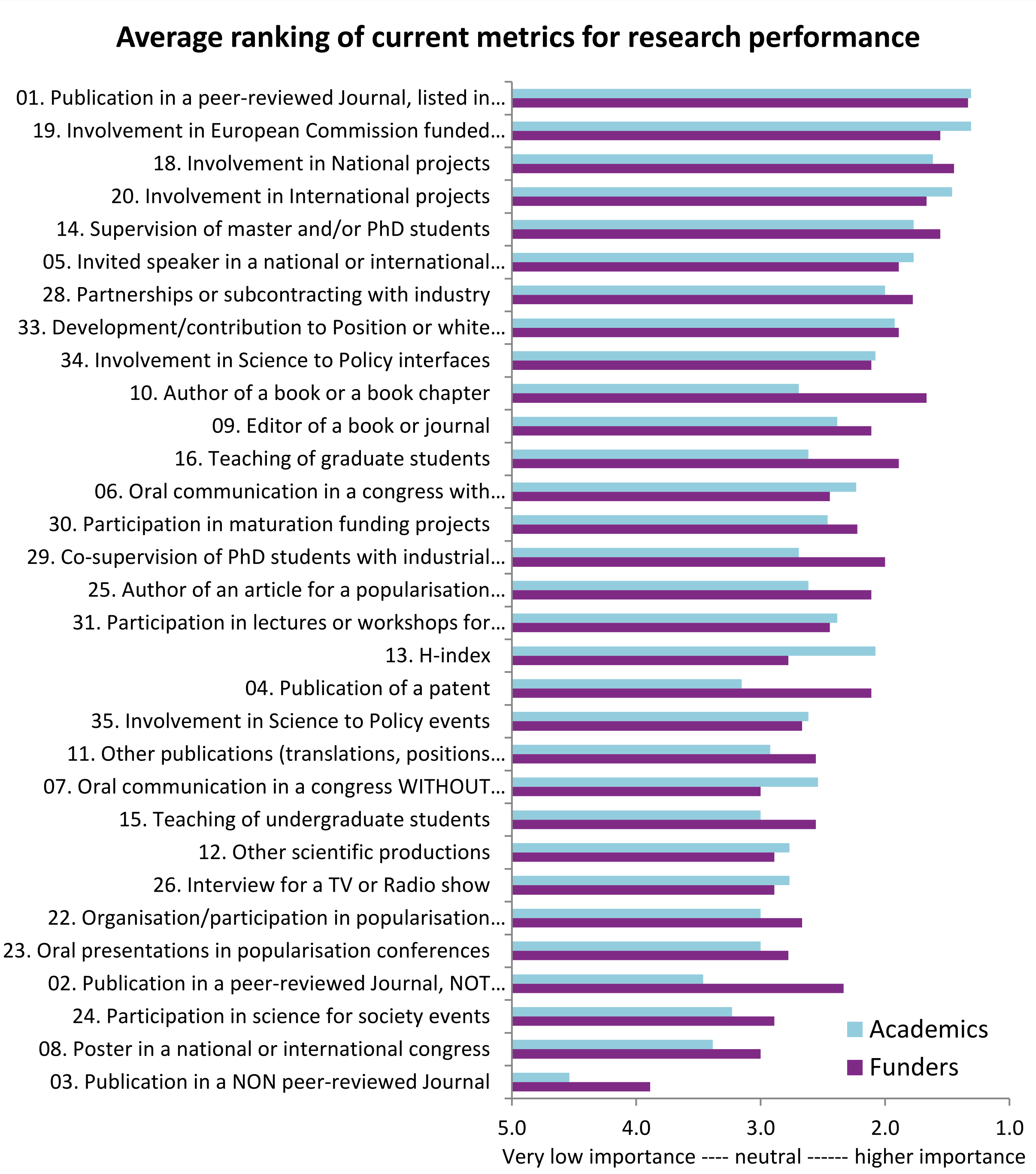
ANNEXES

Annexe 1. Comparative ranking of research performance metrics



Annexe 1. Comparative ranking of research performance metrics from the point of view of academics (blue bars) and funders (violet bars). The items have been sorted from the best rated to the least rated.

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Annexe 2. Comments on performance metrics

The following are comments of participants about research performance metrics:

Academic 1
More quality, less quantity, i.e., less competition for publication, research money and new scientific bureaucracy.

Academic 2
The importance of impact factors and H factors for assessing CVs is still too strong. It happens too often that scientists just know that a person published in a particular journal, but don't even know, what the finding was.

Academic 3
There is no ideal metric that can express research performance. Clearly Knowledge Transfer to outside the research community is not very well integrated in any metric yet. Currently the metrics are dominated by number of publications and impact factors and one tries to fit the system as good as possible.

Academic 4
I feel the informative value of H-index and related indices is largely overestimated, as numbers of citations vary considerably among research areas. A much more balanced and fair system could be a combination of such indices with direct peer review. For example, the German National Science Foundation asks applicants to indicate those five publications that they themselves consider as their best. These may then be evaluated by peer reviewers. Admittedly, this is a more time consuming evaluation process than simple statistics on indices, but why should the evaluation of a complex matter such as science be simple?

Academic 5
On a personal level and for promotion within the organisation, scientific achievement is the most important. However, within the current climate its all about how much money you bring in. We are increasingly encouraged to get involved in knowledge transfer and innovation, but these are often difficult metrics to evaluate and therefore reward within the current promotion schemes.

Academic 6
My research institution relies mostly on bibliometric indicators to evaluate the performance of its scientific staff. It is, of course, the easiest way to "rank" people and attribute promotions. However, it is way too restrictive, especially since the same organisation (like any other research institution) expects its researchers to do much more than only research (i.e. produce intellectual property and protect it, find industrial partners, build multi-centric research projects and get them financed, contribute to teaching programs, popularize their scientific activities, etc.). In my experience, these other activities are largely outweighed by the bibliometric criteria.

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Academic 7
One of the weaknesses of research metrics is that they use to make more emphasis on performance rather than on impact, and there should be more balance on this.

For example, the most important thing of patenting is that someone uses the innovation protected by the patent and that this yields some benefits to the society. Performance metrics, normally consider patent applications and patent granting but not licensing or returns on licensing.
Of course, only if we have a good measurement of performance; we will get an idea of how diligently a system is using research and innovation resources; but is diligence the only thing that should be required? Measuring efficiency, through indicators that look more deeply into impact would be a good step forward.

Another example, in this case more focused on KT metrics: in many areas it has been strongly fostered the start-up of new companies as an effective vehicle for knowledge transfer. Most of the statistics refer to the number of companies set up, but is number of companies the most important indicator? What about survival rates, turn-over, employment, etc.?

Different impact contexts (science, policy, industry, society) would need different sets of indicators and metrics. And the system should recognize them all for career development.

Academic 8
I am allowed to spend time communicating with stakeholders because I am publishing enough and attract enough funds. It is not valuated and often seen as a "waste of time". There is also a lack of training for these activities.

Funder 1
Science must seriously push back against the desire to define simple ways of robust research assessment - they do not exist. The only way to assess research is to deal with the SCIENTIFIC CONTENT of the research output. This requires expertise, time, and effort, but the resulting assessment is vastly superior to any metrics-based assessment."

Funder 2
My organisation evaluates and funds projects, not individual researchers on their CVs; their activities in coordination, collaboration with industry and management of students are important but not major.

Annexe 3. Suggested activities for measuring research performance

Teaching/supervision
Involvement in designing the curricula for students (different levels)
Supervision of postdocs
Continuous professional development
Hosting international scientists
Supervision of research staff including post-docs/technicians/engineers

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Research and Development
Networking and connecting the laboratory and researchers
Scientist/student exchanges
Anything that brings in money!

Science for Society
Participation in public consultations/events related to environmental governance and sustainable development.

Annexe 4. Examples of Knowledge Transfer

Academic 1
Series of workshops based on 'Mobilisation and Mutual Learning' concept.

Academic 2
Not sure I answer this question as you mean it, but we have helped three companies to further develop products: Noldus GmbH, Loopbio GmbH and Marine Breeding Systems GmbH.

Academic 3
I have started a spin-off company

Academic 4
identification of virulence gene in pathogenic bacteria=> diagnostic tools improvement.

Academic 5
Pilot funding was made available between Cambridge University and the British Antarctic Survey to promote innovation and collaboration (max value circa 50k euros) which has been very successful in forging lasting links between the two institutions, which did not exist before. The ultimate aim is to develop products of interest to industry.

Academic 6
We coordinated a pioneer collaboration between fishing companies, fisheries researchers, and fishing gear manufacturers to develop more selective fishing gears. The work methodology involved a lot of knowledge sharing and sensitization, and important efforts on co-creation. The fishermen association and the fishing gear manufacturer in the project continued to work together (hiring research capacities) after the project, since 2010, to develop and test new gear designs to cope with selectivity objectives of the local fleets (to foster compliance with the CFP).

Academic 7
Capacity building project in Africa

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