



Open Science Impact Pathways

Deliverable 1.1

Open Science Intervention Logic

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Table 1: Document Revision History

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Abbreviations

APC	Article Processing Charge
EC	European Commission
EOSC	European Open Science Cloud
EU	European Union
FAIR	Findable, Accessible, Interoperable, Re-usable
OA	Open Access
OECD/DAC	Organisation for Economic Cooperation and Development – Development Assistance Committee
OS	Open Science
PathOS	Open Science Impact Pathways (Horizon Europe project)
RFO	Research Funding Organisation
RI	Research Infrastructure
RPO	Research Performing Organisation
RI-PATHS	Charting Impact Pathways of Investment in Research Infrastructure (Horizon 2020 project)
WP	Work Package

Executive Summary

This deliverable aims to provide the methodological framework for the impact pathways. It starts from the Theory of Change and uses the RI-PATHS approach as a baseline model. We explain Impact Pathways and align on terminology.

We address challenges in describing these pathways, especially on the criticisms that pathway visualisations oversimplify and that pathways hardly address causal relations. For this we follow a stepwise but systematic approach:

1. As a starting point, we will identify individual intervention pathways based on the eight European Union's Open Science policy priorities. This is the traditional approach for describing impact pathways.
2. Next, we will aggregate and zoom out to a higher level, by clustering the outcomes and impacts from step 1 covering academic, economic, and societal impact.
3. Zooming in for narrative overviews and causal relations. This will give room for providing details on how the interventions have worked (or can work).

As the project's focus is on empirical evidence, we will address multiple lines during the project: systematic literature scoping, implementing indicators, but also case studies (both thematic and national) and cost-benefit analysis.

This deliverable will be updated as we will have regular feedback loops from these activities. First experiences indicate that we envisage multiple smaller feedback loops rather than one big loop as was originally planned.

1. Introduction and Scope

1.1. Purpose of the deliverable

PathOS wants to contribute to a better understanding and measurement of Open Science impacts and their causal mechanisms. If we want to shape effective Open Science (hereafter: OS) policies, we need an in depth understanding of the mechanisms and underpinnings of OS practices, as well as their positive and negative effects on outcomes. While we are beginning to understand some of the dynamics of OS in the research system, evidence about how this may affect our economies and societies is more limited.

We want to do this in a systematic way and based on evidence.

Systematic refers to:

- *EC Open Science policy as starting point:* Considering the European context of the project, as well as the potentially guiding effect of EU policy on national or institutional policies, we will use the policy categories that are being used by the EC and the EOSC Steering Board. This policy framework follows a systematic approach by taking the policy and research cycles as starting points and distinguishes eight strategic pillars¹ (see next section). For impact, we will distinguish three types of impact: academic, economic, and societal impact. This is an ideal-type taxonomy, even though from our experience from literature it is revealed that these three types of impact are often interrelated: e.g. patents can be both academic and economic, societal problems solutions may have economic repercussions etc. Hence, it is worth mentioning this taxonomy as "ideal but interconnected".
- *Taking multiple stakeholders into account with a focus on policy dimensions:* Our focus will be on policy advisors and decision takers because the aim of the project is to help policy and decision-making bodies to better understand the rationale of OS and how their impacts materialise.

Based on evidence refers to:

- Use of indicators.

We want to find empirical evidence to support statements about the effects of OS on the different types of impact.

¹ https://research-and-innovation.ec.europa.eu/strategy/strategy-2020-2024/our-digital-future/open-science_en. Note: to align with EC development of these pillars there has been an update on these categories that are also used in the EOSC Observatory – see Annex 1.

- Multiple approaches.

Next to impact analysis, we will also carry out case studies and perform a cost-benefit analysis.

This deliverable is about setting up a *framework for impact pathways* which are constructed to help policy and decision-making bodies to better understand the rationale of OS and how its impacts materialise. This will be connected to other outputs like the *Handbook of Open Science Impact Indicators* (WP2), an *online registry* with a portfolio of use cases (WP3) and connected with the results of a *Cost Benefit Analysis framework* (WP4).

1.1.1. EC Open Science policy

Since 2016, the Commission organises its open science policy according to eight ‘ambitions’ that concern all aspects of the research cycle. Recently new pillars have been added, like ‘open software code’. Table 2 below shows the original and updated Open Science pillars, the latter being used in the EOSC (Open Science) Monitor².

Table 2 Original and updated OS pillars

Original eight OS pillars	Updated OS pillars	Explanation, examples
Future of Scholarly Communication	Publications	research publications that are available in Open Access
European Open Science Cloud & FAIR Data	Data	Research data management and research data that is FAIR/open
	Services	Services that enable research data discovery and exploitation
	Infrastructure	Data stewardship, data repositories, and data preservation
	Software	Software that enables research and is available in open source
Rewards and Incentives	Assessment	Incentives and rewards for researchers to practise Open Science
Skills and Education	Skills/training	Skills and training for researchers to practise Open Science
Citizen Science	Engagement	Research that engages and involves citizens via citizen science
Research Integrity	RRI	Refers to all pillars (‘horizontal’); focus will be on reproducibility of research
Research Indicators & Next-Generation Metrics		Applies to all pillars

We will make use of the updated OS pillars to better connect to the EOSC / Open Science Observatory that has been set up by the Member States and Associated Countries in the EOSC Steering Board.

² <https://eoscobservatory.eosc-portal.eu/home>

1.1.2. Stakeholders

Stakeholders can be involved in activities during the whole process: from initial needs to inputs, results and impacts. For example, (local) governments can be both important providers and users of data. Key is that they play an active role in one of the phases. Contributions and actions can be both positive and obstructive as some stakeholders may oppose the policy interventions. Our initial list of stakeholders is presented in Table 3 below.

Table 3 Stakeholder categories

Main Category	Subcategory
Governments	International policy making bodies, European Commission
	National Governments
	Ministries ³
	Regional (within country) Governments, Local governments
Funders (RFOs)	Public RFOs – for both basic and applied research
	Private RFOs
Industry	Industry & Services Sectors
	Experts (incl. researchers) at companies
	Think Tanks
Publishers	Lobby Organisations
	Large Commercial Publishers
	Small Commercial Publishers
	Not-for-profit Publishers
Universities & Research Institutes (RPOs)	Basic Research Organisations
	Applied Research Organisations
	University Libraries
	Individual Researchers (at RPOs)
Research Communities	Formal associations
	Learned Societies
	Informal Communities
Civil Society	Community-Based Organisations
	(International) Non-Governmental Organisations
	International Groups
General Public	Citizens
	Interest Groups (incl. patient organisations)
	Citizen Scientists

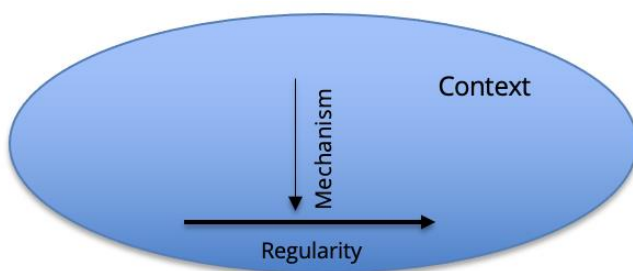
³ Ministries are a separate subcategory as there can be different positions towards Open Science

1.2. Structure of this Deliverable

In chapter 2 we will explain the theory – especially the Theory of Change which is the basis for impact pathways. In chapter 3 we will operationalise impact pathways, taking the approach of a previous project called RI-PATHS as a baseline, implementing pathways and connecting to the other WPs by having feedback loops between this framework and the other actions. Chapter 4 concludes.

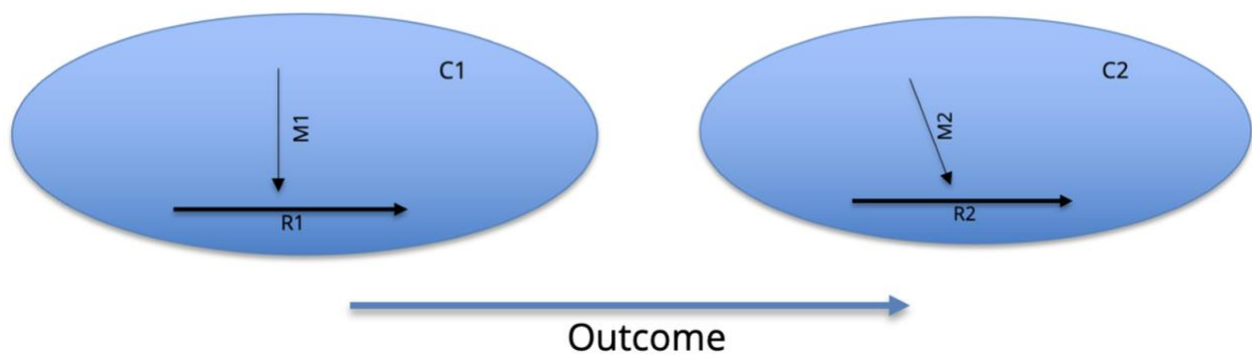
2. Theory

2.1. Understanding change

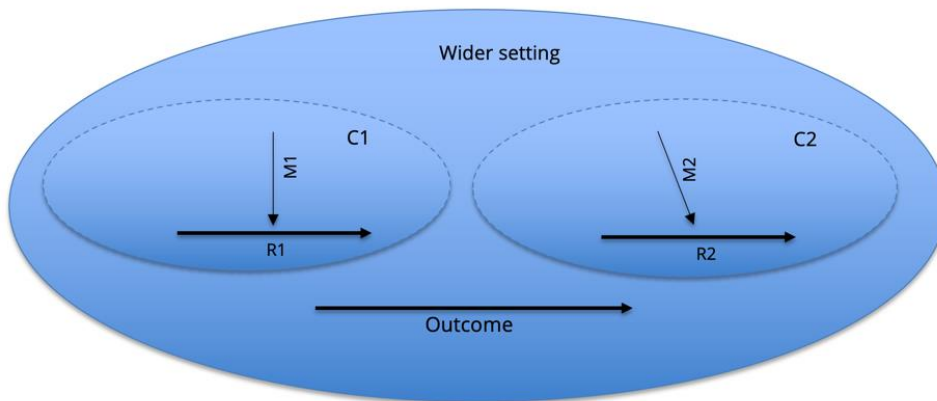


Whenever there is a problem of an ongoing *regularity*⁴, an agent (e.g. government) wants to correct this by changing the *mechanism* that is steering the regularity. All this works in a specific *context* (Tilley, 2000).

Ideally, the effect of the intervention can be studied in a separate environment and compared with the old situation.



⁴ Regularity is something that happens in the usual way, or the fact of something doing this. In sociology it stresses the patterns and the regularities of social life which is, most of the time, orderly and largely predictable - <https://dictionary.cambridge.org/dictionary/english/regularity>.



In practice, we are not in a laboratory setting and the contexts are open to wider settings and occur in open systems. In addition, old and new situations cannot be compared as the new setting replaces the old setting. For example, to examine the effect of green open access, we must compare with a situation where there is no green open access. Hence, we can only compare over time or region (Tilley, 2000).

2.2. Evaluating policies

According to OECD/DAC⁵, impact analysis is a systemic approach to critically assessing the positive and negative effects of proposed and existing regulations and non-regulatory alternatives. It is an important element of an evidence-based approach to policy making.

The OECD/DAC distinguishes six criteria in evaluating policies: relevance, effectiveness efficiency, sustainability, coherence and impact⁶:

- Relevance

Is the intervention doing the right things?

The extent to which the intervention objectives and its design intervention are consistent with beneficiaries' requirements, country needs, global priorities and partners' and donors' policies and priorities. How sustainable the objectives stay in case of changes in circumstances.

- Effectiveness

"Is the intervention achieving its objectives"?

The extent to which the development intervention's objectives were achieved, or are expected to be achieved, taking into account their relative importance.

⁵ <https://www.oecd.org/gov/regulatory-policy/ria.htm>

⁶ SECO/WE, Evaluation Guidelines, <https://www.seco-cooperation.admin.ch/secocoop/en/home/results/evaluation.html>

- Efficiency

“How well are resources being used?”

A measure of how efficiently resources/inputs (economic and legal measures, funds, expertise, time, etc.) are converted to results.

- Sustainability

Will the benefits last?

The continuation of benefits from a development intervention after major development assistance has been completed.

- Coherence

How well does the intervention fit?

Is the project compatible with other plans and objectives? To what extent does it fit in with the other plans and measures implemented in the country?

- Impact

What difference does the intervention make?

Positive and negative, primary and secondary long-term effects produced by a development intervention, directly or indirectly, intended or unintended.

Based on the elements of the Theory of change and the OECD/DAC criteria⁷, the Stages in evaluation and impact analysis provided guidance for the framework of the KIPs, see Figure 1. Note that impact is the only stage while all other criteria describe relations between stages. Also note that there is also the ‘value added’ relation in this figure, describing the relationship between outcomes and (the effects of) other initiatives. Here added value is defined as the contribution of the other initiatives and relates to the context and environment. It is not a direct effect of our intervention and will not be considered as one of the evaluation criteria.

⁷ <https://www.oecd.org/dac/evaluation/daccriteriaforevaluatingdevelopmentassistance.htm>

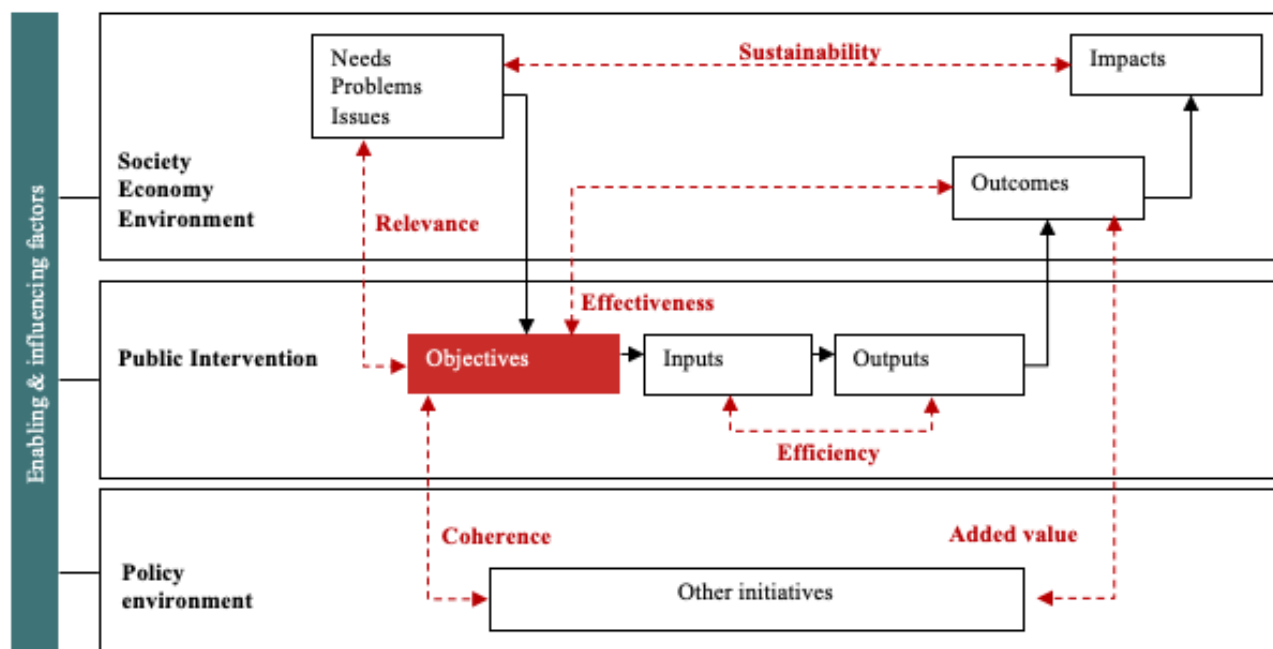


Figure 1 Stages in evaluation and impact analysis

2.3. Impact pathways

To describe impacts we use the several steps that are distinguished in Figure 1: from problems and needs to inputs, activities, outputs and outcomes, and impacts. These terms are in common use, but there is great inconsistency in how they are interpreted. Here we use the OECD definitions (Table 4).

Table 4 Elements of a Theory of Change

Terminology		Explanation
	Problem	What we want to solve, incl. why it is a problem and whom it affects
	Context	The setting in which the intervention takes place, incl. stakeholders involved
	Assumptions	Underlying conditions, expected behaviour that are assumed for the planned change
Intervention (in control)	Inputs	The financial, human, and material resources used for the intervention
	Activities	Actions taken or work performed
	Outputs	The products, capital goods and services that are produced

Results	Outcomes	The likely or achieved short-term and medium-term effects of the outputs
	Impacts	Positive and negative, primary and secondary long-term effects produced by an intervention, directly or indirectly, intended or unintended, behavioural changes

Definitions from OECD (2010)

A main difference between the intervention and its results is that the intervention is under control of the executive organisation, whereas results are based on outputs but not under direct control with potential unexpected spillover effects. KIPs are to indicate and provide assumptions of these events, not under control of the executive body that implemented the intervention.

Especially for impacts, we can add many characteristics and alternative definitions. For example, OECD-UNDP (2000) defines impact as⁸: “Results of a programme or project that are assessed with reference to the development objectives or long-term goals of that programme or project; changes in a situation, whether planned or unplanned, positive or negative, that a programme or project helps to bring about.” Examples include higher standard of living, increased food security, increased earnings from exports, increased savings owing to a decrease in imports. In addition, impacts can be direct or indirect or have primary and secondary effects. Therefore, we will consider *holistically the chain of effects* and validate the causalities through literature and evidence, gathered from other tasks, Work Packages and independent experts.

To really understand the effect of interventions, we want to include causal mechanisms and provide explanations why and how impacts occur. Such approaches are particularly helpful for the production of policy-oriented recommendations and highlighting the conditions to be ensured for a given public initiative or intervention to be successful.

Sometimes, the monitoring focuses on the inputs-activities-outputs, which is called *intervention monitoring*, or other monitoring approaches focus solely on the outcomes and impacts, which is called *results monitoring*. The paths from inputs to impacts are called **impact pathways**. To construct and understand these pathways we need to:

1. To understand the social, economic and academic territorial context that might predetermine causal mechanisms and their degree
2. Identify key elements of pathways (input-activity-output-outcome-impact)
3. Describe how they are linked and work together

⁸ OECD (2000), GLOSSARY OF EVALUATION AND RESULTS BASED MANAGEMENT TERMS, WORKING PARTY ON AID EVALUATION, 33rd MEETING, Paris, 22-23 November 2000

This is based on assumptions that need to be made explicit and hypotheses that need to be checked during evaluations:

4. Validate the causalities and links through evidence and expert groups

Impact pathways are the possible paths that connect the resources and activities to output, outcomes and impact. The initial concept used for PathOS impact pathways is displayed in Figure 2 below. They are driven by problems/needs that induce policy ambitions & objectives (top layer in the figure). The actions can be supported by (external) enabling factors (at the bottom in the figure), although these factors can also hinder or obstruct the effectiveness of the actions.

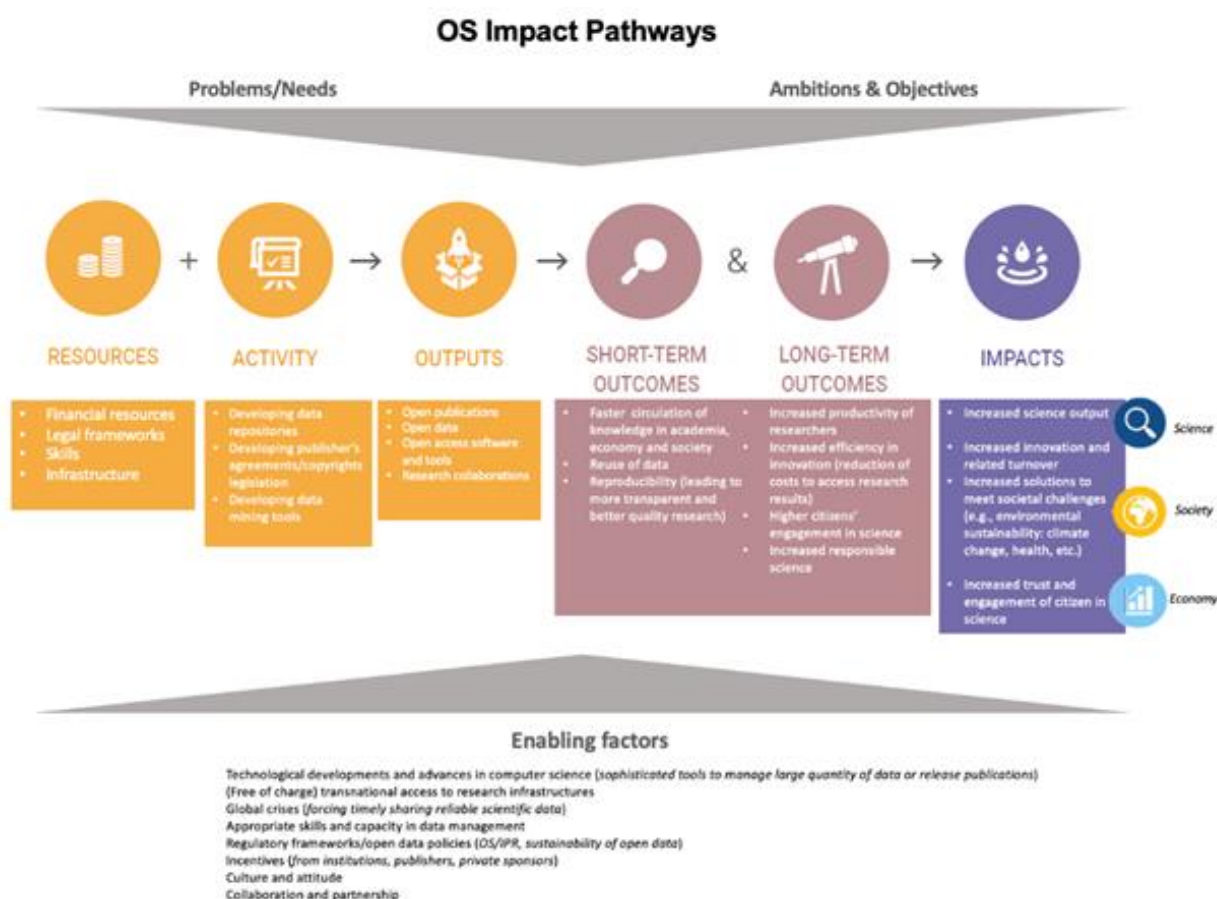


Figure 2 Draft PathOS OS impact pathways (Source: PathOS Description of Action)

While the path from resources to impacts as displayed in the figure above suggests simple and linear effects, this is hardly the case. Designing an intervention logic for a policy or a project should therefore take risks and challenges into account, spell out the underlying assumptions, and define an intervention in a way that minimises the risks for unwanted consequences to take place⁹.

⁹ In the annex we describe the full process of Intervention Logic and elaborate the terminology that is being used.

However, in practice the connection between action (inputs, activities) and impact is not necessarily straightforward. On the way to impact, other effects might be generated. The lefthand side of Figure 3 displays the long distance between actions and ultimately the (different types of) impact. Over time multiple additional effects may also occur and add to the 'direct effect' of an action on impact¹⁰. Moreover, other inputs and activities can contribute to an impact, meaning that the individual contribution of a specific activity may be difficult to identify and measure (righthand side of Figure 3).

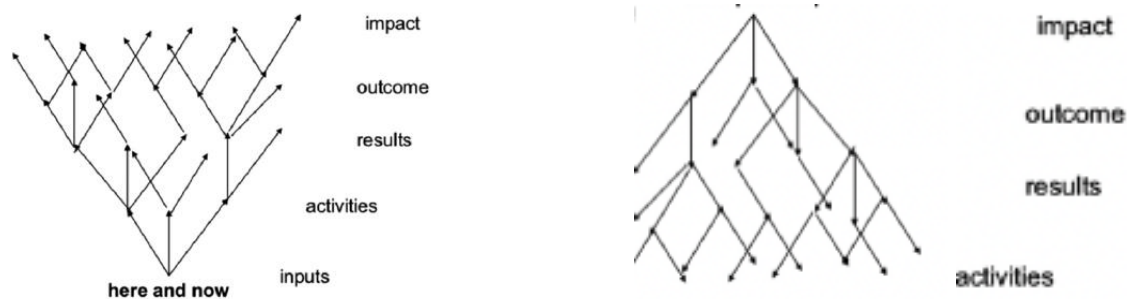


Figure 3 Side-effects and dilution of effects

This complexity of causal chains is often neglected in impact analysis, showing linear effects and simple diagrams between action and impact and not allowing for reactions or feedback loops. This oversimplification is one of the main criticisms of the Theory of Change and KIP models. For example, Rogers & Weiss (2007, p65/66) criticise that just connecting the boxes with inputs, activities, outputs, outcomes and impacts without explaining how the relations work doesn't explain the relations.

In addition, evaluations make strong assumptions about effects. For example, when health promotion programs assume that improved knowledge will change attitudes and hence behaviour. For example, research funders and publishers had opposing interests when gold open access was introduced. Instead of a switch to APC-based journals the hybrid model was effectuated, including the risks of higher costs and even "double-dipping"¹¹. During the internal Mutual Learning Exercises and Workshops with the consortium, similar concerns were collected.

Charting the impact pathways is used to describe the sequence of input-output-outcome-impact relations that show non-linear linkages and the steps from resources to more long-term impacts. It also entails developing narratives describing causal chains, including the effects of possible enabling factors and barriers¹².

¹⁰ Source: Dekker (2019, p. 112)

¹¹ "Double dipping" refers to business models in which publisher charge for subscriptions to scholarly journals whilst also charging for Open Access publishing in the same journals. For more information see <https://blogs.imperial.ac.uk/openaccess/2020/10/20/no-double-dipping-the-rise-of-transformative-publisher-agreements-in-the-transition-to-full-open-access/>

¹² We will address this issue in the next chapter.

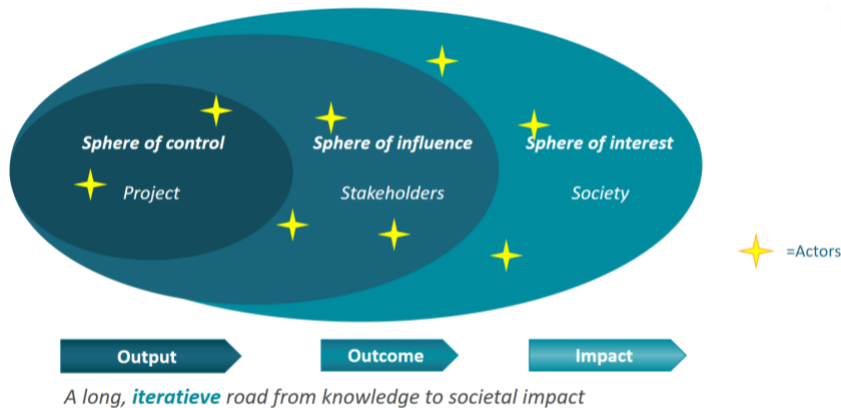


Figure 4 Spheres of impact

(Source: NWO13)

The large number of stakeholders also results in more complexity. In the same example of introducing gold open access: for research funders this was an output of their intervention, but for publishers and for researchers this gold OA functions as an input to their activity of publishing.

2.3.1. Types of impact

When designing an impact assessment, it is therefore advisable to conceptualise what impact is to be assessed in order to make it fit for purpose (ESF, 2012¹⁴). Given our focus on policy advisors and decision takers and to remain concise, we will distinguish three different types of impact:

- Academic¹⁵

Definition (UKRI)¹⁶: Academic impact is the demonstrable contribution that excellent research makes in shifting understanding and advancing scientific method, theory and application across and within disciplines.

- Societal

Definition (NWO)¹⁷: Cultural, economic, industrial, ecological or social changes that are (partly) the result of research-generated knowledge and skills.

- Economic

¹³ <https://www.nwo.nl/en/impact-plan-approach>

¹⁴ ESF (2012), The Challenge of Impact Assessment, <http://archives.esf.org/coordinating-research/mo-fora/evaluation-of-publicly-funded-research.html>

¹⁵ We will use 'academic' rather than 'scientific' to refer to the impact on the research system.

¹⁶ <https://www.ukri.org/councils/esrc/impact-toolkit-for-economic-and-social-sciences/defining-impact/>

¹⁷ <https://impact.nwo.nl/en/an-impact-outlook-for-your-research/theory-societal-impact>

Definition (CQU)¹⁸: Monetary benefits arising from research, either in terms of money saved, costs avoided or increases in turnover, profit, funding or benefits to groups of people, or the environment measured in monetary terms.

For clarification we present the relation with the ESF (2012) types of impact in Table 5 below.

Table 5 ESF types of impact

Academic impact
Scientific impact: contribution to the subsequent progress of knowledge, the formation of disciplines, training and capacity building
Training impacts: contribution to curricula, pedagogical tools, qualifications.
Societal impact
Social impact: contribution to community welfare, quality of life, behaviour, practices and activities of people and groups.
Political impact: contribution to how policy makers act and how policies are constructed and to political stability.
Environmental impact: contribution to the management of the environment, for example, natural resources, environmental pollution, climate and meteorology.
Health impact: contribution to public health, life expectancy, prevention of illnesses and quality of life.
Cultural impact: contribution to understanding of ideas and reality, values and beliefs.
Economic impact
Economic impact: contribution to the sale price of products, a firm's costs and revenues (micro level), and economic returns either through economic growth, productivity growth or innovative capacity growth (macro level).
New knowledge: investment that may not be monetised immediately.
Technological impact: contribution to the creation of product, process and service innovations.

Based on ESF 2012, p. 7

¹⁸ <https://libguides.library.cqu.edu.au/c.php?g=881139&p=6659585>

2.3.2. Two directions

Using this approach offers the option to work from two directions as visualised in Figure 5.

First, one can be an ex-ante¹⁹ evaluation that predicts the most likely outcomes and impacts of an intervention.

Second, an ex-post²⁰ evaluation where one can anticipate how to create impacts by going back the chain towards the (most) effective interventions.

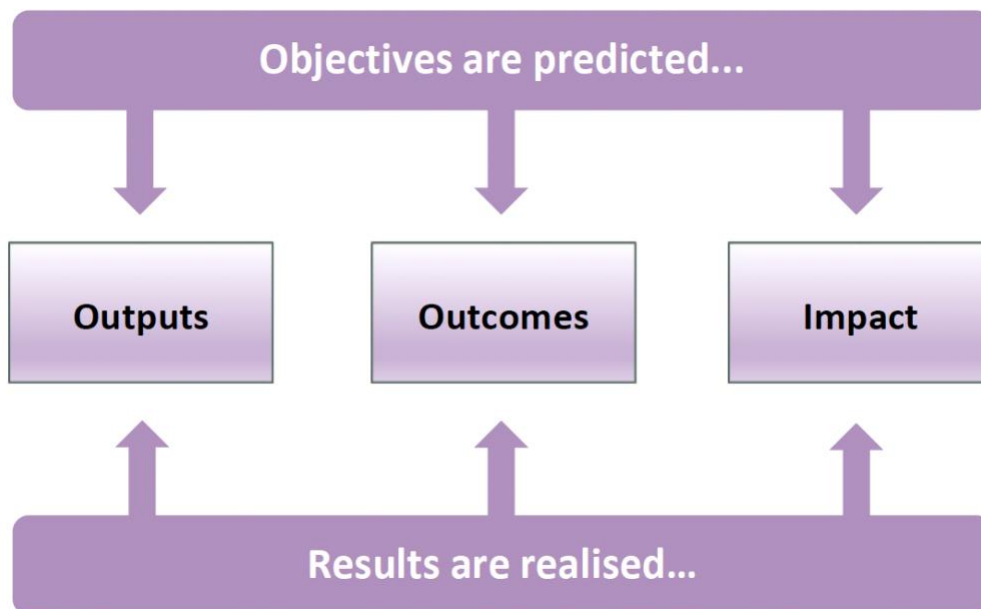


Figure 5 Two directions of impact analysis

In both situations we need to collect data for the whole impact pathway: from inputs to impacts, or the other way round, bearing in mind the multitude of inputs that influence one impact and the diluting effects of one activity (cf. section 2.3).

3. Operationalisation

In this chapter we start with the experiences in the RI-PATHS project, and then elaborate on a stepwise approach based on theory from chapter 2 and addressing the drawbacks as well.

3.1. Baseline: RI-PATHS

The RI-PATHS Horizon 2020 project developed a set of impact pathways for research infrastructures (see <https://ri-paths-tool.eu/en>). Its approach serves as a baseline model for the approach of PathOS. It was chosen as a model for PathOS because it has been designed

¹⁹ predict outcome/impacts before the intervention

²⁰ Evaluation and assessment of the impact after the intervention

with the impact of research activities and research organisations in mind. It is, broadly speaking, a proof-of-concept for applying the impact logic to research areas, which eases the transfer of the approach to Open Science. Moreover, the visual frameworks and online tool provided by RI-PATHS can be used as guiding examples for PathOS outputs.

RI-PATHS applied the impact pathways methodology specifically to the functioning of research infrastructures. It aims to support research infrastructures when developing new activities and/or evaluating their own work. Figure 6 displays the general framework of RI-PATHS, including resource/activity/outputs/outcome, impact and supporting indicators.



Figure 6 RI-PATHS example of impact pathway from communication and public outreach activities

(Source: Griniece et al., RI-PATHS 2020. Licensed under CC-BY 4.0 SA)

This is supported by sets of indicators for the different pathways developed by for each step such as resource/activity/outputs/outcome and impact. It further developed an online tool to compose new specific pathways based on user needs.

One of the major positive characters of the RI-PATHS tool is its visualisation and the creation of 10-15 high level impact pathways relevant to potential users. By addressing 4-5 (RI-policy) questions the tool provides an overview of relevant pathways. Moreover, these can be used to elaborate own, specific pathways, although this part is rather complex.

PathOS aims to develop a similar approach of identify high-level impact pathways useful for different user groups (e.g., national policy makers, research organisations etc.). These will be based on empirical work during PathOS, in particular the literature scoping and case studies. The general approach is explained in the subsequent sections of this deliverable. During the

project we will explore how to make our project outputs²¹ searchable, interactive and dynamic, working closely with WP5 (Engagement and capacity building, especially T5.3 Exploitation of project results).

3.2. Framework: stepwise approach

The identification of impact pathways for Open Science within PathOS will use an approach based on the intervention logic framework and theory-of-change as described in chapter 2. Essentially, this is based on an understanding of inputs/resources and activities leading to specific outputs. These in turn create outcomes, which lead to impacts.

To identify cumulative pathways, this work adopts a framework proposed to evaluate the environmental impact of research and innovation (European Commission et al. 2014). The strength of this framework is that it allows the tracking and visualisation of impacts from academic impact to economic and societal impacts in an intuitive fashion. Practically, this approach focusses on identifying the outcomes and impacts of individual interventions and clustering them across different themes and levels.

How we operationalize the identification of impact pathways for Open Science in three steps is detailed in the following subsections.

3.2.1. Step 1: Identification of individual intervention pathways

As a starting point, we focus the identification of impacts on the interventions relevant in the broad range of the eight European Union's Open Science policy priorities (cf. chapter 1).

For each policy area, which we treat as interventions, we will identify specific impact sequences from activity to output over outcome to impact. This will be based on the codes and themes identified through the literature review and case studies. This will be a foundation for *objective trees* with information on activity, output, outcome, and impact (see Figure 3). These can combine the results of different activities in a single visual framework, albeit centred around specific topics.

Figure 7 presents an example for Green Open Access and the intended results of this approach. The upper part represents a potential objective tree to realise Green Open Access whereas the lower part side displays potential impact pathways for FAIR data derived from a report on the economic benefits of FAIR data (derived from European Commission, 2019).

²¹ Handbook of Open Science Impact Indicators, an online registry with a portfolio of use cases and the results of a Cost Benefit Analysis framework.

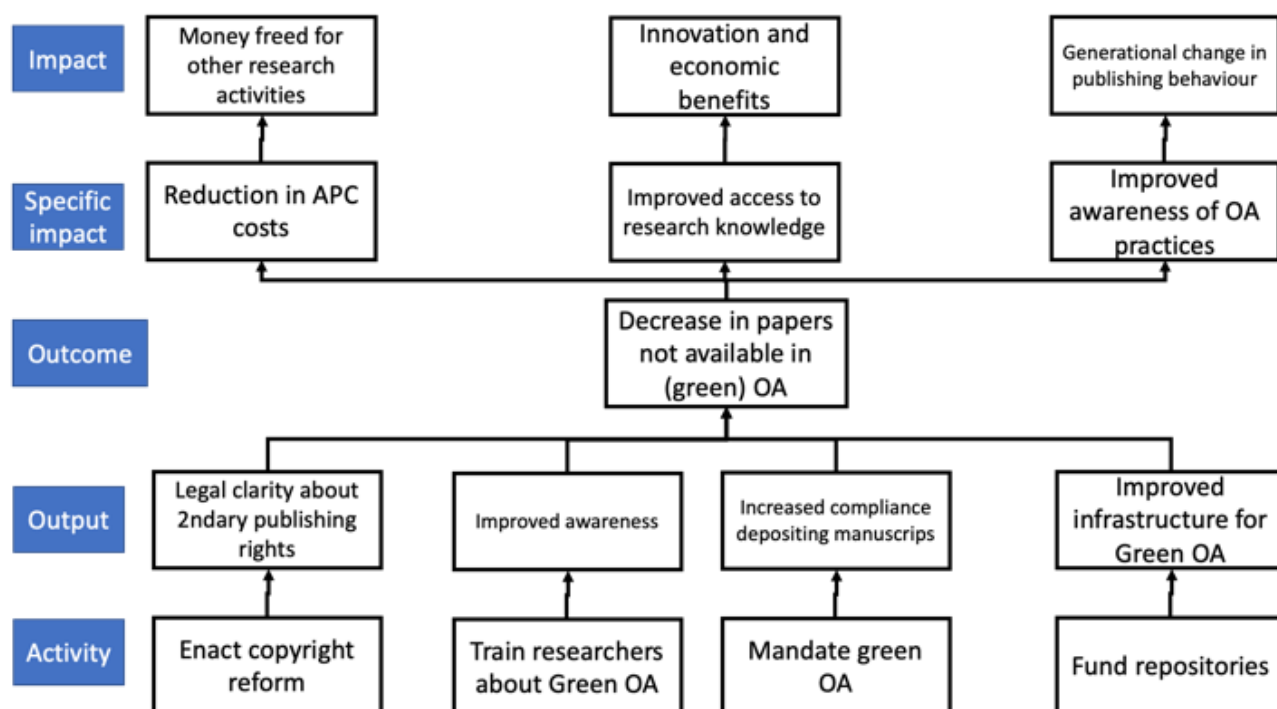


Figure 7 Step 1: Potential Open Science objective trees and individual impact pathways for different topics

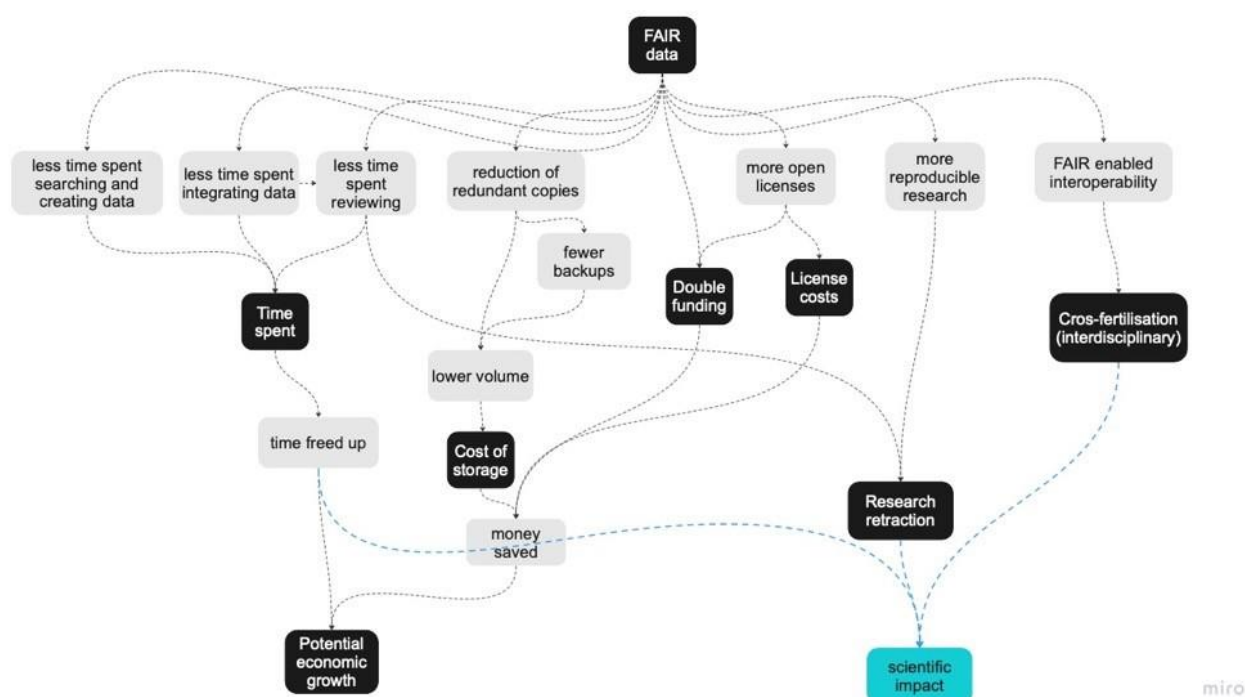


Figure 7 (continued)

As these examples illustrate, literature review and desk research can likely yield extensive objective trees including activities and outputs at a very detailed level (Figure 7, top). Others might only start at a higher level, e.g., assuming FAIR data is a given and modelling the outcomes and impacts of this, without looking at specific activities and inputs (Figure 7, bottom). Both cases can be useful for this analysis. The former, because it contains information about

activities which may in turn be relevant to identify risks, feedback loops and other underlying assumptions. The latter because it provides a focus on the specific impacts of Open Science activities.

Practically, this first step requires a collection of sequences, identified through literature review and case studies, coded with the terminology of activity/output/outcome/impact. Here it is important to make the assumptions and the hypotheses explicit. Secondly, it can be expected that not all literature will offer this information for an entire sequence. Instead, it might zoom in on and only describe the effects of one specific activity or zoom out and provide evidence of contextual determinants. In such cases, the assignment of results to each step (activity/output/outcome/impact) may have to occur at a later moment, provided a specific sequence is recorded.

3.2.2. Step 2: Defining (cumulative) pathways

The objective of PathOS is not to identify isolated impact pathways for Open Science but to provide information about converging impacts. In other words, the aim is to find evidence for cumulated impacts of different interventions.

To achieve this and to define impact pathways, we will need to aggregate and zoom out to a higher level. We will do this by taking the *outcomes* and *impacts* identified in step 1 and cluster them under appropriate themes covering academic/economic/and societal impact. *Cumulative pathways* will exist where different interventions from across policy areas create lead to similar results. Examples would be efficiency gains or financial savings across different Open Science areas or wider reception of research results highlighted by citation advantages of OA/Open Data publications.

Visual examples for the framework are given in Figure 8. The first hypothetical example on the left display impact pathways for a set of data-related interventions. The second example on the right depicts impacts of open access to research outputs. The framework allows visually tracing of the logic of impacts from intervention over academic impact to societal and economic impacts. For end-users, an interactive version would allow mixing and matching both from the top (interventions) and the bottom (impacts).

It should be noted however, that this initial version is required to be updated and validated throughout the research process. For example, academic impact need not be a mediator between intervention and societal and economic impact. These issues will be addressed based on the information generated by the literature review and case studies. In principle, other ways of displaying the pathways can be used. We will explore if the framework may also include information on the strength and directions of impacts or the stakeholder that are concerned at a given moment.

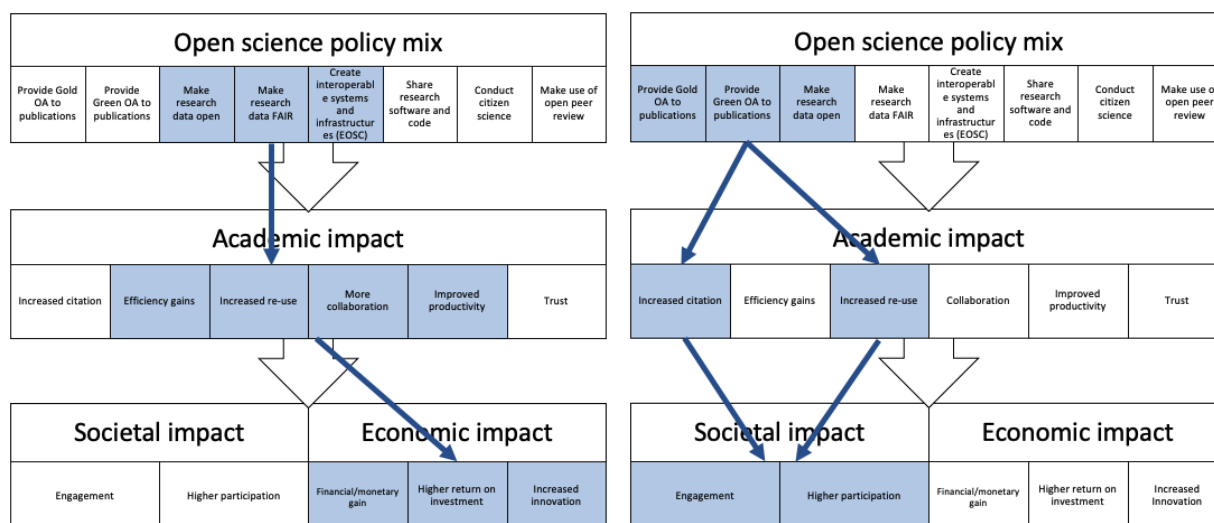


Figure 8 Step 2: Display of potential cumulative impact pathways

We expect interaction between steps 1 and 2, as new information from step 1 may change the aggregated result in step 2. The aggregated results will need an agreed set of impact categorisation under the academic, societal and economic impacts. Hence, further practical considerations to arrive at these impact pathways concern the case of impact at the individual level and the question of refining codes on the way. First, the outcomes and impacts accrued at individual level should be recorded under step 1. For instance, citation advantages are an indicator for wider use of Open Access outputs with a possible impact on individual researchers. While this does not constitute a higher-level outcome and impact, such cases may be useful to record under step 1 to eventually enrich the assumptions and mechanics of impacts. In other cases, they could be aggregated and lead to an outcome or impact. They might also be used as indicator at different levels. Second, while the exercise sets out with several predefined codes for intervention areas (i.e., EC policy priorities), outcomes, and impacts, they will be refined and clustered based on literature review and case studies in order to base them on evidence.

3.2.3. Step 3: Zooming in for narrative overviews

A final step to make the identified pathways a useful, actionable tool for stakeholders is to provide detailed information about impact pathways, similar to the approach of defining high-level impact pathways in RI-PATHS. For this, PathOS will zoom into specific pathways of relevance for stakeholders (to be defined) and show the relevant interventions, outcomes and impacts (Figure 9). This will be supported with narrative details to provide information about contextual factors, indicators and other relevant information. Assumptions about the causal mechanisms, risks and relevant stakeholders can be added as well²².

²² This approach is also used in the PAYBACK FRAMEWORK that was originally developed by Buxton and Hanney. In Donovan and Hanney (2016): Research Evaluation · September 2011 DOI: 10.3152/095820211X13118583635756.

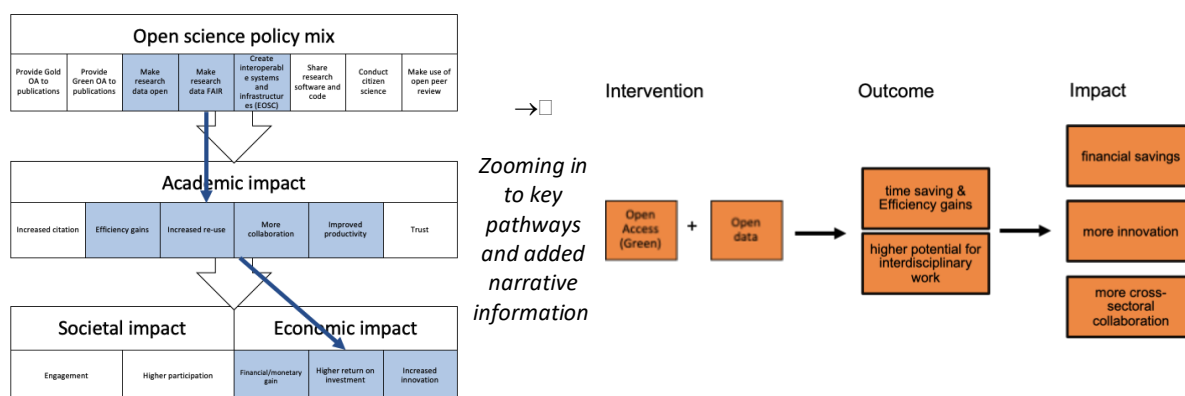


Figure 9 Step 3: from cumulative pathway to narrative display

For users of the key impact pathways, this will enable them to compose impact pathways based on several interventions and see their potential impacts or start from the intended impact and see how to create it. The eventual result, to be supported by an online tool, is an ontology of relationships between interventions, outputs, outcomes, impact, the relevant indicators and stakeholders.

3.3. Templates for literature review and case studies

The ambition of PathOS is that findings are based on *evidence*. We will collect this evidence via literature review, dedicated use cases and cost-benefit analysis. To be able to use and re-use these tools (and their findings) and to be able to add new reviews and cases, we must do this in a systematic and transparent way.

For the literature review we follow Fell (2019) in setting up a data chart, see figure below, adapted for our goal: instead of only economic impact, we also consider academic and societal impact.

Table 6 Data chart for literature review of academic impact

Data chart heading	Description
ID	Identifier for publication
Author	Name of author/s
Title of study	Title of the article or study
Abstract	Abstract of publication
Publication year	Year that the article was published
Publication type	Journal, website, conference, etc.
DOI/URL	Unique identifier
Exclude? (Reason)	If, upon reading the full-text, it is found that that publication is not relevant then (and only then), this field should be marked with the reason for exclusion (usually just "no relevant information"; but if the paper seems an edge-case you may wish to enter more detailed information). If the paper is relevant, leave this field blank.
Study details and design	Type of study, empirical or review, etc. Notes on methods used in study (whether qualitative or quantitative, which population demographics studied, scientometric, survey, modelling, etc.)
Types of data sources	Detail the data sources included
Study aims	Overview of the main objectives of the study
Open Science (OS) type	Open Science in general Open Access Open/FAIR Data Citizen Science Engagement Open Code / Software Open Methods (including infrastructures such as EOSC) Open Evaluation and Assessment
Relevance to which aspect of impact	Academic: (Quality, Citations, Integrity, Equity, Collaboration, Trust, Efficiency, Productivity, Re-use, Reproducibility, Interdisciplinarity, Novelty)
Key findings	Results of the study that contribute to the scoping review question(s) – both positive and negative impacts, and whether the activities worked. Keep short and precise (1-2 sentences, more only for extremely relevant publications)
Coverage / Context	Field to note any relevant information about the level of coverage of the study, e.g., only specific countries, disciplines, demographics covered
Confidence assessment	Optional field to note any concerns about reliability/generalisability of findings (e.g., COIs, potential biases, small sample sizes, or other methodological issues) within the study

Most probably this data chart will be updated after we have performed our literature review. In addition, we also have an instruction or protocol how to find adjacent and related literature. This will be explained further in D1.2, the deliverable on the literature review.

Similarly, we set up a case studies template (in WP3). The table below gives an excerpt of the template as it is without the standardised categories for the different items. In the section on taxonomies we give a complete overview of all the categorisations that we are using.

Table 7 Case studies template

Case studies template v0.1
Name of case study
Short description What is the object of your case study. [Standardised table of OS Strategic Pillars]
HYPOTHESIS / Impact Pathway (i.e. what effects do we want to examine, what are the confounding factors, etc)
General
Specific OS Instruments (type of intervention) [Standardised table of instruments]
Objectives (What is the goal of this policy/OS instrument?)
Context: Enabling and obstructing/confounding factors
Stakeholder groups affected and/or included [standardised table]
Geographical Coverage (e.g., Europe, Portugal)
Domain Coverage [Standardised table of science clusters]
Time Range (to be refined) Please specify <ol style="list-style-type: none"> 1. when the intervention was developed (e.g. when the platform/repository was set up), 2. when it started its operation (e.g. the platform was launched and became public available), 3. when it started/will start to produce impact, 4. for how long you expect impact will keep on materialising (n. of years):
Impact Targets (INDICATOR THEMES) (to be refined) [standardized table of indicator themes] (e.g., publication output, engagement in social media, uptake of innovations)
Causality Methodology (to be refined)
DATA
Quantitative or Qualitative Data sources (e.g., interviews, surveys, OpenAIRE, user data, etc.): make sure to add information on financial data* (to be refined) *For financial data we refer to <ol style="list-style-type: none"> 1. costs related to the set up/development of your intervention as well 2. costs borne to operate it. Specifically, we are interested in knowing the following information: <ol style="list-style-type: none"> A. are these costs available or shall be reconstructed? B. Are these costs covered by one institution or shared between different ones? 3. can this information be shared for the purpose of CBA analysis or are they restricted to circulation?
OPERATIONALISATION
Methods and Tools to be used (e.g., classification, data cleaning, author disambiguation, etc.) (to be refined)
RELATED LITERATURE
Are you aware of any related literature/studies on the same topic or case study?
FOCUS GROUPS AND MEMBER ENGAGEMENT
Goals for first round Focus Group (What do you want to learn from them?)
View Focus Group tentative plan (what we do in each round) here.
Who should be involved? (looking for 8-10 people ideally, less if not possible)
Questions and topics for discussion in first round
Medium and long-term expectations for group engagement (how you envision them being involved across the lifespan of the project)
COMMUNICATIONS
Additional Contacts that could participate in case study-related workshops

This systematic and transparent approach also gives opportunities to scale up and organise large teams for the literature review and case studies.

3.4. Categorisation

For the pathways and the literature scoping it's important to have closed categories. Ideally (and later on) we could expand this to a thesaurus including synonyms, or a taxonomy that includes broader and narrower terms.

3.4.1. Open Science Instruments

Table 8 Open Science instruments

OS Instruments	
1.	Policies, regulations, mandates (e.g., open access mandate, open access policy)
2.	Rewards, incentives (career system)
3.	Norms, visibility
4.	Skills/Training
5.	Services, standards, platforms
6.	Research infrastructures (incl. e-infrastructures)

3.4.2. Science Clusters

Table 9 Science clusters

Science clusters	
7.	Life Sciences
8.	Environmental Sciences
9.	Social Sciences and Humanities (incl. Cultural Heritage)
10.	Astronomy and Particle Physics
11.	Materials, Energy, Physics

3.4.3. Stakeholders

Stakeholder categories were already presented in table 2 of chapter 1.

3.4.4. Impact Targets

Table 10 Impact targets – indicator themes

IMPACT TARGETS – INDICATOR THEMES	
1.	ACADEMIC
a.	QUALITY
b.	CITATIONS
c.	INTEGRITY
d.	EQUITY

- e. **COLLABORATION**
- f. **TRUST**
- g. **EFFICIENCY**
- h. **PRODUCTIVITY**
- i. **RE-USE**

2. SOCIETAL

- a. **ENGAGEMENT**
- b. **PARTICIPATION**
- c. **EDUCATION**
- d. **TRUST**
- e. **POLICY**
- f. **SDGs**
- g. **GENDER**
- h. **DIVERSITY**
- i. **HEALTH INCL. COVID-19**
- j. **CLIMATE & ENVIRONMENT, GREEN**

3. ECONOMIC

- a. **FINANCIAL, RETURN ON INVESTMENT**
- b. **COST-BENEFITS, SAVINGS**
- c. **PATENTING**
- d. **INNOVATION**
- e. **PRODUCTIVITY**

3.4.5. Relation with other WPs

The objective of PathOS Work Package 1 is to develop the underlying conceptual framework for impact pathways, to identify evidence, and, eventually, describe the key impact pathways for Open Science based on this evidence. This is done through close collaboration with the other project WPs.

WP2 will develop indicators for the impact of open science practices on different areas (WP2), WP3 will measure and test on selected cases and WP5 will carry out a Cost-Benefit Analysis (WP4). The results will provide feedback into the framework and provide important evidence, contextual factors, stakeholder feedback and other information.

Interaction with other WPs is a key element in the project. The KIPs need to be validated both from academic and empirical angles, and it needs to be suitable for other WPs to use as a guiding framework for their purposes.

The interaction is also useful for mutual learning that creates understanding for all project partners on key principles, the expected scope, our common objectives and the sustainability of the outcomes. Due to the diverse background of beneficiaries, these mutual learning exercises are also needed to meet key objectives of OS, like interdisciplinarity, common ground and understanding of scientific communication, multisectoral understanding. We put an emphasis also on the interoperability of the model, therefore a constant in-depth alignment, adjustment and communication are needed with other tasks and WPs.

Feedback loops are built-in into the PathOS workflow as depicted in Figure 10. Activities 2-5 will take place in a **phased approach**, and **centered around selected case studies**, each bringing on the table a range of OS specific elements what will allow us to better evaluate and measure them and be able to construct the pathways from start-to-end.

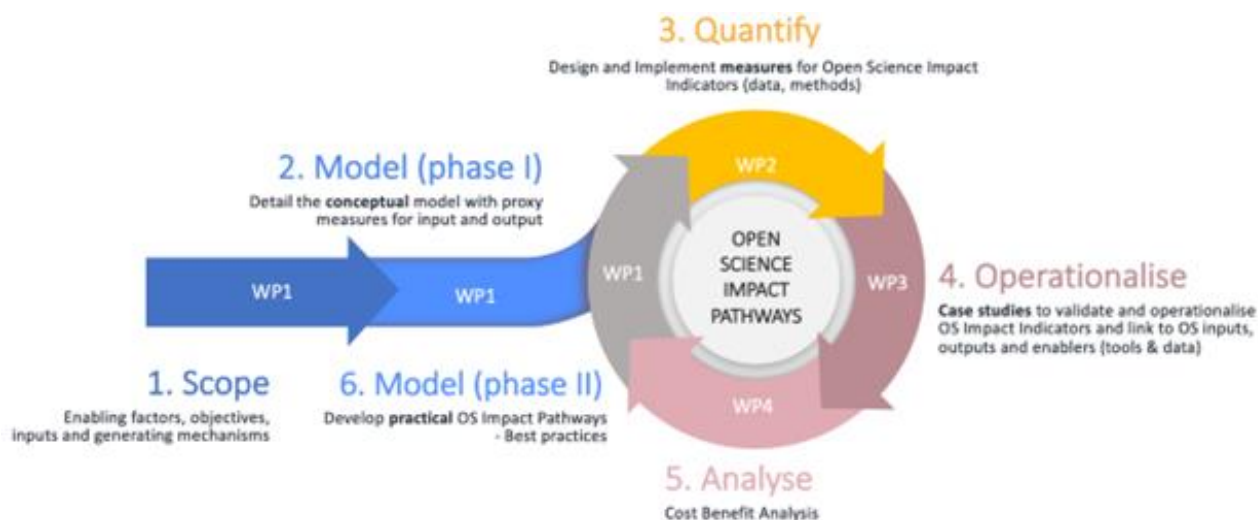


Figure 10 PathOS workflow

In phase 1, WP1 provides, through this deliverable, the initial conceptual model for Open Science impact pathways. This model informs methods and initial working definitions of the other project WPs. During phase 2, after work has been done on indicators, case studies, cost benefit analyses etc, WP1 takes stock of the collected evidence and prepares a set of evidence-based key impact pathways in collaboration with other related WPs through already used practices, as Mutual Learning Exercises, Workshops and by utilising Expert Panels and international expert fora.

WP1 creates the framework for the interdisciplinary dialogue and multisectoral approach by indicating the potential directionalities and needed interactions by the KIPs. KIPs are expected to serve as a point of reference for other tasks and therefore constant discussions, interactions and related exercises will be organised to align all beneficiaries' works.

4. Conclusions

We started from theory to explain how to develop impact pathways. To be useful the pathways need to have sufficient detail and include context, expected causal relations and provide empirical evidence. However, there is a big discrepancy between theory and setting up the pathways that are useful for policy evaluations.

Our approach is systematic in the sense that we take the EC Open Science policy actions as a starting point and that we distinguish between academic, societal and economic impacts. We also benefit from the parallel work in WP1 on the literature scoping. Lessons learned give that

we should categorise (and have taxonomies) as much as possible: stakeholders, actions, instruments and set up templates to systematically analyse and to be able to scale up.

To address major pathways' shortcomings, like lack of causality and oversimplification, we set up a stepwise approach: first we do 'traditional' impact analysis taking the EU policy actions as starting point, but then we zoom out and will cluster impact pathways to give the overview. In the third step we zoom in again to describe causality and relationships. In a way we disentangle the impact analysis into separate, systematic steps.

With this stepwise approach we aim to provide a framework to explain the impacts of open science and provide evidence using multiple sources: from our literature scoping, case studies to cost-benefit analysis. It connects to our planned outputs like the portfolio of use cases & stories, a handbook of Open Science impact indicators, a cost-benefit analysis framework. But ideally, it should also provide a framework to do future evaluations and add results to the portfolio and handbook.

5. References

European Commission, Directorate-General for Research and Innovation, Peter, V., Arnold, E., Doranova, A., et al. (2014) A short guide to assessing environmental impacts of research and innovation policy. Publications Office. <https://data.europa.eu/doi/10.2777/5779>

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Tilley, Nick. (2000). Realistic Evaluation: An Overview, https://www.researchgate.net/publication/252160435_Realistic_Evaluation_An_Overview .

6. Annexes

6.1. EC Open Science factsheet 2019

Source: https://research-and-innovation.ec.europa.eu/system/files/2019-12/ec_rtd_factsheet-open-science_2019.pdf

The eight ambitions of Open Science Open science policy have developed progressively in the EU. It concerns all aspects of the research cycle, from scientific discovery and scientific review to research assessment, publishing and outreach; its cornerstone being open access to publications and research data.

Since 2016, the Commission organises its open science policy according to eight ‘ambitions’:

- Open Data: FAIR (Findable, Accessible, Interoperable and Re-usable data) and open data sharing should become the default for the results of EU-funded scientific research.
- European Open Science Cloud (EOSC): a “federated ecosystem of research data infrastructures” will allow the scientific community to share and process publicly funded research results and data across borders and scientific domains.
- New Generation Metrics: New indicators must be developed to complement the conventional indicators for research quality and impact, so as to do justice to open science practices.
- Future of scholarly communication: all peer-reviewed scientific publications should be freely accessible, and the early sharing of different kinds of research outputs should be encouraged.
- Rewards: research career evaluation systems should fully acknowledge open science activities.
- Research integrity: all publicly funded research in the EU should adhere to commonly agreed standards of research integrity.
- Education and skills: all scientists in Europe should have the necessary skills and support to apply open science research routines and practices.
- Citizen science: the general public should be able to make significant contributions and be recognised as valid European science knowledge producers.

Recently new pillars have been added, like ‘open software code’. Table shows the original and updated Open Science pillars, the latter being used in the EOSC (Open Science) Monitor²³.

Original eight OS pillars	Updated OS pillars	Explanation, examples
Future of Scholarly Communication	Publications	research publications that are available in Open Access
European Open Science Cloud & FAIR Data	Data	Research data management and research data that is FAIR/open
	Services	Services that enable research data discovery and exploitation
	Infrastructure	Data stewardship, data repositories, and data preservation
	Software	Software that enables research and is available in open source
Rewards and Incentives	Assessment	Incentives and rewards for researchers to practise Open Science
Skills and Education	Skills/training	Skills and training for researchers to practise Open Science
Citizen Science	Engagement	Research that engages and involves citizens via citizen science
Research Integrity	RRI	Refers to all pillars ('horizontal'); focus will be on reproducibility of research
Research Indicators & Next-Generation Metrics		Applies to all pillars

6.2. Intervention logic

In the project we will focus on the impact pathways. Still it is good to show how these pathways fit in the bigger picture of Intervention Logic. This part can also be useful later in the project to set up a user manual for designing own pathways.

We repeat the Impact Pathways figure from chapter 2 and will explain now all elements. Keyword from Intervention Logic are in red and will be included in a glossary.

²³ <https://eoscobservatory.eosc-portal.eu/home>



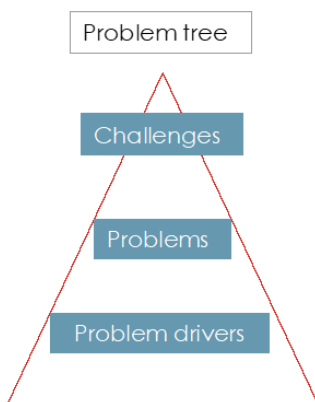
Public policy initiative

Any **public policy initiative**

- Starts with a **need** that must be fulfilled.
- And this initiative is undertaken for a number of **reasons** (rationale).
- But there are **problems** that obstruct this **need**.

Problem analysis

A **problem analysis** elaborates to identify the problems encountered and to establish the *cause-and-effect* relationships between the identified problems.



This can be done by setting up a **problem tree** that consists of three levels:

- the **challenges** (most abstract level),
- the **problems**, and
- the **problem drivers** (causes)

This step is mostly done in a group, brainstorming using Post-Its.

Next, the aim is to group (levels) and cluster the problems, and to remove less relevant items. This will result in the lower part (the roots/causes) of a **problem tree**.

Next step is to determine the consequences of these problems by reasoning and constructing the upper part.

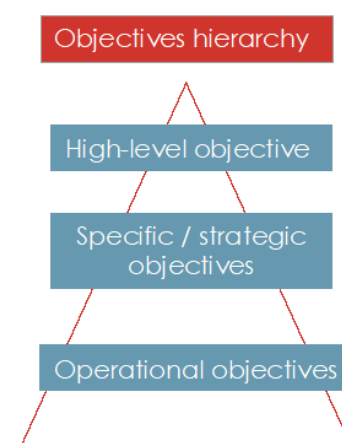
After this inventory of problems, there can be a prioritisation, scrutinizing the difficulties and associated with current policies to help determining the likely **scope** of the revised/new policy.

Synthesis

- *Should all of the problems be included, or should there be a focus on a few key problems?*
- *What is the combination of actions that is likely to be most effective and produce the longest lasting benefits?*
- *What are the likely costs of the various potential activities (capital and recurrent) and what can realistically be afforded?*
- *Which strategies will most effectively achieve the system development objectives?*

Setting Objectives

Next step is to reformulate the **problems, causes and challenges** into **objectives** via positive statements into a **solutions tree**. These items indicate **activities** in the **logframe matrix**. This can be done note-by-note. Be aware to reformulate positively (do more than just remove 'not'). Similarly, the upper part of the problem tree is rephrased into **solutions and objectives**. These items indicate **outputs and results** in the **logframe matrix**.



Stakeholder analysis

Different stakeholders have different **concerns, needs, capacities and interests**

- Matrix with stakeholders & basic characteristics; capacity & current practice; current & future needs; current & expected benefits/interests

Stakeholder	Basic Char's	(current) Concerns	Current capacity	Future capacity	Current needs	Future needs	Current benefits	Future benefits

Logframe matrix

A logical framework or **logframe matrix** is applied to define the **Impact Pathway** and the **Indicator Framework**. This matrix works out how the activities will lead to the immediate outputs, and how these will lead to the outcomes and impacts.

Intervention Logic	Verifiable Indicators	Means of Verification (data source)	Assumptions
Impacts			

<ul style="list-style-type: none"> • Long term • Medium term 			
Outcomes			
Results/Outputs	[then this should be achieved]		
Activities	If this happens →		[and this holds true]
Inputs (Resources)			
Context			
Rationale ²⁴	n.a.	n.a.	
Needs	n.a.	n.a.	

The lower part of the Logframe Matrix provides **inputs** in the form of **resources** and **activities** (delivery mechanisms or process outputs):

- **Activities** = specific actions addressing the **problems / needs / failures** e.g. infrastructure failures? → **actions** supporting the development of infrastructures
- **Resources** = human and financial resources.

It can be relevant to address the **context**, that is: related to **external factors** that have the potential to influence (or even determine) the success of the initiative. It makes sense to check the context for the compatibility of the proposed intervention with other interventions. Two types of contexts are especially relevant:

- Discipline
- Country

In the columns we set up the **Monitoring & Evaluation System** (= indicator framework) and the **assumptions** that are built into the current design of the **activities** and their **outputs**.

Causes & Relationships

The **inputs, activities** (and the **assumptions**) result in **outputs**. The connection between **activities** and **results** come from:

- **Determinants** = factors and mechanisms that determine the outcomes and wider impacts of policy intervention → enabling or hindering factors
- **Internal factors** = the mechanisms that were assumed in the intervention logic to achieve the intended outcomes and impacts
 - The adoption of specific instruments, the specific focus of the activities (and the budget allocated), and the envisaged involvement of specific key stakeholders
- **External factors** = contextual conditions and socio-economic factors and mechanisms that may influence their achievement (see the context analysis)

²⁴ As stated in the beginning, the *Needs* and *Rationale* for the intervention are not always included and the analysis starts with the actions (inputs and activities).

- E.g., in R&I programmes: STEEP-V → socio-cultural aspects, technical and technological aspects, economic factors, environmental factors, political, policy and regulatory and framework factors, and values.

These items are not in the matrix but can be addressed in the **narratives** that complement the logframe matrix.

The upper part of the matrix contains the **Chain of Effects** that describe the short-, medium-, and long-term-effects of the **initiative**:

- **Outputs**
- **Outcomes**
- **Impact**

Hence, this **Chain of Effects**:

- Create **outputs** (concrete goods or services, tangible short-term effects of the initiative, e.g. Open Access publications)
- Which lead to **outcomes** and **results** (short- to mid-term effects on the community targeted by the initiative, e.g. increased interdisciplinary research leading to enhanced excellence in research – formulated in terms of 'change')
- Leading to **impacts** (longer-term effects at the macro-level, i.e. science, economy, society, e.g. enhanced global EU competitiveness in research)

These relationships form the **intervention logic (theory)** - including **assumptions** why the inputs are supposed to create the intended effects

6.3. Indicators & Metrics

We distinguish between indicators, metrics and measurement:

- An indicator for the concept that we are trying to say something about, for example uptake of Open Access.
- A metric is an operationalisation of the indicator, for example: number of Green Open Access publications.
- A measurement of the proposed metric is the source for the metric, for example use data collected by Unpaywall to determine Green Open Access status for publications.

6.4. Case Studies Template

Case studies template v0.1	
Name of case study	
Short description	
Please make clear what is the object of your case study.	
Categories:	
<ol style="list-style-type: none"> 1. Open Science in general 2. Open Access to publications 3. Open/FAIR data 4. Citizen Science/Engagement 5. Infrastructures 6. Services (incl. EOSC) 7. Open Code/Software 8. Open Evaluation/Assessment 9. Skills/Training 10. Open Methods (incl. indicators & metrics) 	
HYPOTHESIS / Impact Pathway	
(i.e. what effects do we want to examine, what are the confounding factors, etc)	
General	
Specific OS Instruments (type of intervention)	
<ol style="list-style-type: none"> 1. Policies, regulations, mandates (e.g., open access mandate, open access policy) 2. Rewards, incentives (career system) 3. Norms, visibility 4. Skills/Training 5. Services, standards, platforms 6. Research infrastructures (incl. e-infrastructures) 	
Objectives (What is the goal of this policy/OS instrument?)	
Context: Enabling and obstructing/confounding factors	
Stakeholder groups affected and/or included	
Main category	Subcategory
Governments	
	EC
	National Governments
	Regional (within country) Governments
Funders (RFOs)	
	Public RFOs
	Private RFOs
Industry	
	Industry & Services Sectors
	Experts (incl. researchers) at companies
Publishers	
	Large Commercial Publishers
	Small Commercial Publishers
	Not-for-profit Publishers
Universities & Research Institutes (RPOs)	
	University Libraries
	Individual Researchers (at RPOs)

	Students
Learned Societies	
	Formal associations
	Research Communities (informal)
Citizens	
	General Public
	Interest Groups (incl. patient organisations)
	Citizen Scientists
Geographical Coverage (e.g., Europe, Portugal)	
Domain Coverage (science clusters)	
<ol style="list-style-type: none"> 1. Life Sciences 2. Environmental Sciences 3. Social Sciences and Humanities (incl. Cultural Heritage) 4. Astronomy and Particle Physics 5. Materials, Energy, Physics 	
Time Range (to be refined)	
Please specify	
5.	when the intervention was developed (e.g. when the platform/repository was set up),
6.	when it started its operation (e.g. the platform was launched and became public available),
7.	when it started/will start to produce impact,
8.	for how long you expect impact will keep on materialising (n. of years):
Impact Targets (INDICATOR THEMES) (to be refined)	
(e.g., publication output, engagement in social media, uptake of innovations)	
4.	Academic
a.	Quality
b.	Citations
c.	Integrity
d.	Equity
e.	Collaboration
f.	Trust
g.	Efficiency
h.	Productivity
i.	Re-use
5.	Societal
a.	Engagement
b.	Participation
c.	Education
d.	Trust
e.	Policy
f.	SDGs
g.	Gender
h.	Diversity
i.	Health incl. COVID-19
j.	Climate & Environment, Green
6.	Economic
a.	Financial, Return on Investment
b.	Cost-Benefits, Savings
c.	Patenting
d.	Innovation
e.	Productivity
Causality Methodology (to be refined)	

DATA
Quantitative or Qualitative Data sources (e.g., interviews, surveys, OpenAIRE, user data, etc.): make sure to add information on financial data* (<i>to be refined</i>) *For financial data we refer to <ol style="list-style-type: none"> 4. costs related to the set up/development of your intervention as well 5. costs borne to operate it. Specifically, we are interested in knowing the following information: <ol style="list-style-type: none"> a. are these costs available or shall be reconstructed? b. Are these costs covered by one institution or shared between different ones? 6. can this information be shared for the purpose of CBA analysis or are they restricted to circulation?
OPERATIONALISATION
Methods and Tools to be used (e.g., classification, data cleaning, author disambiguation, etc.) (<i>to be refined</i>)
RELATED LITERATURE
Are you aware of any related literature/studies on the same topic or case study?
FOCUS GROUPS AND MEMBER ENGAGEMENT
Goals for first round Focus Group (What do you want to learn from them?) View Focus Group tentative plan (what we do in each round) here.
Who should be involved? (looking for 8-10 people ideally, less if not possible)
Questions and topics for discussion in first round
Medium and long-term expectations for group engagement (how you envision them being involved across the lifespan of the project)
COMMUNICATIONS
Additional Contacts that could participate in case study-related workshops