EUROPEAN UNION

EUROPEAN RESEARCH AREA
AND INNOVATION COMMITTEE

– ERAC –
Secretariat

Brussels, 4 July 2017
(OR. en)

ERAC 1206/17

NOTE

From:	ERAC Secretariat
To:	ERAC delegations
Subject:	Final Report of the ERAC Ad-hoc Working Group on Measuring the Impact of EU Framework Programmes for Research and Innovation at National Level

Delegations will find annexed to this Note the final report of the ERAC Ad-hoc Working Group on Measuring the Impact of EU Framework Programmes for Research and Innovation at National Level, as adopted by written procedure.

ANNEX

ERAC AD-HOC WG ON

Measuring the Impacts at National Level of the participation in EU FPs

Final Report

Summary

The present report proposes a template for Member States and Associate Countries to assess the impact at national level of the participation of their national research and innovation organisations in the EU Framework Programmes. The report takes as its starting point that such impact has to be understood multidimensional level. Hence, it identifies different impact dimensions, in addition to the structure of national participation in the programmes: structuring impacts, scientific impacts, innovation impacts, economic impacts and societal impacts. Such a template, however, cannot have the ambition to resolve issues of attribution, nor can it provide complete harmonization of the analysis between the different MS/AC. Measuring impact is complex, relying on sophisticated methodologies, and its depth depends on several factors such as available datasets, maturity of national RDI systems or interactions with local funding schemes.

As such, the template focuses on the identification of indicators, which are either generally available or traditionally used without requiring a very significant dedication of resources. The template provides a series of indicators, for the different dimensions of impact, which MS/AC are invited to use in their own national impact studies, and which include indicators which are considered to be core to the template. Such use is expected to contribute to improve national assessments by facilitating comparison across the ERA and by implementing a longitudinal analysis.

Introduction and objectives

Following the mandate of the ad-hoc WG the present report proposes a template for the assessment of the socio-economic impacts of EU Framework Programmes (FPs) at national level. This "harmonised impact evaluation template [is] based on (i) a core set of evaluation questions, (ii) common evaluation methodologies, (iii) common indicators and (iv) available common datasets and available EU and national databases to assess the socio-economic impacts of EU Framework Programmes at national level."

At the heart of the objective in the development of a harmonised template is the interest in developing analytical and methodological practices for the assessment of the impact of participation in the Framework Programmes (FPs) at national level, which can have a common reference basis for comparison across Europe. At a time when studies on the impacts of research and innovation activities are expanding, such process is expected to contribute both to improving the comparability of data, of particular relevance when Member States and Associated Countries (MS/AC) are considering the impact of their activities through an international programme like the FPs, and to guide and consolidate the practice of assessing the impact of national participation. The latter point is of particular importance taking into account the diversity of previously existing practices in this regard. While some MS/AC have previously developed studies of the impact of national participation (with different degrees of depth), several other MS/AC have not gone beyond the monitoring of participation levels and participation structures in the FPs. The latter monitoring is certainly a relevant dimension for analysis, and one that is considered in the Template presented in Annex, but one that can only be considered as a starting point for a fully-fledged impact study.

Hence, in the present report it was clear that there was a need to consider different levels of expectation regarding the extent of the impact analysis to be proposed and the suggested methodologies, as these might differently correspond to already implemented practices or, on the contrary, to practices to be implemented. As such, we take here as a guiding principle the need to guarantee a template that has the conditions to be implemented throughout the different MS/AC. However, we considered that it was important to take into account methodologies which have already showed relevance, but which may require greater investment in its application, namely

because of difficulty in collecting comparable data. As such, we propose to consider a basis set of indicators (based on availability of information at eCORDA database) and to identify additional indicators, when relevant, that could be compiled by MS/AC depending on data availability and resources available.

It is also acknowledged that the area of impact assessment of research and innovation policies is under significant development. This regards methodological advances, as well as developments in the production of new relevant data. Strong developments in research information systems as well as in the uses of big data are relevant examples. As such, the template proposed here should be considered as a 'living document', open to further development. This template should promote a first set of guidelines that can provide an important contribution for MS/AC to assess the impact of their participation in the FPs with a basis for comparison, but also that such template should not be seen as limiting to further developments. It is to be expected that, as MS/AC develop specific indicators/methodologies/data not considered here and that can be considered as of interest for the adoption by other MS/AC, this template may be adapted accordingly.

National objectives from participation in the FPs

The identification of the relevant research questions to assess the impact of national participation in the FPs relies on the specific objectives that MS/AC have regarding their participation in the FPs. The "general objective of Horizon 2020 is to contribute to building a society and an economy based on knowledge and innovation across the Union". This should be achieved by strengthening the scientific and technological basis of European industry and society, promoting a European research area in which researchers, scientific knowledge and technology circulate freely.

While these objectives, benefitting the ERA and European industry as a whole, are also necessarily reflected at the national level, these may have differing impacts at the national level. In addition, considering the different contexts of the national research and innovation systems, the S&T basis and the competitiveness of the economy at national level, the impacts of participation in the FPs will differ, and national objectives regarding participation are expected to reflect these differences.

As such, it was clear that an initial specification of national objectives from participation in the FPs was needed, to reflect in greater detail expectations and potential impacts. The distinct objectives reflect how each MS/AC can better understand the role of national strategies and support instruments in motivating participation and promoting its positive impact at the national level. From this we are able to identify the following distinct objectives, that are shared by all MS/AC:

- Identifying financial return of national participation in FPs
  - Are there significant differences in success of participation across instruments/organizations?
- Improving internationalization of research and innovation communities
  - Do European networks build on existing links? Do they build new international links?
- Improving research quality and promoting research careers
  - How do research results compare with other similar programmes?
- Achieving economic/innovative impact
  - What was the impact in terms of innovation in participating firms?
- Upgrading of technological/innovative capabilities
  - Has participation in FPs contributed to strengthen technological/innovative capabilities?
- Improving innovation capabilities in specific emerging fields
  - Has participation in FPs contributed to develop new technological/innovative capabilities in emerging fields?
- Creating economic spillovers at national/sectoral level
  - Does national participation cluster in specific sectors?

– Promoting societal impact of research

  - What wider societal impacts can be identified?
  - Has civil society organisations (CSO) participation led to new lines of action/collaboration?

These different objectives have led us to identify different main dimensions that correspond to potential impacts at the national level from the participation in the FPs, and which reflect the different national objectives. These are presented below in more detail according to the following dimensions of analysis:

- participation structure;
- structuring impacts;
- scientific impacts;
- innovation impacts;
- economic impacts;
- societal impacts.

The indicators can be used to monitor change overtime, both between MS/AC, as well as for an individual MS/AC. Trend analysis can be used to identify change, growth for instance.

The following sections introduce the relevance and justification of each specific impact dimension and the indicators/data identified to be collected. It should be noted that the present report identifies the common questions, indicators, data and sources, as requested by ERAC. Naturally, these indicators are not expected to stand alone in the impact assessments to be developed in the future. The analysts from each country, who will implement the template recommended here, will have further information and knowledge, both through additional existing secondary materials as well as by contextualizing such figures within their knowledge of the system, through which to analyse

the results from the indicators suggested below. The indicators identified below are considered precisely as sources which can provide essential information for an appropriate analysis of the impact of the participation at the national level.

Policy context of 'impact' and methodological issues

The analysis of the impact of research and innovation projects and programmes has seen significant debate in recent years among the academic and the policy-making communities. Several developments have led these upsurge in interest. In the policy context the increasing pressures on public budgets resulting from the global economic crisis, as well as the greater global competitiveness through research and innovation activities, has led to needs for improved basis for allocation of resources as well as greater demands for accountability, requiring a better understanding of the impact of public initiatives. Developments in research and innovation practices, through increased globalisation of these activities, together with open innovation processes, has led to a more open and shared processes of knowledge production and use, launching new questions regarding the flows of knowledge and modes of impact. The digitalisation of innovation and knowledge production has at the same time created new traces of knowledge flows, suggesting that the identification of more varied forms of knowledge flows and impacts may be facilitated. Research information systems have been widely developed in this line (e.g. EuroCRIS, OpenAIRE). Accordingly new services have emerged in this area, together with alternative metrics, at the same time as the dominance of quantitative metrics is questioned (Wilsdon *et al*., 2015). This has also led to developments in assessment processes, with particular interest being placed in the identification of impacts that go beyond the traditional focus on scientific indicators and firm based innovation processes. The UK REF exercise, implementing in large scale the assessment of the societal impact of academic research as one institutional assessment criteria (with similar trends in other countries), has had a relevant impact in this debate, and has been followed by extensive academic analysis.

However, the developments in the area are not fully consolidated and still lack in their systematization and international comparability. In preparing this report and template the central objectives of comparability and usability by the different countries were considered to be central. While the first has primary implications regarding the sources of data and standardization of methodologies (and is clearly noted in the mandate of the WG), the second has largely to do with the investment associated with the development of the impact assessment analysis. These were points of internal discussion and of sharing of expectations and needs. In this regard, there was a central concern in developing a framework which does not entail significant additional work of data collection or very advanced analytical methodologies of data processing. There was also a concern, put forward by several representatives, regarding the burden placed on the beneficiaries, from requests for additional information or survey response (survey fatigue has been highlighted), and on the national administrative offices with responsibility for monitoring participation and for implementing this impact assessment.

Considering this, the WG focused on identifying indicators and methodologies, which best reflected the impact assessment objectives and the underlying questions, for which there are data readily available, or for which there are sources clearly identified. Data from secondary sources, of a qualitative nature (such as other national or international reports), was also considered. In this way, a primary level of comparability, which addresses different dimensions of impact, is guaranteed to a reasonable extent. There are, of course, differences at the national level in the existing information infrastructure, or on the existing prior experience in the assessment of the impact of the national participation in the FPs. But the underlying information infrastructure at the European level regarding the FPs[1], together with other existing exercises of production of indicators to assess, for example, the consolidation of the European Research Area, provides an important basis to develop an appropriate impact assessment.

[1] The indicators identified often refer to H2020, rather than FPs. Also, specific pillars, or instruments, of H2020 are mentioned. These references to the current FP should be seen as being made simply for the purpose of simplicity and more concrete exemplification. The template is considered to be applicable to other FPs, with the necessary adaptations (e.g. Societal Challenges have been introduced in H2020, but a similar instrument/programme can be identified in other FPs).

In this way, it was decided not to favour surveys among the methodologies proposed for this study, considering the additional burden on beneficiaries, as well as the investment required, together with concerns regarding the robustness of survey data for impact assessment in research and innovation activities. Case studies are considered in particular dimensions, when the collection of qualitative information is of primary relevance.

Limitations of impact assessment

Impact assessment analysis in the field of research and innovation has serious limitations that are widely recognized, and must be noted.

The impacts of research and innovation tend to have a long time lag between investment and concrete impact. There are certainly outputs, such as publications, which can be identified in the short term, but these are only indicative of the direct results of the research activities. The socio-economic impacts of the activities often result from several subsequent interactions, including during the project, and uses of the project's results and outputs, involving further projects and other intermediaries. In assessing the impacts of participation in a specific project, and the impact of the corresponding public support, the time passed may not be sufficient to appropriately identify the corresponding impacts. Policy-makers require results which can be used to steer subsequent initiatives and programmes, thus preferring to assess the impacts shortly after the end (or at interim period) of the public support programme. The traces of the flows of knowledge, underlying trajectories of impact, may not be easily identifiable (as some studies have found, this may be better followed through a qualitative approach; developments in research information systems are also improving the potential traceability).

Additionally, the issue of attribution of impact to a specific direct intervention poses several challenges. Impacts result from different paths and from the accumulation of several interventions (and also externalities). So, isolating the impact of a particular instrument, or of the Framework Programme, may be difficult. There are specific methodologies to address this issue, and these are taken into consideration here when possible. Nevertheless, the issue of attribution is particularly difficult to address with this dimension of intervention, largely of a collaborative nature.

In this regard, there are different methodological approaches that are considered to best address this issue. In relation to macro-level impacts, such as structuring impacts on the system, the template considers the identification of national comparative indicators, to assess the extent to which the corresponding indicators promote improvements in the system, or international comparisons in relation to the dimension of the research system (namely in relation to the number of researchers in FTE). The development of case studies can also contribute to address specific questions, for which the case study approach may contribute to better understand the underlying processes of impact, and the relations with participation in FP projects.

For the dimensions of scientific, innovation and economic impact, the existence of relevant meso-/micro-level data facilitates the identification of corresponding control groups. In scientific impacts national scientific publication data, according to the relevant research field, is a relevant comparative unit. For firm level data, the existence of national level surveys (e.g. CIS survey, R&D survey, or other databases, namely from private sources) can provide the underlying data for comparison, provided that, in articulation with the corresponding national statistical body and with the appropriate

requirements regarding data privacy, it is possible match the firm identification through registry data[2] to identify participants and those non-participants that can constitute a control group (e.g. using propensity score matching). Societal impact assessment is a field in development. At present, there are no set methods or databases. However, there are concepts that are generally agreed upon. Data and indicators which provide evidence on distinct channels, partners and publics which reflect forms of societal involvement in or use of research are central. The recent development of altmetrics is a case in point, contributing to identify the wider visibility and impact of research.

Thus, the approach taken here partially addresses the concerns regarding attribution by identifying different dimensions of impact and by collecting multiple indicators that reflect different processes through which these impacts are produced. In this way, we expect that an overall picture of the impact of national participation in the FPs, and of its different dimensions, can be drawn from the proposed approach.

[2] Privacy regulations may differ in this regard.

It is important to note that we are focusing here particularly on the benefits accrued from participation in the FPs. It must be noted, however, that participation in the FPs may also have negative impacts. Some may result from the lack of additionality vis-à- vis national interventions. These are expected to be identified, if existing, through quantitative methodologies proposed here. Other negative impacts may be related to indirect impacts in the system, for example regarding the extent to which the dynamics of the national system coincide, or not, with those of the FPs. These may be identified through qualitative approaches.

Impact Dimensions

For each of the dimensions of analysis identified (participation structure; structuring impacts; scientific impacts; innovation impacts; economic impacts; and societal impacts), the sections below present an initial overview and rationale for the corresponding dimension, followed by the identification of the relevant indicators and source data. The Tables below present more detailed information for each set of indicators, including references to sources and methods. Before analysing the more concrete dimensions of impact, it is important to have a wider overview of the country's participation in the FPs, as it provides an overall view of the structure of national participation. This analysis corresponds to the base level which the different MS/AC are already developing, and to which this template can also contribute to harmonise.

Participation structure

The analysis of the structure of national participation in the FPs corresponds to the most common form of monitoring developed by MS/AC. Participation data has the advantage of reflecting the formal information regarding proposal submission and formal project contracts, and therefore this is the data most easily accessible.

While in earlier FPs these data were mostly made available through Programme Committees, it has now been structured in standardized form, across the different programmes and instruments, in the eCORDA database. As such, it is easily available and provides the background information on participation on the FPs. While it includes already normalization procedures in the application process (e.g. existence of PIC number which allows the correct identification of organisations), it still has limitations, namely in the identification of individuals and teams (because it is based on the contractual process, it often has information on research managers or institutional representatives rather than on the actual principal researchers).

As participation data is essentially focused on the proposal and contract phase (which can be considered as outcomes of application processes, but are starting points for the research phase), these data do not have the limitations that exist when impact assessment processes focus on outputs and outcomes of the research projects themselves.

As previously mentioned, it should be noted that the analysis of the participation structure cannot be considered a dimension of impact assessment as such, but rather a dimension for the monitoring of performance of the system. Nevertheless, as will be seen below in the section on Structural Impacts, participation levels can be considered to be relevant indicators of structural impacts at national level of the participation in the FPs.

Indicators

Regarding the analysis of participation structure we highlight different dimensions:

- Number of projects awarded[3], number of projects coordinated, number of total national participations, total funding awarded to national participants
  - these absolute values should be made comparable in relation to each country's research base (as measured by the number of researchers in FTE) and comparable in relation to the yearly progression;
  - these absolute values should be made comparable in relation to each country's share of the total value for the same variable across the FP;
  - these figures signal the level of involvement of the national research and innovation communities in the dynamics of the European FPs, and hence higher levels of participation have the potential to have a wider impact at national level;
- Success rates in the application process, and share of applications included in the reserve list. (i.e. assessed above the threshold);
  - these figures are directly comparable across countries, or to the FPs average;
  - figures should distinguish between overall success rates and the success rate of proposals coordinated by a national partner;
  - figures should be prepared across pillars/instruments and according to organization types;

[3] References to number of projects refer to number of projects with at least one legal entity from the MS/AC. References to funding refer to funding awarded to national participants, not the total funding to the project. References to team refer to the research team (researchers, independently of nationality) from the legal entities from the MS/AC participating in the project, not all the researchers, from the different participating organisations, in the project. References to national or country refer to the country (MS/AC) applying the template, unless otherwise noted.

- these figures reflect both the capacity to participate, or to lead, in successful proposals, hence a recognition of research quality, and are also indicative of efficiency in the investment made in the application process, with lower success rates signalling a negative impact, in terms of resources invested in the application process which did not lead to a funded research project;

– Number of cooperation links resulting from participation in FPs

  - Cooperation networks should be compared vs earlier FP or vs national profile of research collaboration (e.g. in scientific co-authored publications)
  - Main partner countries according to projects with links
  - Comparison with countries overall participation distribution in H2020 (normalising through relative collaboration index)
  - Comparison with country pre-existing dominant collaborative pattern (earlier FP or internationally collaborative publications)
  - Presenting network analysis graph
  - Cooperation networks can identify direct contribution to extend existing collaborative links.

– Distribution of participation by the different types of organisations (HEIs, PRIs, SME, LFs, Other) and regions;

  - these figures should be primarily considered at the level of distribution of participations; number of projects with national participants from each organisational type, as well as number of project coordinators from each organisational type; finally success rates can also be analysed according to type of participant;

- it should be noted that the type of participant is expected to reflect, to a large extent, the distribution of participant type per programme; as such, comparative analysis should be made mostly at the level of pillar and programme; the deeper analysis of type of participation will be developed in the corresponding dominant dimension of impact;
- these figures should be primarily considered at the level of distribution of project participations; number of projects with participants ; success rates and funding distribution will also be relevant to comparatively assess both weight of programme/instrument in national participation (with implications for the analysis of the dimensions below), with regard to funding distribution, and to assess performance, through success levels compared to the overall FP success levels for each pillar;
- further analysis at the level of specific programmes/instruments will be developed in the context of the more relevant impacts below;

Table 1 - Participation Structure

Questions	Methodologies	Indicators	Databases
Has the success of national participation in the FPs improved?	Statistical analysis	- Share of participations (C*) - Share of coordinations (C*) - Share of FP funding (C*) - Success rates of application (C*)	eCORDA National STI statistics
Have national actors prepared high-quality proposals?	Statistical analysis	- Share of applications in reserve list (C*) - across instruments, organization types (C*)	eCORDA National STI statistics
Do European networks build on existing links? Do they build new international links?	Network analysis	- Cooperation links (C*)	Programme data (eCORDA) National STI statistics
Are specific institutional actors more successful in participating?	Statistical analysis	- Institutional distribution of participations (HEIs, PRIs, SME, LFs, Other) (C*)	Programme data (eCORDA) National STI statistics
Does the regional distribution of participants reflect national distribution?	Statistical analysis	- Regional distribution of participations (C*) - Regional cooperation links	Programme data (eCORDA) National STI statistics

Structuring impacts

The participation in the European FPs has impacts that go beyond the micro-level of the individual participant. It may have a wider, structuring impact at the level of the system. Structuring impacts are particularly relevant in relation to the national policy-making processes and at the organizational level of the system.

The assessment of structuring impacts at the national level from the participation in the FPs can be largely framed through the lens of the ERA Roadmap. The priorities that have been considered to delineate the ERA Roadmap reflect the MS/AC view on dimensions that are essential to structure the European Research Area. While this may be considered to be largely an impact at the European level rather than at the national level, it should be noted that the MS/AC have also considered these priorities at the national level, through the National ERA Roadmap initiatives, and as such do have relevant national RTI policies.

Several ERA-Indicators are defined and used in the ERA progress monitoring. There is no need to duplicate them. Some of the indicators used to monitor ERA progress are directly related to Horizon 2020. An example for this is the so called Adjusted Research Excellence Indicator, which relates to ERA objective 1 "Effective national research systems". It covers four dimensions including two dimensions with direct reference to Horizon 2020:

1. *"ERC grants per public R&D*" to proxy the success of countries in securing ERA-wide project based funding and

2. *"Participation in Marie Sklodowska-Curie Fellowships"* to proxy the extent of researcher exchanges across national, sectoral and disciplinary boundaries.

We consider in this regard that the ERC grants have a particularly structuring effect on the attraction of a certain research location, and hence on creating structural conditions for the development of research of highest quality, beyond the specific context of the ERC project.

It can be argued that making national research systems more effective is primarily an issue of national RTI policy. However, Horizon 2020 can support such policy changes, provide organizational learning for participants, and thus have a structural impact in that regard.

While the optimum ratio between competitive funding and institutional funding is not clear, nor easy to harmonize between different research systems, success in H2020 calls, namely in ERC calls, reflects the capacity to succeed in competitive funding structure, and can contribute to improve it. The Horizon 2020 itself is a competitive programme and can raise the competitive share of research funding. It can thus be argued, that the higher a country's participation success in Horizon 2020 is, the more this contributes to the effectiveness of national research systems.

Following this example, we consider that the structural impact of the FPs at the national level can be indicated through the different ERA Priorities, which are already structural dimensions at the intersection between the national and European levels. In this way, we analyse the structural impacts through the lens of ERA Priorities and indicators identified in that regard.

Indicators

- Priority 1 - Effective national research systems
  - Number of participations in H2020 per 1000 researchers (FTE)
  - Number of ERC grants per 1000 researchers (FTE)
  - Identification of new funding instruments implemented nationally based on H2020 instruments (number and funding level) – qualitative analysis
    - Success in participating in international competitive funding programmes is considered to reflect and to contribute to the effectiveness of national research systems, and the experience of participating may contribute to enhance the organization of local research funding systems
    - Includes additional national funding (in €) for above threshold proposals, not funded through H2020 (e.g. seal of excellence)
  - Number of participation of MS/AC in mutual learning exercises and peer-reviews organised under the H2020 Policy Support Facility

- Priority 2a - Optimal transnational cooperation and competition
  - National public funding to H2020-supported transnational cooperation initiatives (e.g. ERA-NETs, JTIs and JPIs) in % of total GBARD
  - Alignment of strategies/measures/programmes of EU MS/AC with jointly prepared strategies/measures/programmes at European level – qualitative analysis
  - International scientific co-publications, with ERA countries, from H2020 projects per 1000 researchers (FTE) in the public and higher education sector
    - The impact of the national funding to joint initiatives is partly dependent on the alignment of national and joint strategies.
- Priority 2b - European Strategy Forum for Research Infrastructures
  - Availability of national roadmaps with identified ESFRI projects and corresponding investment needs (ESFRI)
  - Share of participations in H2020 funded research infrastructures (INFRA Pilar 1) (%)
  - Number of researchers with access to research infrastructures through H2020
    - These indicators reflect the potential impact on structuring research infrastructures in each country
- Priority 3: Open Labour Market for Researchers
  - Share of participations in Marie Slodowska-Curie projects (%)
    - Comparison with overall national participation in H2020
    - Comparison, in relative terms (number of researchers FTE), with other countries

- Balance of outgoing and incoming researchers through MSCA and ERC grants
    - Number of outgoing researchers through MSCA and ERC grants (residents going abroad)
    - Number on incoming researchers through MSCA and ERC grants (non-residents moving to the country)
- Number of researcher posts funded by H2020 advertised through the EURAXESS job portal, per 1 000 researchers in the public and HE sector
    - H2020 mobility programmes contribute to more open labour market, reflecting both inwards and outwards mobility;
- Percentage of early-career researchers supported by MSCA or ERC starting grants, whose jobs were secured after termination of project funding (disaggregated by gender and origin [national/international])

– Priority 4: Gender Equality and Gender Mainstreaming in Research
    - Share of women as coordinators of national teams in H2020
        - compared to overall distribution and to national average in similar programmes;
    - Share of women among national participants in H2020 projects
    - Share of publications resulting from H2020 projects with gender dimension in research content

– Priority 5a: Scientific knowledge transfer
    - H2020 projects with collaboration between HEI/REC and firms
    - domestic firms in COST actions in % of all participations of a country in COST actions
    - Number of public-private co-publications from H2020 projects per 1000 researchers

- Priority 5b: Promoting Open Access to scientific publications
    - Share of H2020 scientific publications published in open access (total/diamond, gold and green)
    - Number of projects producing open data sets
    - Share of H2020 projects with evaluated data management plans (DMPs) in % of granted H2020 projects
- Priority 6: International cooperation
    - Number of collaborations in H2020 projects with non-ERA partners
    - International scientific co-publications, with non-ERA countries, from H2020 projects per 1000 researchers (FTE) in the public and HE sector
    - Participation in projects with an explicit international dimension in Horizon 2020
    - Number and funding volume of multilateral joint calls with non-ERA countries
        - These indicators reflect the impact of the participation in the FPs on the global collaboration patterns, on the one hand, and, on the other, on the development of projects with an external outlook.

Table 2 - Structuring Impacts

Questions	Methodologies	Indicators	Databases
Has participation in the FPs contributed to more effective national research system?	- Descriptive statistics - Case study	- Number of participations in H2020 per 1000 researchers (FTE) (C*) - Number of approved ERC grants per 1000 researchers (FTE) (C*) - Identification of new funding instruments implemented nationally based on H2020 instruments (number and funding level) ☐ Includes additional national funding (in €) for above threshold proposals, not funded through H2020 (e.g. seal of excellence) - Number of participation of MS/AC in mutual learning exercises and peer-reviews organised under the H2020 Policy Support Facility	- eCORDA; National STI Statistics - eCORDA; National STI Statistics - Secondary sources; interviews

Has participation in the FPs promoted optimal transnational cooperation and competition?	- Desk research	- National public funding to H2020-supported transnational cooperation initiatives (e.g. ERA-NETs, JTIs and JPIs) in % of total GBARD (C*) - Alignment of strategies and programmes of EU MS/AC with jointly prepared strategies or programmes at European level - International scientific co-publications, with non-ERA countries, from H2020 projects per 1000 researchers (FTE) in the public and HE sector	- National STI Statistics - Secondary sources; interviews
Has participation in the FPs contributed to the coordination of European research infrastructures?	- Desk research - Descriptive statistics	- Availability of national roadmaps with identified ESFRI projects and corresponding investment needs (ESFRI) - Share of participations in H2020 funded research infrastructures (INFRA Pilar 1) (%) (C*) - Number of researchers with access to research infrastructures through H2020	- National policy documents - eCORDA data - H2020 Monitoring Report

Has participation in the FPs promoted a more open labour market for researchers?	- Descriptive statistics - Desk research	- Share of participations in Marie Sklodowska-Curie projects (%) (C*) - Balance of outgoing and incoming researchers through MSCA and ERC grants ☐ Number of outgoing researchers through MSCA and ERC grants (residents going abroad) ☐ Number on incoming researchers through MSCA and ERC grants (non-residents moving to the country) - Number of researcher posts funded by H2020 advertised through the EURAXESS job portal, per 1 000 researchers in the public and HE sector - Percentage of early-career researchers supported by MSCA or ERC starting grants, whose jobs were secured after termination of project funding ☐ disaggregated by gender and origin [national/international])	- H2020 Monitoring Indicators - eCORDA

Has participation in the FPs contributed to gender equality and gender mainstreaming in research?	Descriptive statistics Content analysis	- Share of women as coordinators of national teams in H2020 compared to overall distribution (C*) - Share of women among national participants in H2020 projects - Share of publications resulting from H2020 projects with gender dimension in research content	- eCORDA data - Web of Science / Scopus
Has participation in the FPs contributed to improved knowledge exchange?	Descriptive statistics	- H2020 projects with collaboration between HEI/REC and firms (C*) - domestic firms in COST actions in % of all participations of a country in COST actions - Number of public-private co-publications from H2020 projects per 1000 researchers	- eCORDA data - COST projects data
Has participation in the FPs promoted open access to scientific publications?	Descriptive statistics Desk research	- Share of H2020 scientific publications published in open access (total//diamond, gold and green) - Number of projects producing open data sets - Share of H2020 projects with evaluated data management plans (DMPs)	- Web of Science / Scopus - OpenAIRE -Project Data

Has participation in the FPs strengthened international cooperation?	Descriptive statistics Content analysis Desk research Network analysis	- Number of collaborations in H2020 projects with non-ERA partners - International scientific co-publications, with non-ERA countries, from H2020 projects per 1000 researchers (FTE) in the public and HE sector - Number and funding volume of multilateral joint calls with non-ERA countries	- eCORDA data - Web of Science / Scopus - National data

Note: All references to specific data is relative to corresponding national data, unless noted (e.g. H2020 projects refers to H2020 projects with national participation)

Scientific impacts

The European Framework Programmes have been central instruments in the strengthening of the European science and technology knowledge base, which remains as a central objective and potential impact at the national level, in addition to the contribution to technological competitiveness.

As such, the impact of the FPs in the national S&T knowledge base should also be assessed on the basis of the scientific impacts from participation in the FPs. While the traditional collaborative dimension of the FPs have been of central importance to the consolidation of the European Research Area, and to the strengthening of the international scientific networks, funding through the European Research Council can have direct impact on the scientific performance of the supported research teams, providing conditions for the development of world-level research. The Excellent Science Pillar in Horizon 2020 is expected to support excellent, risky research, strengthening research at the national level and creating conditions for the advanced training of the next generation of scientists. Since this pillar is most representative of the objective of the FPs to contribute to the strengthening of the S&T knowledge base, this should receive particular focus when addressing scientific impacts.

Scientific impacts have traditionally been assessed through indicators on publications of international standing, through the strengthening of international networks, reflected in international co-authorship patterns, and through the contribution to training. It should be noted that the standard cautions regarding the use of bibliometric indicators should be taken into account when analysing results. While the use suggested here focuses on overall data resulting from national participation, rather than individual or institutional analysis, and is therefore not intended for evaluation purposes but rather for overall assessment, limiting some of the well-known implications of using bibliometric data in those contexts, it should nevertheless be noted that overall comparison, at international level or with the overall programme, should take into consideration the profile of national participation and the corresponding field distribution. As such, when considering publication and citation data, field normalization should be adopted.

Particular care should be taken to analyse publication data from the social sciences and the humanities.

Indicators

The following indicators are suggested to assess the scientific impacts at national level:

- Participation in the Excellent Science Pillar, with particular reference to ERC projects
  - Number of projects awarded, number of projects coordinated, number of total national participations, total funding awarded, success rates
  - these absolute values should be made comparable in relation to each country's research base (as measured by the number of researchers in FTE) and comparable in relation to the yearly progression;
- H2020 academic output in terms of papers, journals and books published
  - Compared to national publication indicators
  - Compared to the same indicator for national ERC projects
- Number and share of scientific articles[4] in top 10% highly-cited papers
  - Compared to national publication indicators
  - Compared to the same indicator for national ERC projects
  - Compared to the same indicator for national scientific articles internationally co-authored

[4] References to publications and other outputs refer to the publications and outputs from the H2020 projects, unless otherwise noted.

- Number and share of scientific articles published in high-impact journals
    - Compared to national publication indicators
    - Compared to the same indicator for national ERC projects
    - Compared to the same indicator for national scientific articles internationally co-authored
- Average citation rate of H2020 publications (field normalized)
    - Compared to national publication indicators
    - Compared to the same indicator for national ERC projects
    - Compared to the same indicator for national scientific articles internationally co-authored
- Number and share of internationally co-authored scientific articles (considering co-authorship with ERA countries, with non-ERA countries and with all)
    - Compared to national publication indicators
    - Compared to the same indicator for national ERC projects
- International PhD programmes through MSCA
    - Number of publications from ITN programmes, in relation to number of ITN programmes
    - Assessment of the training programme and quality of the research output
        - Case study understanding differences from national programs

Table 3 - Scientific Impact

Questions	Methodologies	Indicators	Databases
Is the national research community proposing excellent science?	Descriptive statistics	- Participation in the Excellent Science Pillar, with particular reference to ERC projects (C*) - Number of projects awarded, number of projects coordinated, number of total national participations, total funding awarded, success rates (C*)	eCORDA Data
Is participation in the Excellent Science Pillar promoting excellent research?	Scientometric analysis Altmetrics	- Academic output in terms of papers, journals and books published - Number and share of scientific articles in top 10% highly-cited publications of the field; - Number and share of scientific articles published in high-impact journals (top 10% in the field) - Average citation rate of H2020 publications (field normalized) - Number and share of internationally co-authored scientific articles - Citations in social networks (using altmetrics) to scientific publications from FP projects	- WoS, Scopus - Project Reporting

Is the participation in the FPs promoting international research collaboration?	Scientometric analysis	- Proportion of internationally co-authored scientific articles	WoS, Scopus eCORDA Data
Is the participation in the FPs enhancing training?	Descriptive statistics Scientometric analysis Case studies	- Participation in International Training Networks through Marie-Sklodowska Curie Actions (ITN) - Number of publications from ITN programmes; - Assessment of the training programme and quality of research output	eCORDA Data WoS, Scopus

Innovation impacts

The impact on the innovative capability of the European industry is, arguably, the main objective of the Framework Programmes and ought to be identified here in particular, independently from the wider economic impacts of the national participation. The FPs provide support to research and innovation projects, in international collaboration, thus contributing to advanced innovation processes. Often involving active collaborations between business firms and universities and public research institutes, in leading edge research and innovation, the participation in the FPs contributes to the improvement of the absorptive capacity of firms. It also contributes to open the knowledge flows for the innovation process, bidirectionally, both as a benefit for the firm, benefitting from advanced knowledge in the public research system, and for public research actors, experiencing the needs of innovative firms at the European level.

While the whole FPs are oriented towards innovation, particularly instruments can be singled out as exemplary of specific innovation processes, in emerging areas and with regard to the involvement of SMEs. These can be considered quite different instruments and beneficiaries, but are indicative of different innovation processes that also reflect specific concerns at the national level. Participation in these programmes are indicative in this regard (Industrial Leadership Pillar is considered more widely in regard to the economic impacts).

<u>Indicators</u>

- Participation in the Future and Emerging Technologies and the Innovation in SMEs programmes;
- Participation of SMEs;
- FP funding to firms vs trend in BERD
    - Number of projects awarded, number of projects coordinated, number of total national participations, total funding awarded, success rates

- these absolute values should be made comparable in relation to each country's research base (as measured by the number of researchers in FTE), and to the overall national share of participation;
    - Although all the programmes are expected to have an impact on innovative processes, here there is a focus on the FET and SME Innovation programmes, as a specific focus; other analysis takes into account all H2020 projects

– Number of patent, licence applications

– Co-authored publications between HEIs and firms

– Innovations introduced (product and process)

– Cooperation between public and private orgs

– Sources of knowledge in innovation (CIS Data)

– Number of new knowledge-intensive companies, including spin offs and spin outs

- Compared to national figures

Case studies on the success of leading R&D projects to the market

- For the analysis of these impacts a control group of non-participating firms must be identified, with data collected (when available) for both groups; Survey is only recommended if other methods are not available and if considered as a possible option.

Table 4 - Innovation Impacts

Questions	Methodologies	Indicators	Databases
Has the research and industrial community been successful in attracting FPs investment?	Descriptive statistics	- Participation in the Future and Emerging Technologies and the Innovation in SMEs programmes (C*) o Number of projects awarded, number of projects coordinated, number of total national participations, total funding awarded, success rates o these absolute values should be made comparable in relation to each country's research base (as measured by the number of researchers in FTE) and to the overall national share of participation; - Participation of SMEs (C*) - FP funding to firms vs trend in BERD	eCORDA Data National R&D statistics Eurostat

Has participation in FPs promoted firm-level growth?	Statistical analysis Survey	- Number of patent, licence applications - Co-authored publications between HEIs and firms	National statistical data Patent databases (e.g. PATSTAT) Private proprietary databases (e.g. Amadeus)
Have H2020 projects led to innovative products and processes?	Statistical analysis Survey	- Number of innovations introduced (product and process)	CIS data Survey data
Has participation in FPs contributed to market success?	Survey	- Cooperation between public and private orgs . Sources of knowledge in innovation (CIS Data)	Survey data
Has participation in FPs contributed to market success?	Survey	- Number of new knowledge-intensive companies, including spin offs and spin outs	Survey data
How has participation in FPs contributed to promote ?	Case study	- Analysis of success of leading R&D projects to the market	Interview data

Economic impacts

Beyond the impacts of the participation in the FPs at the level of national research and innovation systems, as indicated in the impact dimensions identified above, the Framework Programme has within its objectives to promote the competitiveness of the Union's industry and to contribute to the EU2020 Strategy towards smart, sustainable and inclusive growth. It is thus clear that the wider economic impacts are also to be considered when assessing national impacts from participation.

As previously highlighted, the identification and measurement of such impacts are not straightforward. The analysis of the economic impacts highlights the additionality deriving from public interventions. Three main forms of additionality are traditionally suggested in the literature (Cunningham *et al*, 2012; CSES, mimeo):

– Input additionality – degree to which firms inputs increased because of the government support; is public support promoting or substituting for private investment;

– Output additionality – amount of firm outputs increased because of government support such as increased sales, increased exports, etc.;

– Behavioural additionality – persistent behavioural change influence by government support; effects related to less tangible changes in firm/organisational behaviour.

These forms of additionality are expected to be reflected both at the micro level (within the participating firms/organisations) as well as at the macro level (within the overall national level). Most studies are developed on the basis of micro level evidence, often using existing firm-level data already collected in existing surveys. Macro level analysis requires macro-economic models which require more extensive data collection, and wider variables, which may be more sensitive to the models used and quality of the data in relation to the specific policy instruments. Micro-economic approaches tend to be more easily implemented by the programme management level than macro-economic analysis.

Indicators

- Participation in the Industrial Leadership Pillar
    - Number of projects awarded, number of projects coordinated, number of total national participations, total funding awarded, success rates
    - these absolute values should be made comparable in relation to each country's research base (as measured by the number of researchers in FTE) and comparable in relation to the yearly progression;
- Growth in revenue
- Growth in exports
- Growth in employment
- Number of high-skilled employment opportunities created
    - Compared to control group
- Share of participants considering participation a market success
        - For the analysis of these impacts a control group of non- participating firms must be identified, with data collected (when available) for both groups; Survey only to be considered if considered as a possible option at national level

Table 5 - Economic Impacts

Questions	Methodologies	Indicators	Databases
Has the research and industrial community been successful in attracting FPs investment?	Descriptive statistics	- Share of Participation in the Industrial Leadership Pillar (C*) - Number of projects awarded, number of projects coordinated, number of total national participations, total funding awarded, success rates - these absolute values should be made comparable in relation to each country's research base (as measured by the number of researchers in FTE) and comparable in relation to the yearly progression;	National R&D statistics Eurostat
Has participation in FPs promoted firm-level growth?	Econometric analysis	- Growth in revenue - Growth in exports - Growth in employment - Number of high-skilled employment opportunities created o Compared to control group	National statistical data Private proprietary databases (e.g. Amadeus)
Has participation in FPs contributed to market success?	Survey	- Share of participants considering participation in H2020 project a market success	Survey data

Societal impacts

One particularly important aspect of impact assessment, from the point of view of the wider society, regards the impact of research beyond the scientific peer community. It should therefore be considered how the research has relevance for the society. It must be acknowledged that societal impacts include economic impacts. However, these are considered already under the previous section on economic impact; this section deals with the wider societal impacts beyond the economy and science itself and how these impacts can be measured. While relevant societal impacts are expected across the FPs, the more specific impacts under the Societal Challenges Pillar are of particular relevance.

Given that we expect the participation to contribute to tackling the societal challenges, to contribute to an increase in public awareness and understanding of science and social issues, and finally to contribute to a more evidence based policymaking, we can define the overall societal impact to be some change in policy or behaviour in society. Since these impacts are at the end of a chain of different outputs, outcomes and impacts, we need to find a way to identify the links in the chain, identifying the pathways to impact. These links imply that we include process indicators.

Societal impact in this context can be the use and adoption of specific knowledge with a potential social value by researchers in different scientific disciplines and by stakeholders, or other non-academic partners within a project or after the project. The societal impact can also come from an output (e.g. product, methods, tools, models) which is based on knowledge with a potential social value. And finally it can come from the social benefits of the use of results (better health, more security, etc.).

Societal impacts can best be assessed through the identification of different *impact pathways*, linking to non-academic partners and users. In this case it is important to identify the dissemination, uptake and use of knowledge and other results outside academia as an indication of a possible outcome and impact. Both the non-academic partners and users should at first be in fields that are relevant under the Societal Challenges Pillar. It is therefore necessary to identify the structure and kind of collaboration and assess its relevance for society.

In the case of societal impact one interesting and useful concept is that of productive interactions (see Spaapen, J and van Drooge, L, 2011, SIAMPI final report). It can be one way of capturing the contribution of research to societal impact, where the interaction between "researchers" and "stakeholders" can provide a tool for how to assess the output from research and the way it can turn in to relevant social outcomes and broader societal impact in different areas.

Three categories of productive interactions have been used so far in the literature:

- Direct interactions involving direct contacts between humans, through face-to- face meetings, phone calls, e-mail or videoconferencing.
- Indirect interactions which are contacts established through a media or carrier (texts, artefacts, exhibitions, etc.).
- Financial interactions when potential stakeholders engage in economic exchange with researchers (contracts, financial or in kind contribution in research programmes, facility or data sharing).

One example of a pathway would be how research in a field with relation to for example health can be turned into a new treatment of a certain disease, and how this treatment can be spread and used on a large scale. In the first step the result must be knowledge that is new and can be approved within the research community. This requires publications in some form and some indication of it being read and used in other publications, e.g. citations (and which is recognized here as a scientific impact). The knowledge may then be applied for a new treatment which will have to be tested and approved within clinical practice. Since it can compete with existing treatments it needs to be proved to be better and more cost effective than these existing treatments (this may also lead to innovation and economic impacts). Legal and policy aspects concerning use of certain substances or methods, and public procurement (e.g. for delivering services that are already being delivered through another contract) are aspects that might need changes in policy or law both on local and global levels, before the new treatment can be fully applied.

In this case the interaction with other researchers in relevant fields is needed for the spread and use of knowledge in the first step. This knowledge will then be used in the development of the treatment and therefore other interaction with other than the researchers in the own field or sector (hospital clinics, companies other research groups), as well as interaction, in the implementation process, with policy makers, legal authorities to change regulations that may hinder the implementation. As such, while the ultimate societal impact, in terms of the health benefits for society, which may be later reflected in specific indicators, may be more difficult to assess and to attribute, the focus on the diverse productive interactions enables capturing pathways that are essential to the wider societal impacts.

While the national dimension remains here as an important frame of impact assessment, it should be noted that societal impacts can have an intrinsic value that goes well beyond the national borders, and which is well reflected in the concept of the societal challenges. The Societal Challenges Pillar identifies issues of concern for the European and global society. In this way, while the results of research projects are expected to have an impact at national level by way of national participation and the resulting capability development through the participating teams, the wider impacts are often distributed globally, by contributing to better address the challenge. This can be the case, for example, with research on climate change, on health or on development challenges. The analysis of productive interactions does not distinguish between interactions which are developed at the national or at the international level, but rather focuses how such interactions can be more widely productive in promoting the uses and the shaping of the knowledge produced in the context of the corresponding projects.

Indicators

- Participation in the Societal Challenges Pillar
    - Number of projects awarded, number of projects coordinated, number of total national participations, total funding awarded, success rates, by Societal Challenge;

- these absolute values should be made comparable in relation to each country's research base (as measured by the number of researchers in FTE) and comparable in relation to the yearly progression;

– Share of projects involving civil society organisations (CSOs)

  - Compared between H2020 programmes/instruments

– Share of projects addressing global challenges

– Transdisciplinary global networks developed, i.e. networks including RPO's (research performing organisations), as well as private companies and CSO's

– Project results cited in public debates (altmetrics)

– Number of non-academic publications

  - Compared between H2020 programmes/instruments

– Evidence and advice submitted to policy-making processes (national and international), including policy briefs

– Growth in innovations tackling societal challenges

– Growth in publications addressing societal challenges

– Number of citizen science projects and projects with citizen engagement initiatives

Table 6 - Societal Impacts

Questions	Methodologies	Indicators	Databases
Has participation contributed to tackling societal challenges?	Descriptive statistics	- Participation in the Societal Challenges Pillar (C*) - Share of projects involving civil society organisations (CSOs) (C*)	eCORDA
Has participation contributed to tackling societal challenges?	Content analysis (identification of keywords referring to global challenges in project summaries) Network analysis	- Share of projects addressing global challenges - Global / transdisciplinary networks developed	eCORDA
Has participation contributed to tackling societal challenges?	Altmetrics	- Project results cited in public debates	Twitter API Altmetrics Plumanalytics alm.plos.org
Has participation contributed to tackling societal challenges?	Survey Case studies	- Evidence and advice submitted to policy-making processes (national and international)	Project data

Has participation contributed to tackling societal challenges?	Scientometric analysis Content analysis	- Growth in innovations tackling societal challenges - Growth in publications addressing societal challenges	Patent database Publications database
Contributed to increasing public awareness and understanding of science, economic and societal issues?	Scientometric analysis Survey Statistical analysis	- Number of citizen science projects and projects with citizen engagement initiatives	eCORDA Project outputs

Recommendations for MS/AC and EC

The approach being proposed here, focusing on common indicators, data and methodologies across MS/AC, is now possible because there have been significant advances in data collection and management at European and national levels. At European level there is significant data sharing with the MS/AC regarding participation data which allows for the main information to be analysed in a consistent manner, on a permanent basis. Nevertheless some recommendations follow:

Recommendations for Member States and Associated Countries

- MS/AC are encouraged to use the current template and to exchange results for comparison purposes and to promote its methodological development and exchange;
- MS/AC should promote the interoperability of national research information structures, and open repositories, with the research information system supporting the FPs;
- national statistical offices/administrations should be encouraged to create panel data with relevant impact assessment variables to allow the dynamic analysis of impact.

Recommendations for the European Commission

- data collected through eCORDA should be improved through clear identification of the research teams involved, considering existing privacy rules, rather than on the basis of managerial responsibility;
- information on all outputs reported by FP projects should be collected in a common research information system, on the basis of open repositories, and made accessible to MS/AC for dissemination and for impact assessment purposes;
- FP project participants should be encouraged to report research results for a period beyond the formal end of the projects.

REFERENCES

Boekholt, P. et al. (2014), "Evaluation Reference Model: In Search for a Benchmark of Impact, Effectiveness and Efficiency of Innovation Instruments", Technopolis Group.

CSES (mimeo), "Guidelines for evaluating national impacts of the EU Framework Programmes for RTD", draft, mimeo, Centre for Strategy and Evaluation Services.

Cunningham, P.; Abdullah Gok; Philippe Laredo (2013) "The Impact of Direct Support to R&D and Innovation in Firms", Nesta Working Paper 13/03, NESTA.

Dimitrova, A.; Dimitrova, A.; Hametner, M. and Martinuzzi, A. (2015), "How did research in the 7th EU framework programme address the Sustainable Development Goals (SDGs)?", Institute for Managing Sustainability, Vienna University of Economics and Business.

van Drooge, L., van den Besselaar, P., Elsen, G. M. F., de Haas, M., van den Heuvel, J. J., Maassen van den Brink, H., ... Westenbrink, R. (2010). "Evaluating the societal relevance of academic research: A guide. (ERiC)". Den Haag: ERiC-Evaluating Research in Context.

EC (2015), "Horizon 2020 indicators: Assessing the results and impact of Horizon", Directorate-General for Research and Innovation, European Commission, Brussels.

ERAC (2015), "ERAC Opinion on the ERA Roadmap - Core high level indicators for monitoring progress", ERAC 1213/2015.

Haustein S, Costas R, Larivière V (2015), "Characterizing Social Media Metrics of Scholarly Papers: The Effect of Document Properties and Collaboration Patterns". *PLoS ONE* 10(3): e0120495. doi:10.1371/journal.pone.0120495

de Jong , Stefan; Katharine Barker; Deborah Cox; Thordis Sveinsdottir; Peter Van den Besselaar (2013), "Understanding societal impact through studying productive interactions", Rathenau Institute WP 1304.

Larivière, Vincent; Tim Bowman; Jean-Pierre Robitaille; Alexandra Pollitt; Salil Gunashekar; Benoit Macaluso (2015), "Comparative scientometric assessment of the results of ERC funded projects - Alternative metrics report (D7)", European Research Council Executive Agency.

Lemelin, Pascal; Vincent Larivière; Alexandra Pollitt; Salil Gunashekar; Jean-Pierre Robitaille (2015), "Comparative scientometric assessment of the results of ERC funded projects - Patent Analysis Report (D6)", European Research Council Executive Agency.

Mutual Learning Exercise (MLE) on Open Science: Altmetrics and Rewards (2017), "Different types of Altmetrics", Background/Challenge Paper No. 1.

Robitaille, Jean-Pierre; Benoit Macaluso; Alexandra Pollitt; Salil Gunashekar; Vincent Larivière (2015), "Comparative scientometric assessment of the results of ERC funded projects - Bibliometric assessment report (D5)", European Research Council Executive Agency.

SIAMPI final report (Rathenau institute)

Spaapen, J. and van Drooge, L. (2011), "Introducing 'productive interactions' in social impact assessment", *Research Evaluation*, 20(3): 211-218.

Wilsdon, J., *et al*. (2015). *The Metric Tide: Report of the Independent Review of the Role of Metrics in Research Assessment and Management*. DOI: 10.13140/RG.2.1.4929.1363

Further materials:

National Impact Assessment Studies developed by several Member States/Associated Countries.