Acronym: COLUMBUS

Title: *Monitoring, Managing and Transferring Marine and Maritime Knowledge for Sustainable Blue Growth*

Grant agreement n° 652690

Deliverable D8.6

Recommendations for European and National Funding Agencies to embed Knowledge Transfer Systems in Current and Future Funding mechanisms

February 2018

Lead parties for Deliverable: AquaTT
Due date of deliverable: M36
Actual submission date: M36
Revision: Version 1.0

Project funded by the European Commission within the Horizon 2020 Programme (2014-2020)	
Dissemination Level	
PU Public	X
PP Restricted to other programme participants (including the Commission Services)	
RE Restricted to a group specified by the consortium (including the Commission Services)	
CO Confidential, only for members of the consortium (including the Commission Services)	

Acknowledgement

The work described in this report has been funded by the European Commission under the Horizon 2020 Framework Programme.

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Executive Summary

The European Union is at the forefront of marine and maritime research. However, this does not necessarily translate directly to marketable or productive innovation. If Europe is to truly exploit this research and achieve its agenda of a Blue Economy, it must take active measures to foster a research culture where Knowledge Transfer is a critical part of calls, proposals and projects. It is crucial that the generated knowledge, insights and technologies from marine and maritime research projects are achieving their full potential to contribute to the design and implementation of Blue Growth strategies.

The COLUMBUS project (2015-18) is an EU-funded Horizon 2020 "Coordination and Support Action" (CSA) dedicated to Marine and Maritime Knowledge Transfer. Its overarching objective was to ensure that applicable knowledge generated through EU-funded science and technology research be transferred effectively to advance the governance of the marine and maritime sectors, while improving the competitiveness of European companies and unlocking the potential of the oceans to create jobs and economic growth in Europe, in line with the principles of Blue Growth. COLUMBUS focused on validating the core concepts of Knowledge Transfer, as well as evaluating techniques for fostering a culture of open innovation and exploiting the full potential of marine and maritime research.

Among the outputs of the project was the development of a robust and adaptable Knowledge Transfer methodology. Following this process of collection, analysis and transfer of knowledge from the marine and maritime sector, 53 “COLUMBUS stories” were published describing individual Knowledge Transfer activities carried out within the project. These stories demonstrate where a step-wise approach to Knowledge Transfer has resulted in real merit and measurable impact.

Furthermore, working with funding agencies and stakeholders, COLUMBUS examined the feasibility of improved systems and processes for European and national funding agencies to ensure measurable value creation from research.

To facilitate and expedite the uptake and impacts of these outputs, COLUMBUS has developed a set of recommendations for funding agencies at national, regional and European levels to consider. These recommendations outline how funding programmes could incorporate Knowledge Transfer at all stages of the research lifecycle (pre-funding, project implementation and post-project). The following recommendations are focused on Knowledge Transfer aspects of the funding lifecycle only and are based on the principle that effective implementation of Knowledge Transfer activities in projects increases the chance of measurable impact.

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The COLUMBUS recommendations for European and national funding agencies to embed Knowledge Transfer systems in current and future funding mechanisms are:

Pre-Funding Stage

Recommendation 1: Funding call topic descriptions should provide clear expectations on the expected impacts of a project, making the distinction between what is expected to be achieved and transferred to potential end-users within the lifetime of a project versus what ultimate impacts might be achieved post-project.

Recommendation 2: Where communication activities are expected to be carried out by project partnerships, funding agencies should consider providing sufficient guidance, support and training, with corresponding application form templates to aid projects in designing fit for purpose communication activities.

Recommendation 3: Funding agencies should provide sufficient guidance and training to evaluators so that they are able to assess if applications have designed suitable communication activities. Where possible, multi-stakeholder evaluation panels working together might be better suited to assess the overall potential of a project to achieve the expected impacts of a call.

Recommendation 4: The negotiation period between selection and contracting could be used to improve any weaknesses in projects' communication and Knowledge Transfer components.

Project Implementation Stage

Recommendation 5: Ensure that funding agency staff tasked with monitoring project implementation understand Knowledge Transfer principles and strategies so that they can effectively monitor and support projects.

Recommendation 6: Templates and instructions for official project reporting should prioritise the identification of the knowledge outputs generated, Knowledge Transfer activities carried out, and the impacts of the application of such knowledge**.**

Post-Project Stage

Recommendation 7: Project assessments should include as a major component an evaluation of the efforts to carry out Knowledge Transfer and assess whether a project has measurably achieved its expected impact within its time frame, as well as the potential for further impacts post-project.

Recommendation 8: Funding mechanisms for post-project Knowledge Transfer would help maximise the chances of measurable impacts from research investments.

Recommendation 9: Efforts to carry out effective Knowledge Transfer should be encouraged, recognised and promoted.

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Key Terms

Several terms are regularly used in this document. This section provides an explanation of how these terms relate to each other. The definitions below may differ from other sources but are the adopted definitions for the COLUMBUS project.

Knowledge Transfer: The term for the overall process of moving knowledge between knowledge sources to the potential targeted users of knowledge. Knowledge Transfer 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.

Knowledge Output: A unit of knowledge or learning generated by or through research activity. They are not limited to de-novo or pioneering discoveries but may also include new methodologies/processes, adaptations, insights, alternative applications of prior know-how/ knowledge.

Knowledge Output Pathway: This can be one step, or a series of steps required to carry a Knowledge Output to its Eventual Impact. Where there are a series of steps, it will include detailed mapping of the steps, the users involved at each step and their predicted role in the pathway to Eventual Impact.

Eventual Impact: The ultimate end benefit of the application of the Knowledge Output. It is defined as an enhanced situation that is contributing to "Blue Growth" including the implementation of the Marine Strategy Framework Directive (MSFD). *(This is not to be confused with the impact of an intermediary user taking up knowledge and transferring it down a step in the Knowledge Output Pathway to Eventual Impact. This is termed "Transfer Impact".)*

Transfer Impact: The demonstrable evidence that a Knowledge Output has travelled down a single step on the Knowledge Output Pathway.

Target User: The individual(s) identified in the Knowledge Output Pathway to whom a Knowledge Fellow will transfer the Knowledge Output.

End User(s): The individual(s) who will apply the Knowledge Output at the end of the Knowledge Output Pathway.

Exploitation Partner: An external organisation/institution/individual who has an interest and/or expertise that may assist in transferring the Knowledge Output down the Knowledge Output Pathway to its Eventual Impact.

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Introduction

Europe 2020, the European Union's growth strategy, states that Europe's future jobs and economic growth will increasingly have to come from innovation in business models, products and services[i]. However, such innovation has been stymied by the lack of a comprehensive and sustained capacity for transferring research results into goods and services in knowledge intensive sectors. The European Commission (EC) recognises this, noting that while the EU remains a research powerhouse, this research too rarely succeeds in being converted to innovation or reaching the market[ii].

Europe must therefore be better at making the most of its innovation talent: fostering a culture of open innovation within research programmes presents a powerful tool for accomplishing this. The potential benefits of opening up research information are clearly identified in the EC's investment plan for Europe where it is stated that to 'boost research and innovation, EU competitiveness would benefit from fewer barriers to knowledge transfer, open access to scientific research and greater mobility of researchers'[iii]. Indeed, this need was emphasised by the High-Level Group[iv] on maximising impact of EU Research and Innovation Programmes.

A critical avenue for inducing this culture shift will require that communication about European research projects aims to demonstrate the ways in which research and innovation is contributing to a European 'Innovation Union' and account for public spending by providing tangible proof that scientific evidence and collaborative research adds value[v]. Activities to disseminate information, exploit research and innovation results, and carry out communication activities are thus an integral part of the EC's current Research and Development Programme, Horizon 2020.

One knowledge intensive area requiring an improved research-to-innovation pathway is the economically vital marine and maritime sector[vi]. As the EU continues to advance a strategy of Blue Growth to effectively and sustainably support a more robust Blue Economy, the marine and maritime field is faced with grand challenges which can only be addressed by innovations that are underpinned by solid science (see Navigating the Future IV[vii] and the Rome Declaration 2014[viii]).

COLUMBUS brought together a new extended multi-stakeholder, multi-disciplinary, transnational partnership with the experience, strategic positioning and track record in the marine and maritime sectors to achieve the ambitious impacts of the call topic. Understanding that strategic changes are needed in how the marine and maritime community interact and collaborate for mutual benefit, the partnership represented all aspects of the research lifecycle (funding agencies, researchers, communications experts and knowledge users) and all regional sea basins in Europe.

To achieve its objectives, COLUMBUS established a "Knowledge Fellowship", a distributed network of Knowledge Transfer Fellows embedded in different types of organisations across Europe. These Fellows roles were to carry out Knowledge Transfer using the COLUMBUS Knowledge Transfer methodology, a replicable methodology that offers a practical solution for stimulating impact and measuring value creation. These Fellows focused on the following sectors: Aquaculture; Fisheries; Marine Biological Resources; Marine Environment and Futures; Marine Governance and Management; Marine Monitoring and Observation; Marine Physical Resources; and, Maritime Transport and Logistics.

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COLUMBUS successfully carried out a large-scale pilot of Knowledge Transfer activities across European marine and maritime sectors resulting in 56 stories of Knowledge Transfer activity, 48 of which have previously been made public[ix] (some of the remaining stories will not be published at the request of the knowledge owner due to intellectual property rights considerations). These stories describe how, as a direct result of COLUMBUS, research was accepted, adopted and exploited by relevant users, providing evidence to support that value from research investment can be created by using Knowledge Transfer practices.

On 22 February 2018, COLUMBUS presented the culmination of the project's findings and recommendations to members of the European Parliament, who hosted the COLUMBUS final public event entitled "Accelerating Blue Growth through Marine and Maritime Knowledge Transfer". The findings were well received and fostered a lively discussion on the future role of Knowledge Transfer in EU research projects. The presented evidence and content of this debate, along with the many others held over the course of the project, were incorporated and considered alongside the activities and outputs of COLUMBUS and have been synthesised into this report, a set of recommendations on how to embed Knowledge Transfer systems into current and future funding mechanisms.

COLUMBUS Recommendations

Throughout the implementation of the COLUMBUS CSA project, the partnership has been active in different stages of the research project lifecycle. Based on these observations, COLUMBUS has developed **a set of nine recommendations for funding agencies** to consider in relation to Knowledge Transfer.

It is the belief of the authors that these recommendations could help agencies optimise their funding schemes by embedding Knowledge Transfer principles (Annex 1) into all stages of the research lifecycle, and by so doing maximise the likelihood of effective Knowledge Transfer, resulting in measurable impacts.

It is important to note that not all of these recommendations will be relevant to the very different types of public funding programmes covering many scales (e.g. budget, geographic coverage).

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Pre-Funding Stage: Funding Call Description

Call topics can vary widely from being very open, promoting "bottom up" ideas from partnerships to solve a specific challenge, to "top down" prescriptive descriptions of what is desired with regards to expected activities within a given project. Regardless of the framing of call topics, it is important to define expectations with regards to "expected impacts" within the timeframe of the projects and the "expected measures to achieve impacts".

For applicants to be able to design suitable "Knowledge Transfer" processes and activities within a project, they need to appreciate what the funding agency expects of them within the lifetime of a project and what will be assessed. With clarity on expectations, consortia will be in a good position to design and embed appropriate "Knowledge Transfer" principles in their project design including appropriate financial resourcing of Knowledge Transfer activities, inclusion of appropriate expertise into the partnership, and selection of suitable tools, channels, mediums, Key Performance Indicators (KPIs) etc proportional to the level of expectation defined by the funding body.

By funding agencies setting out clear expectations with regards to expected impacts and measures to achieve these impacts, applicants are more likely to set themselves realistic targets that are achievable and measurable, reducing the likelihood of proposing unrealistic ambitions in applications.

Recommendation 1:

Funding call topic descriptions should provide clear expectations on the expected impacts of a project, making the distinction between what is expected to be achieved and transferred to potential end-users within the lifetime of a project versus what ultimate impacts might be achieved post-project.

Proposed Actions

- Adopt a SMART approach (specific, measurable, achievable, relevant and time-limited) to describing expected impacts within the timeframe of a project.
- Provide support documents that outline how to embed best-practice Knowledge Transfer principles into project design.
- Insist upon Knowledge Transfer principles being implemented into project proposals and carried out for the duration of the project
- Include a requirement for qualitative and quantitative milestones for each activity of the project, to assist tracking of the expected impacts.
- Distinguish between the long-term impacts of a project versus expected impacts which are achievable within the lifetime of a project.

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Pre-Funding Stage: Proposal Submission Criteria and Requirements

Researchers typically take the lead in designing research projects and writing applications. Projects are now expected to take a more active role communicating about e.g. the ambitions of the project, its intended activities, the knowledge outputs generated in the project and/or the impacts or potential future impacts of the research. The intended recipients of the knowledge include potential end-users who could apply the knowledge, stakeholders who have an interest in the results and the wider public.

However, researchers are not professional communicators, nor should they be expected to be. There is therefore currently a lot of confusion and misunderstanding surrounding communication terminology in the research community. In relation to communication of research results to different audiences, terms such as dissemination, communication, outreach, engagement, knowledge exchange, Knowledge Transfer, Technology Transfer, and exploitation often have varying definitions. Furthermore, research projects are increasingly composed of multi-disciplinary, multi-stakeholder partnerships where misunderstandings of terminology can be further amplified due to the use of specific terms for differing purposes in different communities.

For applicants to understand funding agencies´ expectations with regards to expected communication activities within their projects, there is a need to address this terminology issue. Appropriate guidance on communication aspects (including definitions of terms) in the context of a specific funding call will provide clarity at proposal writing stage. Within such guidance, indications of the weighting (in terms of budget designation and expected effort) between communication activities as well as in the overall project design will help applicants design appropriate and realistic activities suited to the call.

Effective communication requires complete customisation of the channel, medium and tools used to engage target audiences. It is not always possible to define such approaches at proposal stage as the expected Knowledge Outputs of a project don't always match actual Knowledge Outputs during implementation, and specific target users may not be known. Thus, funding agencies (and the evaluators they use) must recognise that it is acceptable and positive to propose a Knowledge Transfer process suitably embedded in a project design and that such built-in flexibility is in fact a more proactive approach than defining all transfer activities at proposal stage.

Recommendation 2

Where communication activities are expected to be carried out by project partnerships, funding agencies should consider providing sufficient guidance, support and training with corresponding application form templates to aid projects in designing fit for purpose communication activities.

Proposed Actions

- Ensure application form questions frame the expected communication activities for project applicants.
- Provide guidelines, such as the COLUMBUS handbook[x], that include definitions for different communication terminology (dissemination, exploitation, Knowledge Transfer, etc) and outline a methodology that can be incorporated into project design.
- Consider providing training workshops on how to approach Knowledge Transfer in project design.

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Pre-Funding Stage: Proposal Evaluation

Researchers typically evaluate research project applications. Such peer review is necessary to be able to understand if bids fulfil the scientific excellence criteria and if the scientific methodology is appropriate, etc. When it comes to assessing more generic parts of applications including suitable communication and Knowledge Transfer, not all evaluators have the required competence or expertise. Similarly, not all evaluators have a full understanding of how specific knowledge outputs might enter a commercial value chain or achieve the expected scientific or policy impacts set out in a given call topic. While it is very difficult to source evaluators with all the skills needed to assess a project application, a multi-stakeholder and mixed team competence approach to evaluation panels can be hugely beneficial in selecting the best project for any given call. Facilitating evaluation panels to meet and provide their combined expert perspectives on the applications can help in the assessment process. Even with a combined profile, the evaluating panel also requires the correct instructions to adequately score proposals on their Knowledge Transfer strategy and the contents of the 'impact' section. In addition, appropriately briefing evaluators on the expected impacts (within- and post-project) and guidance, scoring criteria and weighting for assessment of a project's potential to achieve the call impacts, as well as the "measures to achieve impact", will aid the assessment process.

Recommendation 3

Funding agencies should provide sufficient guidance and training to evaluators so that they are able to assess if applications have designed suitable communication activities. Where possible, multi-stakeholder evaluation panels working together might be better suited to assess the overall potential of a project to achieve the expected impacts of a call.

Proposed Actions

- Ensure that evaluators are familiar with the expected impacts of the call and are differentiating between expectations within the project duration versus post-project.
- Provide guidance to evaluators on expectations for communication/Knowledge Transfer aspects that should be included in applications.
- Ensure the evaluation criteria, weighting and scoring for "impact" and "measures to achieve impact" is appropriate to the funding call.
- Build evaluation panels that combine individuals with different profiles and competence, including an expert(s) in communication and Knowledge Transfer who can assess suitability of proposed plans.
- Provide an opportunity for evaluators of a call to come together in a facilitated discussion to ensure a team approach in discussing and assessing applicants' responses to "impacts" and "measures to achieve impacts".
- Ensure that the scoring guidance allows for consortia to propose Knowledge Transfer processes with in-built flexibility to adapt as required during implementation.
- Ensure that the scoring guidance rewards projects that have ensured that the allocated resource is proportionate and reasonable with regards to achieving the call's expected impacts and project's activity.

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Pre-Funding Stage: Contract and Grant Negotiation

Funded projects are typically those that exceed a minimum threshold per criteria and score highest overall. Recognising that selected projects may be strong in some areas and weaker in others, the "negotiation" period between selection and contracting provides an opportunity to make improvements to project design through negotiation between funding agencies and partnerships. If communication experts are used during evaluation, they will be able to identify weaknesses in dissemination and exploitation plans and such feedback could be used as a basis for improvements. Communication specialists in the funding agencies and/or external experts could take responsibility for such engagement with partnerships.

Where funding agencies may no longer allow adjustments during negotiation period due to the negative delaying effect it has in signing contracts and projects commencing (e.g. Horizon 2020), such agencies may consider additional external support (e.g. CSA project like COLUMBUS or the Common Dissemination Booster tender contract) to projects during implementation, and/or more monitoring by management agencies, and/or more guidance to applicants at the application stage. Where the external support approach is taken, Grant Agreements (contracts) should include clauses that oblige projects to cooperate with external support.

Recommendation 4

The negotiation period between selection and contracting could be used to improve any weaknesses in projects´ communication and Knowledge Transfer components.

Proposed Actions

- Consider using the negotiation period to optimise the communication/Knowledge Transfer aspects of selected projects.
- Consider providing external advisory and training support in Knowledge Transfer to funded projects.
- Ensure that those involved in negotiations related to communication/Knowledge Transfer aspects are experts.

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Project Implementation Stage: Monitoring Knowledge Transfer Aspects within Projects

Researchers are often unaware of the value of the knowledge that they possess. Where they are aware, they may not have time and/or the know-how to transfer it effectively so that it can be taken up and applied by others. Nevertheless, partnerships are typically contractually obliged to communicate their results, for example, the Horizon 2020 Consortium Agreement commits partners to actively disseminate their results within and beyond the lifetime of a project.

Funding agencies or external contractors are typically assigned to monitor projects. A major part of the monitoring is ensuring that the projects adhere to their contractual commitments. Beyond the administrative component, more and more funding agencies want to assess the impact of projects. To be able to accommodate this broader monitoring role, staff tasked with monitoring require new skills and competence in Knowledge Transfer processes, how to assess Knowledge Transfer activities and the metrics to assess whether success has been achieved.

The COLUMBUS Knowledge Transfer methodology (summarised in Annex 1) could be a useful reference guide for monitoring staff as it outlines key processes and considerations in relation to Knowledge Transfer components within projects.

Recommendation 5

Ensure that funding agency staff tasked with monitoring project implementation understand Knowledge Transfer principles and strategies so that they can effectively monitor and support projects.

Proposed Actions

- Train monitoring staff in Knowledge Transfer principles to assist them in supporting and assessing project activities.
- Provide advisory/mentoring support to projects that are implementing Knowledge Transfer activities.
- Establish a database of experts that could be called upon to support specific projects in carrying out Knowledge Transfer steps, such as expert analysis, the development of Knowledge Output Pathways, support on customised knowledge transfer plans etc.
- Provide guidance to projects on Knowledge Transfer approaches.
- Facilitate analysis meetings with external experts as part of the monitoring process.
- Monitor the collection and analysis of Knowledge Outputs to ensure that there is sufficient time for the transfer of knowledge.
- Provide support through Knowledge Transfer funded initiatives to perform the analysis and transfer of identified Knowledge Outputs.
- Provide advice on opportunities, events and/or experts that might inform the design of Knowledge Transfer plans and activities.
- Establish an external, expert Knowledge Transfer team to be available as a help desk (e.g. similar to the IPR helpdesk) to support projects.

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Project Implementation Stage: Project Reporting

Project reporting is a necessity to ensure that projects adhere to their contractual obligations. However, some reporting structures have evolved over time to become administratively heavy and burdensome on funding agencies and project partnerships alike. Furthermore, they don't always focus on what should be the top priority for all public funding agencies: the identification of the conversion from scientific discovery to impactful value creation for society at large, based on research investments.

Efforts to simplify and streamline reporting would benefit and be appreciated by both funding agencies and project partnerships.

Reduction of administrative aspects could then free up partnerships to take time to reflect upon and report on the Knowledge Outputs generated in the project, the activities that took place to transfer knowledge and an assessment of the success of such efforts. Such reporting would enable funding agencies to tangibly identify impacts within the project duration and potential impacts post-project. Such information could be used to communicate back to society the impacts of the overall research programme as well as inform where more research investments may be required.

Recommendation 6

Templates and instructions for official project reporting should prioritise the identification of the knowledge outputs generated, Knowledge Transfer activities carried out, and the impacts of the application of such knowledge.

Proposed Actions

- Change the focus of reporting from project activities to the specific Knowledge Outputs generated and the steps taken to transfer the knowledge.
- Request that Knowledge Outputs are collected in a structured and consistent manner on an ongoing basis in projects.
- Provide feedback on the depth, quality and clarity of descriptions of Knowledge Outputs.
- Provide a deliverable template which includes a table at the beginning which identifies the Knowledge Output(s) described within the report and included in the electronic repository (below), that can evolve and be updated with the project.
- Develop a free and publicly available repository to allow projects to upload (and update) Knowledge Outputs (including details of innovations, patents and publications), or utilise an existing platform, e.g. the EC's Information Sharing Platform for marine and maritime research, Marine Knowledge Gate or Researchfish®[xi], during the project lifetime.
- Ensure that quality guidelines are in place for those uploading the Knowledge Outputs, and those checking the descriptions.
- Provide incentives for regular provision of quality Knowledge Outputs as they are generated and penalties for late submissions.

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Post-Project Stage: Project Assessment

At the interim or completion stage of a project, there is typically an assessment by funding body staff or external assessors. Assessment of activity and achievements of the project are expected in final reporting but sometimes the scale of a project (numerous work packages, dozens of deliverables, published documents etc.) can make assessment difficult and time consuming. Accordingly, the assessor may not develop a clear understanding of the overall impact achieved during the project or what could be achieved if future effort was carried out post-project.

If a report were to focus on the knowledge outputs produced by a project, how it was applied and if the project responded to the call text, an assessment of impact would be far more achievable and insightful. This would allow funding agencies to have a real assessment of whether a project's activities contribute to societal benefit and how. It is important to note that such an approach can also cover the more traditional scientific outputs of a project. Basic research which is subsequently published in a scientific journal also has a value to society. The contents of a scientific paper can be examined to identify and describe one or multiple knowledge outputs within it (e.g. de-novo knowledge, innovative methodology, new data set etc.). Converting a paper into multiple knowledge outputs makes identification easier and the knowledge more accessible to multiple potential target users.

Recommendation 7

Project assessments should include as a major component, an evaluation of the efforts to carry out Knowledge Transfer and assess whether a project has measurably achieved its expected impact within its time frame as well as the potential for further impacts post-project.

Proposed Actions

- Adapt report templates to make it easier for assessment to take place (e.g. description of results in terms of Knowledge outputs).
- Provide detailed guidance on what partnerships should include and how it should be presented in final reporting (e.g. Knowledge Output Table).
- Assessment should cover identifying and validating impacts from Knowledge Transfer carried out within the project duration and the potential for more impacts post-project.
- Consider approaches like the UK Research Council where a final report is no longer a requirement if beneficiaries submit details of their outputs, outcomes and impact to a central repository (e.g. Researchfish®).

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Post-Project Stage: Continued Knowledge Transfer

Achieving impact can be a lengthy process and without sustaining Knowledge Transfer activities beyond the lifetime of a project, knowledge can be lost or left unapplied. Even with the best Knowledge Transfer strategy in place, rarely will a partnership be able to achieve all expected impacts within a project timeframe (typically 3-5 years).

The role of who should transfer knowledge post-project is unclear in most cases. Many scientists in Europe are on short-term contracts and there is a pressure to find and move on to the next research contract or job to continue to carry out research, as well as "publish or perish".

There is a current gap in many funding programmes to support follow-up initiatives to allow high potential knowledge from funded research to continue to be transferred following the expiration of research funding. Such funding could be used by the original partnership or a sub-group of the same, or transfer could be carried out by other actors with an interest or mandate in ensuring the knowledge moves down a Knowledge Output Pathway to achieving an ultimate impact.

Where several projects have been funded in a topic area, the cumulative value of the knowledge may be important or significant for use in policy, industry, science or society. There may be value in clustering knowledge and supporting initiatives that transfer knowledge clusters for a specific application or user group.

Recommendation 8

Funding mechanisms for post-project Knowledge Transfer would help maximise the potential of measurable impacts from research investments.

Proposed Actions

- Add a section to the final report to include details of the status of Knowledge Transfer efforts, requesting partnerships to suggest follow on steps that could be carried out, and whether partners would be interested in carrying out such steps if financial support was available.
- Provide follow on funding mechanisms to support post-project Knowledge Transfer activities.
- Provide the possibility for short term Knowledge Transfer extension for partnerships to apply for to carry out post-project transfer, e.g. €50k-100k extension for 4 – 12 months.
- Establish an internal team within a funding agency or engage a subcontractor that is responsible for assessing projects that are completed and identifying high potential knowledge that require further Knowledge Transfer to achieve impact. Such a team could potentially carry out the transfer or engage other actors to support transfer in cooperation with project partners.
- Ensure that all collected Knowledge Outputs are deposited in a public portal that can be used by various stakeholders in different ways.

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Post-Project Stage: Celebrating Impact

The world of research has its own established metrics for assessing researchers´ scientific impacts. Such metrics are not always in-line with the type of impacts desired by funding agencies targeting societal impacts and value creation for society. To bring about a culture shift in of impactful research, funding agencies can help by being seen to celebrate the achievement of impact. This will educate researchers on what impact is and how varied it can be. Furthermore, research organisations might begin to recognise non-traditional achievements of their scientists, such as the development of patents, spin-offs and collaborations, training courses, textbooks or methodologies used by others. If Knowledge Transfer is going to be embedded in future calls, then there needs to be recognition of the value of Knowledge Transfer activities at all organisational, institutional and cultural levels, for instance via career progression or champions.

Impact stories can be included in formal reports required by the funding agencies and expressed in public facing press releases. They can also be used to illustrate how public spending on research results in value.

Recommendation 9:

Efforts to carry out effective Knowledge Transfer should be encouraged, recognised and promoted.

Proposed Actions

- Identify and promote publicly successful Knowledge Transfer and impact stories.
- Identify researchers who can be champions of Knowledge Transfer.

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Conclusion

Reflecting on the overall process, it is clear is that there is a lack of established terminology and processes for Knowledge Transfer. Currently there are no clear established guidelines on Knowledge Transfer for European-funded research and as such the methods and understanding of Knowledge Transfer vary widely from project to project. There is a need to better define the objectives and methods for different communication activities within projects – dissemination versus outreach versus Knowledge Transfer versus technology transfer. The value of upskilling all actors in the research system to help them better understand the concepts and methodologies for various communication activities and how to measure success in effective communication cannot be underestimated. The roles and responsibilities of actors in the process needs to be reassessed and established, as in many cases it is unclear who has the responsibility for Knowledge Transfer.

It is also clear from the experiences of the COLUMBUS project that while there are challenges surrounding the Knowledge Transfer process (what it is, how to carry it out, how to measure impact), there are also bigger issues at play which concern the manner in which publicly-funded scientific research is carried out and the role it plays in society. Inherent differences exist between the research community, industry, policy-makers and other users of knowledge, insofar as each has their own concept of technical levels, priorities, vocabularies, agendas, and time scales. These differences create multiple barriers that prevent effective Knowledge Transfer and innovation. There also needs to be a culture change within the research community that places less emphasis on peer-reviewed publications and provides more incentives for ensuring results are transferred and utilised by users. Such a cultural shift has the potential to influence the evolution of the entire scientific research lifecycle, which in turn could result in an increased return on investment in research and a stronger, more robust knowledge-based economy.

The work of COLUMBUS has helped progress the state-of-the-art in Knowledge Transfer of European Commission marine and maritime funded research. The methodologies used can be applied by others who could replicate the process for other research communities. The COLUMBUS partnership is committed to continuing its work and ensuring not only demonstrable value creation from research investments for the advancement of society, but also that the research community is recognised and rewarded for the value creation they bring to society.

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Annex 1: Key Principles of the COLUMBUS Knowledge Transfer Methodology

Collection

- Knowledge is collected in units of knowledge (defined as *Knowledge Outputs* by COLUMBUS) generated by the project rather than grouped together in project reports/deliverables.
- Knowledge is collected on an ongoing basis to maximise the time available for transfer within the timeframe of the project.
- Descriptions of Knowledge Outputs are clear so that users understand what the Knowledge is and why they are relevant to them.
- Collected Knowledge Outputs go through a validation process to guarantee accuracy of descriptions.
- How and where Knowledge Outputs will be stored and made publicly and freely available is clear from the start of the project (e.g. publicly accessible knowledge repositories like the EC Information Sharing Platform or the Marine Knowledge Gate).

Analysis

- Analysis of Knowledge Outputs takes place and covers at least the following;
    - Potential applications and impact potential (short, medium and long term)
    - Market or policy readiness
    - Alternative applications vs the original expected application (other sectors or markets etc)
    - Transfer potential within the timeframe of a project
- A "Knowledge Output Pathway" (KOP) is designed per Knowledge Output that defines a route and timeline towards an intended impact. It comprises a single step or a series of steps and includes detailed mapping of timelines, activities and users. The first user in a KOP is termed the "Target User".
- Target user(s) are profiled per Knowledge Output. Profiling is needed to ensure that their preferences, motivations and capacities are considered in the design of a customised Knowledge Transfer plan.

Note: External advisory boards or committees comprised of multi-stakeholder groups are extremely useful when carrying out analysis steps.

Knowledge Transfer

- A customised Knowledge Transfer Plan is developed that significantly improves the chance of successful transfer.
- All Knowledge Transfer Plans have built in metrics to assess the transfer activity carried out and, measure the uptake and application of the knowledge by the target user.
- Knowledge Transfer Plans also outline metrics for determining if and how far the Knowledge Output moves down a Knowledge Output Pathway towards an ultimate impact.

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- Resourcing of Knowledge Transfer is appropriate and proportionate to the expected impacts within the project duration as defined in the funding call.

Note: Projects may not have the time, resources or remit to ensure that knowledge has an ultimate impact beyond the projects' scope. Thus, it is important to identify any potential intermediaries who have an interest or mandate to help knowledge move down a pathway. Transfer and uptake of knowledge is not easy and can be very time consuming and resource intensive. Acceptance that transfer efforts can and often fail should be expected. Significant learning can still be derived from failed efforts and if time/resources permit, other attempts could take place within the lifetime of any given project.

Impact Measurement

- SMART impact indicators are in place before the transfer activity occurs and measure:
    a) The occurrence of transfer activity;
    b) Any uptake of knowledge by target users;
    c) The application of knowledge by target users;
    d) The progress of knowledge towards long-term impacts.

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End Notes

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[x] COLUMBUS (2018) Deliverable 8.5 COLUMBUS Blue Society Knowledge Transfer Handbook.

[xi] UK's Researchfish® is an online facility that enables research funders and research organisations to track the impacts of their investments, and researchers to log the outputs, outcomes and impacts of their work. It is currently used by over 100 funders in the UK, North America and Europe to gather information from researchers about the outcomes of their work.

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